

BHAVNAGAR MUNICIPAL CORPORATION

Notice Inviting On -Line Tender

Tendar Notice No.- Drainage Dept./ E- 06 /2024

Department Name	:-	Drainage Department (Bhavnagar municipal Corpo.)
IFB No.	:-	Drainage / E- 06 /2024 (2nd Attempt)
Name of Project	:-	Atal Mission for Rejuvenation and Urban Transformation(Amrut 2.0) Scheme.
Name of Work	:-	BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR (2nd Attempt)
Estimated Contract Value (INR)	:-	Rs. 14,70,03,332.00/- (Indian Rupee Fourteen Crore Seventy Lacs Three Thousand Three Hundred Thirty Two Only) (Construction Cost + O & M Cost)
Class of Registration required	:-	Class "AA"
Period of Completion (in month)	:-	1 Year (12 month)
Bid Call (Nos)	:-	Open (Percentage Rate Tender)
Tender Currency Type	:-	Single
Tender Currency Settings	:-	Indian Rupee (INR)
Joint Venture	:-	N.A.
Rebate	:-	N.A.
Amount Details		
Bid Document Tender Fee	:-	Rs.15,000/-(Non-Refundable)
Bid Document Fee Payable To	:-	Executive Engineer (Drainage Department) BMC Bhavnagar
Bid Security / EMD (INR)	:-	3% of Total tender Cost Rs.44,10,100/- (Indian Rupee Fourty four Lacs Ten Thousand Hundred only)
Bid Security / EMD in favour of	:-	Executive Engineer (Drainage Department) BMC Bhavnagar
Defect liability period	:-	3 year
EPF registration no.	:-	The bidder shall have to submit valid certificate of registration for having EPF and ESIC number.
Tender Dates		
Bid Document Downloading Start Date	:-	19.09.2024 18:00 Hrs
Bid Document Downloading End Date	:-	19.10.2024 18:00 Hrs
Pre Bid Meeting	:-	30/09/2024 At 12:00 Hrs
Last Date & Time of Receipt of Bid (Submission Of Bid)	:-	24.10.2024 18:00 Hrs
Bid Validity Period	:-	180 Days

Remarks	:-	CLASS OF REGISTRATION REQUIRED FOR BIDDER MUST BE " AA " AND ABOVE. .Cheque/Demand Draft/fdr for tender fee & Emd shall be submitted in Electronic Formate through online scanning alongwith all the supporting documents such as Registration, Bank Solvency Certificate etc. while uploading thebid. Offer of those will be opened whose EMD & Tender fee is received electronically alongwith the bids. however for the purpose of realization of Cheque/Demand Draft/FDR, bidder shall send them in original alongwith all the required documents mentioned in the tender documents through RPAD/Speed post/Reg AD so as they reach to the office of Exe. Engg. - Drainage.Dept. Bhavnagar Municipal Corporation during office hours within 24/10/2024 18:00 pm. Penaltative action shall identinitiated for not submitting the supporting documents in original to E.E. by bidder. Hard copy will not be accepted and considered.Successfull Bids (Preliminary & Technical Bid), if possible will be opened on the 24.10.2024, 17:30 pm at the City Engineer's office - BMC
Bid Opening Date	:-	05.09.2024- 15:00 PM
SPECIAL CONDITION FOR SUBMISSION OF BG,SD,FDR:-		For SD, FDR or Bank guarantee issued by State Bank of India will not be accepted. Bidder should submit FDR or Bank guarantee issued by other nationalized bank only.
Other Details		
Officer Inviting Bids	:-	Executive Engineer, Drainage Department,Municipal Corporation,Bhavnagar
Bid Opening Authority Members in committee	:-	(1) Executive Engineer (2) City Engineer (3) Chief Accountant (4) Chief Auditor
Address	:-	BMC, Bhavnagar. Sir Mangal Sinhji Road, Near Kalanala, Bhavnagar-364001.

E-tendering relate instructions

- (1) Bidders can download the tendar document free of cost from the website.<https://tender.nprocure.com/>
- (2) Bidders have to submit Technical bid as well as Price bid in Electronic for only on <https://tender.nprocure.com/> website till the Last Date & time for submission.
- (3) Offers in physical form will not bi accepted in any case.
- (4) Free vendor training camp will be organized every Saturday between 4.00 to 5.00 p.m. at (n)code solutions - A Division of GNFC Ltd.,Biders are requeste take benefit of the same.

All bids should be digitally signed,for details regarding digital signature certificate related training involved,kindly,contact the below mentioned address.

(n) Code Solutions A Division of GNFC Ltd.

403,GNFC Infotower,Bodakdev,

Ahemedabad - 380 054 (India)

Tel. +91 79 26854511/12/13 (EXT :501,512,516,525) +91 79 26857316/17/18 (EXT :501,512,516,525)

Fex.+91 79 26857321,40007533

E-mail :nprocure @gnvfc.net

Web-site :www.nprocure.com

Toll Free :1800-233-1010(EXT :501,512,516,525)

CONTRACT NO.

Bhavnagar Municipal Corporation
BHAVNAGAR



(A WHOLLY OWNED BHAVNAGAR MUNICIPAL CORPORATION UNDERTAKING)

ESTIMATED COST

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

(2nd Attempt)

ESTIMATED COST: RS. 14,70,03,332.00/-

VOLUME – I: TECHNICAL BID

Employer

EXECUTIVE ENGINEER

(Drainage Dept.)

BHAVNAGAR Municipal Corporation

Sir Mangal Sinhji Road, Near Kalanala,

Bhavnagar,

Bhavnagar,-364001.

Contact Number: 0278 2424801-10

TENDER NOTICE

1	Department Name	Bhavnagar Municipal Corporation
2	Circle/Division	Executive Engineer (Drainage Department), BMC Bhavnagar
3	Tender Notice No	BMC/UGD PROJECT/AMRUT 2.0/
4	Name of UGD PROJECT:	UPGRADATION OF SEWERAGE NETWORK AT VARIOUS PLACES OF BHAVNAGAR MUNICIPAL CORPORATION
5	Name of Work:	BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR (2 nd Attempt)
6	Estimated Cost (INR)	Rs. 14,70,03,332.00/- (Indian Rupee Fourteen Crore Seventy Lacs Three Thousand Three Hundred Thirty Two Only) (Construction Cost + O & M Cost)
7	Period of completion of work (In Months)	1 Year (12 Months) (Including Monsoons and 1 Months Trial Run)
8	Period of O & M (in Years)	Not Applicable
9	Bidding Type	Two Bid System
10	Bid Call (Nos.)	1
11	Tender Currency Type	Single
12	Tender Currency Settings	Indian Rupee (INR)
13	Joint Venture	Not Applicable
14	Rebate	Not Applicable
15	Bid Document Fee / Bid Processing Fees / Tender Fee:	Rs. 15,000/- (Non-Refundable) (Indian Rupee Fifteen Thousand Only)
16	Bid Document Fee Payable To:	Executive Engineer (Drainage Department) BMC Bhavnagar
17	Bid Security/EMD/Proposal Security (INR):	3% of Total tender Cost Rs. 44,10,100/- (Indian Rupee Forty-four Lacs Ten Thousand Hundred only)
18	Bid Security / EMD In Favour of:	Executive Engineer (Drainage Department) BMC Bhavnagar

	Tender Dates	Note: All Dates are in dd/mm/yyyy, hr: min as per Indian Standard Time (IST)
19	Bid Document Downloading Start Date	Dt.19/09/2024 18:00 Hrs onwards
20	Site Visit	At the Convenience of Contractor
	Contact Number	0278 2424801-10
	Contact Address for Site Visit	At BMC Bhavnagar
21	Pre-Bid Meeting	Dt. 30/09/2024 12:00:00 PM onwards
	Address for pre-bid meeting	Bhavnagar Municipal Corporation Address: Sir Mangal Sinhji Road, Near Kalanala, Bhavnagar-364001. Gujarat
22	Bid Document Downloading End Date	Dt. 19/10/2024 18:00:00 hrs
23	Last Date & Time for Online Receipt of Bids	Dt. 19/10/2024 18:00:00 hrs
24	Physical Submission of documents last Date & Time	Dt. 24/10/2024 till 18:00:00 hrs
25	Bid Opening Date	Preliminary Opening: Dt. 24/10/2024 (If possible) Technical Opening: On confirmation of receipt of hard copy of Tender Fees & EMD
26	Bid Validity Period	180 Days from the last date of submission of bid.
27	Physical submission of Tender Fee, and Earnest Money Deposit	Instrument of tender fee & EMD shall be submitted in electronic format only through online (By scanning while uploading the bid). This submission shall mean that Tender Fee and EMD are received for purpose of opening the bid. Accordingly offer of only those shall be opened whose tender fee and EMD is received electronically. However, for the purpose of realization of instrument of tender fee & EMD, bidder shall send the same in original through RPAD/ Speed Post so as to reach to BMC, Bhavnagar. Sir Mangal Sinhji Road, Near Kalanala, Bhavnagar-364001. Gujarat as mentioned in point no. 24 above, during office hours. For not submitting DD/FDR/BG in original, bidder shall be banned to participate in any tender of BMC for period of 3 years as a penal action. Any document in supporting to tender bid shall be submitted in electronic format only through online (by scanning etc.) and submission only in hard copy will not be accepted separately.

28	Payments details	<p>1. Tender fee, Earnest money deposit, PAN Card shall be uploaded online only.</p> <p>2. Tender Fee (Document fee) amounting to Rs. 15,000/- (Indian Rupees Fifteen Thousand Only) in favour of "BMC Bhavnagar in form of Demand Draft shall be issued by Any nationalized bank or as per list mentioned in latest GR of Finance Department</p> <p>3. Earnest money Deposit Rs.44,10,100/- (Indian Rupee Forty-four Lacs Ten Thousand Hundred only) in form of DD or FDR or Bank Guarantee in favour of " BMC Bhavnagar ", valid up to 28 days from the date of closure of the bid validity period of 180 days i.e. (180 days + 28 days=208 days), shall be issued by any nationalized bank or as per list mentioned in latest GR of Finance Department (Enclosed).</p>
29	Special Condition For Submission of EMD,BG,SD,FD:	Henceforth Bank Guarantee, Earnest Money Deposit, Security Deposit, Fixed Deposit, Demand draft of State Bank of India will not be accepted.
	OTHER DETAILS	
30	Officer Inviting Bids:	EXECUTIVE ENGINEER (Drainage Dept.) BMC Bhavnagar
31	Bid Opening Authority:	EXECUTIVE ENGINEER (Drainage Dept.) BMC Bhavnagar
32	Address:	Bhavnagar Municipal Corporation Sir Mangal Sinhji Road, Near Kalanala, Bhavnagar-364001. Gujarat
33	Contact Details of Officer Inviting Bid:	0278 2424801-10
34	Submission of tender	<p>The following documents shall be uploaded while submitting the BID online:</p> <ul style="list-style-type: none"> • Scanned copy of Demand Draft as tender fee • Scanned copy of FDR / BG as EMD • Scanned copy of Contractor's registration certificate (AA Class) and shall have to comply with Registration requirement mentioned in Volume I, Section II, Clause 1. • Scanned copy of Bidder's solvency certificate. (Minimum Rs.2.94 Cr of current calendar Year) • Scanned copy of GSTIN • Scanned copy of PAN card • Scanned copies of Experience certificates showing successful completion of work (with certificate) • Scan copies of financial documents.

		<p>In addition to the documents mentioned above, the documents required as per attached Forms & Annexure are also to be uploaded. Bidder shall submit their offer i.e., Technical bid as well as price bid in Electronic format on stipulated website& date as mentioned in the tender document. No offer in physical form will be accepted.</p> <p>If any uploaded scanned submissions do not open, then such documents shall not be considered as “submitted”. And such unopenable docs shall be treated as “Not submitted” and shall not be taken into consideration for evaluation.</p>
35	General Terms & Conditions	As Per Tender Document
36	Mode of Quoting Rates	Percentage rate basis, in words and figures at the end of Schedule-B.

For any clarification the bidder may contact:

EXECUTIVE ENGINEER - UGD Projects,

Bhavnagar Municipal Corporation,

Sir Mangal Sinhji Road, Near Kalanala,

Bhavnagar-364001.

Gujarat.

Phone- 0278 2424801-10

1.0 Details to be furnished along with application: -

1. Interested Bidders can view these tender documents online. The bidders who are interested in bidding in these tenders can download tender documents as mentioned above.
2. Tender Documents are available only in electronic form. Bidders shall upload the tender documents as per timeline specified as above, Tender fee and Bid Security (EMD) shall have to be furnished as specified in **Sr. No 15 to 18 and 28 of Tender Notice**. The intending bidders have to submit the following documents also. The bidder should submit all the forms electronically only.

a. Power of attorney.

A power of attorney on ₹300/- Non-Judicial stamp paper of appropriate value duly notarized, if power is delegated for signing the bid to other persons by applicant. (Scanned Copy).

b. Company's profile and Certificate of Registration of company under the law.

Bidders, who wish to participate in this tender, will have to register on <https://tender.nprocure.com>. Further, Bidders who wish to participate in online tenders will have to procure Digital Certificate as per Information Technology Act-2000 using which they can sign, their electronic bids. Bidders can procure the same from GNFC, Ahmedabad, who are licensed certifying authority by Government of India, and they will assist them in procuring the same as below mentioned address. Bidders who already have a valid Digital Certificate need not procure a new Digital Certificate.

M/s. (n) Code Solution, A Division G.N.F.C. Ltd.,

301, G.N.F.C. Info Tower, Bodakdev, S.G. Road,

Ahmedabad, Gujarat – 380054 (INDIA)

Phone No.079-40007501, 40007512, 40007516, 40007517 Fax 079-26857321

Email: nprocure@gnvfc.net

2.0 Contacting Officer:

Further details of the work and plans can be available from the office of Executive Engineer (Drainage Dept.)- UGD PROJECTs, Bhavnagar Municipal Corporation, Sir Mangal Sinhji Road, Near Kalanala, Bhavnagar-364001.

Gujarat

Phone No.:0278 2424801-10

Email Id: bmcdrainage@gmail.com

In case bidder needs any clarification or if any training is required for participating in online tendering, they can contact the following office:

M/s. (n) Code Solution, A Division of G.N.F.C. Ltd.,

301, G.N.F.C. Info Tower, Bodakdev, S.G. Road, Ahmedabad, Gujarat – 380054
Phone No.079-40007501, 40007512, 40007516, 40007517 Fax 079-26857321

Email: nprocure@gnvfc.net

3.0 DOWNLOAD OF TENDER DOCUMENT:

The tender document for this work is available only in Electronic format, which bidders can download free of cost from the internet site <https://tender.nprocure.com/>

4.0 SUBMISSION OF TENDER:

Bidder shall submit their offer in Electronic format on above mentioned website within the date specified in the Tender Notice after Digitally Signing the same. Offers, which are not Digitally Signed, will not be accepted. No offer in physical form will be accepted and any such offer, if received by the BMC, will be out rightly rejected.

Submission of Tender fee, bid security, other documents shall be as per Tender Notice.

5.0 OPENING OF TENDER:

The Technical bid will be opened as per the date mentioned in Tender Notice on website <https://tender.nprocure.com/>. Intending bidders or their representative who wish to participate in online tender opening can log on to <https://tender.nprocure.com/> on the due date and time, mark their presence or participate in online tender opening. For more details vendors are requested to refer "Vendor Training Manual". Bidder who wishes to remain present at BMC premises at the time of tender opening can do so. Only one representative of each firm will be allowed to remain present. Date of opening of Price bid will be informed only to the qualifying bidders.

6.0 GENERAL INSTRUCTIONS: -

- a) The Bid Document Fee will not be refunded under any circumstances.
- b) EMD in the form specified in tender document only shall be accepted.
- c) The offer shall be valid for 180 days from the last date of submission of bid.
- d) Tenders without Bid Document Fee, Earnest Money Deposit (EMD), Valid Registration Certificate and which do not fulfill all or any of the conditions or those submitted incomplete, in any respect shall not be considered for evaluation.
- e) Not more than one tender shall be submitted by a Bidder.
- f) Conditional tender shall not be accepted.
- g) BMC reserves the right to accept the lowest responsive offer, based on evaluation of package and reject any or all tenders without assigning any reason.

- h)** The notice shall form a part of contract document.
- i)** The bidders are advised to read carefully the “Instruction” and “Eligibility Criteria” contained in the tender documents.
- j)** The internet site address for E-Tender is <https://tender.nprocure.com/> and that of corporate website is <https://bmcgujarat.com>
- k)** The bidder should quote percentage above/below/at par with respect to total amount put to tender in schedule B.

EXECUTIVE ENGINEER
(Drainage Dept.)
BMC Bhavnagar

EMORANDUM OF WORK IN BRIEF

1. **Name of work: As Mentioned in Tender Notice**
2. **Name of Employer:** Executive Engineer (Drainage Dept.)
Bhavnagar Municipal Corporation. BHAVNAGAR
3. **Name of concerned Officer: Executive Engineer :**
 - a. Address: The office of Executive Engineer (Drainage Dept.) BMC
Sir Mangal Sinhji Road, Near Kalanala,
Bhavnagar-364001.
Gujarat,
 - b. Phone No.: 0278 2424801-10
 - c. E-mail address: bmcdrainage@gmail.com
4. **Estimated Cost: As Mentioned in Tender Notice**
5. Time allowed for completion of the work: **As Mentioned in Tender Notice**
6. Amount of Earnest Money deposit (E.M.D.) as specified in the bid: **As Mentioned in Tender Notice.**

Mode of submission of tender documents:

- 8.a) Functional guarantees of plant as per Volume IIIC, Technical bid & Price bid duly filled in with Scanned copy of EMD and tender fee and other supporting documents. Online submission only on <https://tender.nprocure.com/>
- 8.b) Other documents in Hard copy -Tender fee, EMD is required. Bhavnagar Municipal Corporation, Sir Mangal Sinhji Road, Near Kalanala, Bhavnagar-364001. Gujarat
By RPAD / Speed Post only.

Note: Tenders sent by any other mode than specified in 8a & 8b above will be outright rejected.

7. **Validity period of the offer :** 180 days from the last date of submission of bid.
8. **Opening of the Tender :** On the date specified, the electronic tender box will be opened:
9. **Place of opening :** As specified in the Tender Notice
10. **Date & Time of Opening :** As specified in the Tender Notice
11. **Amount of security Deposit:** As specified in the Tender Notice

Bid submission Checklist			
S.No	Particulars	Submission	
		Online	Physical
1	Scanned copy of Tender Fee in the form of DD	Yes/No	Yes/No
2	Scanned copy of EMD in the form of DD/BG/FDR	Yes/No	Yes/No
3	Scanned Copy of Pre-Contract Integrity Pact duly signed by Bidder as per Annexure of RFP	Yes/No	NA
4	Copy of GST registration certificate	Yes/No	NA
5	Copy of PAN Card	Yes/No	NA
6	Duly filled in and digitally signed declaration form as last item of Section-1 & Memorandum duly filled in & digitally signed as given in Section-2	Yes/No	NA
7	EPF Registration Certificate or ESIC certificate as applicable.	Yes/No	NA
	IF not applicable, Bidder should submit an affidavit with his bid subscribing on his company letter head duly attested by Power of Attorney stating “EPF/ESIC Not Applicable” mentioning the reason.		
8	Affidavit stating the authenticity of submitted document and information (On Rs 300 Non-judicial stamp paper duly signed by the authorized representative and notarized)	Yes/No	NA
9	Site visit certificate - To be submitted on company’s letter head duly sealed and signed by PoA	Yes/No	NA
10	Power of Attorney duly authorized by notary public (On Rs 300 Non-judicial stamp paper duly signed by the authorized representative and notarized)	Yes/No	NA
11	Joint Venture Agreement to be executed if applicable (On Rs 300 Non-judicial stamp paper duly signed by the authorized representative and notarized)	Yes/No	NA
12	Scanned copy duly filled in approved or authenticated tender Annexures in the prescribed format	Yes/No	NA
13	MOU Memorandum of Understanding (MoU) with qualified technology provider of STP/Pipe Manufacturer/Other Technology provider	Yes/No	NA
14	Details of financial information		
a	Gross Annual Turnover in all kinds of Civil Engineering Works	Yes/No	NA
b	Annual Net Worth or Solvency Certificate	Yes/No	NA
c	CA Audited Balance Sheets to be attached separately	Yes/No	NA
15	Declaration of financial liabilities, work on hand/completed UGD PROJECTs on Rs.300/- non-Judicial stamp paper	Yes/No	NA
16	Scanned copy of all approved/authenticated “ Technical Eligibility & PQ ” documents in the prescribed formats mentioned in BID FORMS		
a	Eligible bidders		

i	Registration details of the firm partnership deed/ Company Incorporation certificate/ Articles of Association/ Memorandum of Association (as applicable) based on type of establishment.	Yes/No	NA
ii	Declaration stating ineligibility for Corrupt and Fraudulent practices in his past assignments	Yes/No	NA
iii	History of termination/blacklisting/debarred by any State Govt/Municipal Corporations/ Central Govt./ Any state Govt Organization, Urban Local body and/or its undertaking company or its SPV, Asian Development Bank/ World Bank or similar international funding agencies organizations due to delay and non-performance in his past UGD PROJECTs	Yes/No	NA
b	Eligibility criteria		
iv	Minimum existence of the Firm	Yes/No	NA
v	Eligible class of Contractor- Certificate of registration as approved contractor of prescribed category-Valid proof of license and registration should be furnished with the bid -Civil & Electrical works	Yes/No	NA
vi	Details of Plant & Machinery available with tenderer for use on the works	Yes/No	NA
vii	Details of Plant & Machinery proposed to be procured for the works	Yes/No	NA
viii	Details of technical, supervisory and administrative personnel employed/engaged or proposed for the work	Yes/No	NA
c	Pre-Qualification criteria		
ix	Minimum average annual Financial Turnover	Yes/No	NA
x	Positive net worth or Solvency certificate of required value in the tender prescribed format	Yes/No	NA
xi	Proof of experience of Similar Nature of Work	Yes/No	NA
xii	Physical criteria experience <i>Note: Physical criteria experience may be different from similar nature of work experience produced with the bid. But it will be part of qualifying criteria</i>	Yes/No	NA
17	The Bidder shall offer his quote in “Envelop” Online only.	Yes/No	NA
	Note: No document should be submitted in hardcopy except tender fee and bid security. Only the original instrument of Tender Fee and Bid Security to be submitted physically.		

VOLUME – I

**SECTION-II:
INSTRUCTIONS TO BIDDERS**

SECTION – II

INSTRUCTIONS TO BIDDERS

1.0. GENERAL

Online tenders are invited and published by the Authority as per Tender Notice, for the work **(as mentioned in tender notice)** from the contractors who are registered in **AA class** in R&B Department or Narmada Water Resources, Water Supply & Kalpsar Department and GWSSB/WASMO department the other bidders equivalent of class in Government (State/Central), Board, Corporation, and Government Undertaking /Organisations of State & Central Government.

- (i) The concerned Contractor shall submit the certificate of registration as in concerned State/ Government bodies/ Authority along with the tender.
- (ii) The Contractors who are not registered in AA class in Government of Gujarat (R&B Department or Water resources Department) OR GWSSB/WASMO Department and having the above stated Registration, such Contractor shall have;
 - a) to apply on or before the last date of submission of tender documents to get himself registered in **AA class** in Government of Gujarat (R&B Department or Water resources or GWSSB/WASMO Department);
 - b) to obtain registration in **AA class**, in Government of Gujarat, (R&B Department or Narmada Water Resources, Water Supply & Kalpsar Department OR) before the date of work order of project contract to be issued, if awarded;
 - c) the proof of valid application for Registration in **Class AA** shall have to be uploaded with the Tender documents;

Failure of taking action mentioned above for (a) and (c) the concerned contractor shall be disqualified and for (b) agency to be bound to the decision of BMC.

- (iii) In case of Bidder participating as a Joint Venture:
 - a) The lead member shall have AA class Registration as per (i) and (ii) above
 - b) The other member shall also have AA class Registration as per (i) and (ii) above.

The proof of registration of all the members of Joint Venture in concerned State/Government bodies/Authority along with documents as per (i) or (ii) to be uploaded along with bidder's submission.

1.1. SPECIAL ATTENTION

- (i) This tender consists for the work **(as mentioned in tender notice)**
- (ii) A pre- bid conference for the works, open to all intending bidders, shall be held on the date & venue as mentioned in the Tender Notice.

- (iii) All Bidders are urged to submit a written request immediately upon receipt of the tender documents for the matter where clarification and/or additional information are desired, along with the details of work. The request shall be submitted not less than four days in advance of the pre-bid conference.
- (iv) The tender document shall be submitted as per procedure laid down in Section-II, Para No. 26, for submission of tender.
- (v) Earnest money deposit details & scanned copy shall be submitted as prescribed online and after submission online, in form specified shall be submitted in office of concerned officer (**As per Sr. No. 27 of Tender Notice**), as per details given online in sealed envelope. If earnest money deposit is not received within prescribed time limit the bid shall be rejected.
- (vi) Tender shall be opened as per procedure laid down in this Section-II, clause 28 and as per detailed tender notice.
- (vii) All Bidders are cautioned that e-tender containing any deviation from the contractual terms and conditions, specifications or requirements shall be rejected as non-responsive.
- (viii) Conditional offer will be out right rejected. No condition shall be included in tender.
- (ix) **Deleted**
- (x) Qualification of bidder will be done whose tender is considered responsive and meets the specified evaluation and qualification criteria as per tender conditions.
- (xi) Bidders shall have to declare regarding the tender submitted in the prescribed format.
- (xii) The department reserves the right to qualify/ disqualify any bidder without assigning any reason thereof.
- (xiii) **The bidder shall be disqualified if;**
 - a. The bidder had made misleading or false representation in the forms, statements and attachment submitted in proof of qualification requirements and/or
 - b. A record of poor performance such as abandoning the work, not properly completing the contract, inordinate delays in completion, litigation history or financial failures etc.
 - c. The Bidder has been blacklisted by any Government/ Non-Government / Private agencies/ Organizations/ Institutions/Government Undertakings and funding Agencies in the last 05 years.

The bidder should provide accurate information on litigation and/ or arbitration resulting from contract completed or under execution by him over the last five years. A consistent history of arbitration awards/ judgments against the bidder or any partner of a joint venture may result in disqualification for proposed work. If the details of litigation history is hidden by the bidder or any partner of a joint venture and later on it comes to knowledge of the employer the bidder shall be disqualified for the proposed work and other appropriate actions shall be taken against the bidder.

The bidder should submit undertaking on non-judicial stamp paper of ₹300/- dully attested by notary public regarding document submitted, are true. BMC would have the right to forfeit the EMD and blacklist to the bidder if any of the information given by the bidder is found faulty or incorrect or misleading.

- (xiv) If the bidder has submitted tender fee and EMD on line & in hard copy, the request of the bidder for not opening of bid shall not be accepted in any circumstances.
- (xv) If bidder has not submitted in original, tender fee and E.M.D. offline, but same is scanned and submitted with his bid online or vice versa within stipulated period, to the designated officer as per Tender document, the bid shall be liable to be considered as non-responsive.
- (xvi) All those documents which are scanned and submitted should be numbered chronologically and with their reference in the self appraisal of prequalification will have to be given for the proof of qualification.
- (xvii) The bidder/ JV Member /MoU partners whose contracts are earlier terminated / blacklisted/ debarred on account of poor performance in any State Govt/Board/ Municipal Corporations/ Central Govt./ Any State Govt Organization, Urban Local body, and/or its undertaking company or its SPV, Asian Development Bank/ World Bank or similar international funding agencies organizations during last five years, will not be eligible for this tender.
- (xviii) Any bidder who has been barred by the State/Central Government or any entity control by them (Controlling Stake) from participating in any project and the bar subsists as on the day of issue of notice inviting tender and/or submission of bid, the bidder shall not be eligible to submit the tender document either individually or as a member of consortium. However, the bidder submits the bid, the tender shall not be considered for evaluation.

- (xix) The experience of works executed in Government (State / Central), Board, Corporation, and Government Undertaking / Organizations of State & Central Government including all Public Sector Units shall only be considered for evaluation.

The experience certificate from the client equivalent to not below the rank of Executive Engineer shall only be considered. The experience of sublet works/ in house/ private/ foreign work shall not be considered. The bidder who had already applied as a prime contractor for the same tender shall not be eligible to apply under joint venture.

Note:

The experience of work (only for ETP/CETP work) in private organization shall be considered if the work carried out under the overall banner of industrial association either independently or by formation of SPV. (A scanned copy of the original certificate by the concerned authorized signatory of industrial association/ State/ Organization shall be required for evaluation). Bidder to submit the following documents, if employer is not a government organization:

- a. Self-attested copy of Work Order
 - b. Self-attested copy of Agreement
 - c. Self-attested copy of Completion Certificate
 - d. Self-attested copy of Final Bill
 - e. Self-attested copy of TDS certificates
 - f. Performance Certificate from employer (As per Form-23)
- (xx) Bidders shall not be listed under a declaration of ineligibility for corrupt or fraudulent practices issued by the central/ state govt. in accordance with sub clause 45.1 (c) or not in the list of black listed contractors announced by Government (State / Central), Board, Corporation, and Government Undertaking / Organizations of state & central government including all Public Sector Units.
- (xxi) Bidder (individual or any member in case of JV/ consortium) shall not have suffered bankruptcy/ insolvency during the last 5 years. For this, Certificate of CA appointed by the bidder must be produced along with a self affidavit to same effect of prescribed stamp paper of affidavit.
- (xxii) Memorandum of Understanding (MOU) shall be done before online submission of BID to BMC.
- (xxiii) The approved Vendor list for the Civil/Mechanical/Electrical/Instrumentation and other equipment is available on GWSSB's official website at <http://www.gwssb.gujarat.gov.in>. The Vendor list as available on the date of

submission of the BID and in future at the time of approval of QAP, the latest or amended vendor list shall be applicable & considered for executing the job.

- (xxiv) BMC shall provide ROU (Right of Use) of adequate width for laying of pipeline/construction of WTP once as per availability. During excavation, laying, back filling, any damages to the hidden object beneath the earth like pipelines, cables etc. shall be the responsibility of contractor. The contractor has to rectify the same without any financial implication on BMC within stipulated time as instructed by EIC. The crop compensation only for single time is the responsibility of BMC.

However, if any delay, due to any reasons in contractor's part, if the next crop compensation is required to be paid, it will be the responsibility of the contractor and in event of failure by contractor, to do so, BMC shall deduct and recover the same amount from contractor's bills. Any damage in the area beyond the ROU, will be responsibility of the contractor. After successful completion of the pipeline works like laying, excavation, back filling etc the contractor is also required to level the field where pipelines are laid in original condition with caution.

Further ROU (Right to Use) in terms of length shall be provided as per site availability by BMC and it may be in selective available length also. Any demand by the contractor to get continuous length to start the work will not be considered by BMC under any circumstances.

- (xxv) The contractor shall have to pay the labor registration fee of Rs. 25 / labor and annual contribution of Rs. 75.00 vide Ref: PB/Monitoring Cell/ Standard Contract Document/2013-14/2294, Dated: 07/09/2013. (Circular Enclosed).
- (xxvi) Since this is an EPC contract, the bidders are to quote their rates based on the actual market scenario. Any rates which are found to be abnormal higher/lower or unworkable shall lead to rejection of the bid. The decision of the BMC shall be final and legally binding to all the bidder.
- (xxvii) It shall be the sole discretion of the competent authority to decide the total numbers of packages for evaluation/award to the bidder based on the facts and circumstances of the cases.

This will be based on the least cost combination and as may be the most advantageous to BMC and shall be final and binding to all the bidders.

- (xxviii) The rates for recommended Spare Parts/ Patented materials as required for successful operation of the facilities for Operation & Maintenance works shall be considered while quoting the rates for O&M.

- (xxix) The Employer wishes to clarify that regardless of the contents of a bid, the successful Bidder shall be required to conform in all respects to the requirements of the Contract, and all proposals shall be subject to the approval of the Engineer In-charge. Acceptance of the Bidder's proposal for the purposes of bid evaluation and award of tender shall not be construed as approval by the BMC. All details will subsequently be subject to the approval of the Engineer In-charge during execution of the Contract. No claim for additional payments shall be entertained, other than in accordance with the Contract.
- (xxx) If mutually agreed the Operation and Maintenance contract can be extended for further four years.
- (xxxi) All necessary repairs, maintenance, overhaul, replacements etc., shall be made during the Operation and Maintenance, to maintain the Plant & associated works at the status of formal handing over after the commissioning. After completion of the Operation and Maintenance period the Sewage Treatment Plant(s) is to be handed over to concerned BMC in consultation with BMC in satisfactory working condition. At the end of Operation and Maintenance period the plant shall be handed over to the Employer in fully functional condition and without capacity degradation..
- (xxxii) In the event of any rectification of a defect or replacement of any defective goods during the warranty period, the warranty for the rectified/replaced goods shall be extended to a further period of twelve months (12) months from the date such rectified / replaced goods start functioning to the satisfaction of the purchaser.
- (xxxiii) The Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor 12 months after the completion of whole work i.e. Including O&M under the contract and for all other bidders. If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged /determined by the competent authority of BMC.
- (xxxiv) The Contractor shall completely indemnify and hold harmless BMC and its employees against any liability, all claims by statutory authorities, losses under various Labour Laws, statutes or any civil or criminal laws in connection with employees deployed by him or damages sustained by it or them by reason of any breach of contract, wrongful act or negligence by the Contractor or any of its employees engaged in the provision of the manpower services to BMC.

GENERAL DESCRIPTION OF THE WORK

This is a **BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING R.C.C. NP3 PIPE UPGRADATION OF SEWER COLLECTING SYSTEM AND EXISTING ROAD RESTORATION WORK AT VARIOUS LOCATION OF BHAVNAGAR MUNICIPAL CORPORATION, BHAVANAGR DISTRICT: BHAVNAGAR. (2nd Attempt)**

The successful bidder shall have to undertake site surveys, route surveys for ascertaining the terrain, topography of site and planning the scheme as well as to conduct geotechnical investigations for designing of foundation system of various structures. The contractor shall carry out all the process & hydraulic design, civil, structural, mechanical, and electrical and instrumentation designs and submit to client or their representative for review and approval before executing the same. This is applicable to all the components of this project. The successful bidder shall have to prepare and submit 'As Built Drawings' depicting the exact construction carried out on site, in soft and hard copy format. Defect liability period shall be part of the contract and start from successful commissioning of the plant.

BMC will be responsible to get all statutory permissions and clearances from the concerned central/ state or local statutory authorities. However, the contractor shall have to manage the day-to-day co-ordination and follow up activities based on these clearances on site. BMC shall provide required help and assistance for such day-to-day activities.

After the successful commissioning of the scheme, the contractor shall operate and maintain the system for **(As Mentioned in Tender Notice Sr No 8)** years. This includes carrying out necessary repairs of equipment, which meet original specifications; replacement of any components required for smooth running of the system, etc. during O&M period, the replacement of the items should be of the same specifications as in the original contract documents. Efficiency of all the systems as considered for design should be maintained throughout the O & M period. The power factor should be maintained throughout the maintenance period.

The detailed description of the works is included in the "Extent of Work" under Volume-III (A).

PARTICULARS PROVISIONAL

The particulars of the proposed works given as well as in the accompanying brief note are provisional and must be considered only as advance information to assist bidders.

1.2. DEFINITION

In this document the following words and expressions have the meaning hereby assigned to them.

1.2.1. **APPROVED / APPROVAL:**

Means approval in writing.

1.2.2. **B.I.S:**

Means Bureau of Indian Standards.

1.2.3. **BIDDER / TENDERER :**

Means individual, proprietary firm, firm in partnership, Limited Company, Corporation or group of firms forming a joint venture, MOU Partner applying to become eligible to tender.

1.2.4. **DIGITAL SIGNATURE :**

Any electronic documents, which contains encrypted message digest using hash algorithm and Tender public key is known as Digitally Signed Documents and the process of generating such document is called digitally signing it.

1.2.5. **CONSTRUCTION PLANT:**

Means all equipment, appliances or things of whatsoever nature required for the execution, completion or maintenance of the primary work or temporary works but does not include materials or other things intended to form or forming part of permanent work.

1.2.6. **CONTRACT:**

Means the instruction and information to bidder, general and special conditions of contract, specifications, drawings, schedules of quantities & tender prices, other parts of the Bid Document, the formal agreement between the employer and contractor and all addenda and attachments related to the above.

1.2.7. **CONTRACTOR:**

Means the bidder with whom the contract has been made for executing the works.

1.2.8. **CONTRACT VALUE:**

Means the agreed amount stated in the Contract Agreement for Designing, Supplying, Construction, Installation, Testing, & Commissioning including O&M of the works and to remedy of any defects, and includes adjustments (if any) in accordance with the Contract

1.2.9. **CAPITAL COST :**

Means the agreed amount stated in the Contract Agreement for Designing, Supplying, Construction, Installation, Testing, & Commissioning of the works for the stipulated period in

accordance with the Contract. It is the total cost needed to bring a project to a commercially operable status.

1.2.10. CONTRACTOR'S EQUIPMENT:

Means all equipment, tools, apparatus, machinery, vehicles and other things required for the execution and completion of the works and the remedying of any defects. However, Contractor's Equipment excludes Temporary works, Departmental equipment (if any) or plant, materials and any other things intended to form or forming part of the permanent works.

1.2.11. COMPLIANCE WITH LAWS:

The Contractor shall, in performing the Contract, comply with all applicable Laws related to all actions of his obligation as per the contract.

1.2.12. CONTRACTOR'S OBLIGATIONS:

Means the obligation to execute the Project in all its entirety and shall, without limitation, include Operation and Maintenance.

1.2.13. CONTRACTOR'S USE OF EMPLOYER'S DOCUMENTS:

As between the Parties, the Employer shall retain the copyright and other intellectual property rights in the Employer's requirements and other documents made by (or on behalf of) the employer. The contractor may, at his own cost, copy, use, and obtain communication of these documents for the purposes of the contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.

1.2.14. COUNTRY:

Means the Country in which the site (or most of it) is located, where the Permanent Works are to be executed.

1.2.15. COMMISSIONING:

Means the successful operation of the project after successfully running for a period of One (1) months as a part of trial run or till prescribed parameters are not attained & whichever is later of the two.

1.2.16. **COMPLETION:**

Means the date of successful commissioning of all the equipment/ facility in the scheme after satisfactory running for three months as a part of trial run or till prescribed parameters are not attained & whichever is later of the two

1.2.17. **DAY:**

Means a day from midnight to midnight.

1.2.18. **DEFECTS LIABILITY PERIOD:**

Means the period of **3 years** from the certified date of completion of work. It shall be counted after the successful trial runs for a period of 1 months or till prescribed parameters are not attained & whichever is later of the two. During the defect liability period the contractor shall be responsible for repair and replacement of any defective material used on the entire work and he will carry the full liability to make good to the complete satisfaction of the Engineer In-charge, any defects in the completed work or any bad work visible or detected afterword's.

1.2.19. **DRAWINGS:**

Means the drawings referred to in the specifications, any modifications of such drawings approved in writing by the Executive Engineer, and such other drawings as may from time to time be furnished or approved in writing by the Engineer-in-charge.

1.2.20. **E- TENDER :**

Tender in which the bidder can participate online by means of logging in onto the respective website is called E- Tender.

1.2.21. **EMPLOYER / OWNER / DEPARTMENT:**

Bhavnagar Municipal Corporation Gujarat or the person named as Employer or Owner in the Contract Agreement and the legal successor in title to this person.

1.2.22. **EMPLOYER'S EQUIPMENT:**

Means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Employer's requirements but does not include plant which has not been taken over by the Employer.

1.2.23. **EMPLOYER'S USE OF CONTRACTOR'S DOCUMENT:**

As between the Parties, the Contractor shall retain the copyright and other intellectual property right of the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.

The Contractor shall be deemed by signing the Contract to give the Employer a non-terminable, transferable, non-exclusive royalty-free license to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This license shall:

- Apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works.
- Entitle any person in proper possession of the relevant part of the works to copy, use and communicate the Contractor's documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the works, and
- In the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the site and other places as envisaged by the Contract, including replacements of an computers supplied by the Contractor. The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this Sub-Clause.

1.2.24. ENGINEER-IN-CHARGE:

Means the Engineer-in-Charge of the works, or in-charge of specified parts of the works under the contract or such other assistants or sub-ordinates to whom the Engineer-in Charge may have delegated certain duties, acting separately within the scope of the particular duties entrusted to them.

1.2.25. ESTIMATED COST:

The estimated cost of the Project (the "Estimated Cost") has been specified at Sr No 6 of Tender Notice.

1.2.26. FACILITY:

Means the entire system to be designed and constructed in accordance with the provisions hereof, including the equipment, buildings, structures, ramps, pits, pipes, pipeline appurtenances, fencing, lighting, testing and analysis equipment, tools, computers, software programs, safety equipment, plant machinery, supplies, instruments and inventory incorporated therein, as well as all open areas within the site, and including any additions, modifications, alterations, adjustments, replacements and repairs as may be made thereto from time to time.

1.2.27. **GOODS:**

Means Contractor's Equipment, Materials, Plant and Temporary Works, all or any of them as appropriate.

1.2.28. **GOVERNMENTAL AUTHORITY / GOVERNMENT:**

Means any Central or State authority or body exercising executive, legislative, judicial, regulatory or administrative functions, including, without limitation, any Government authority, agency, department, board, commission or instrumentality of Indian or any political subdivision thereof, court, tribunal, arbitrator or self-regulatory organisation.

1.2.29. **IT ACT-2000:**

Means Information Technology Act, 2000 of Government of India

1.2.30. **JOINT AND SEVERAL LIABILITIES:**

If the Contractor constitutes (under applicable Laws) a joint venture, consortium or other unincorporated grouping of two or more persons:

- These persons shall be deemed to be jointly and severally liable to the Employer for the performance of the contract.
- These persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and

The contractor shall not alter its composition or legal status without the Prior consent of the Employer.

1.2.31. **LAWS:**

Means and includes all the provisions of all National (or state) legislation, Indian statutes, regulations, ordinances, codes, official or other standards, administrative or other rules, zoning and other plans and restrictions, building and other permits, judgements awards and decrees of, or agreements with any Governmental, semi-Governmental or quasi- Governmental Authority as currently in effect or as may be in effect from time to time and /or as may be amended or supplemented from time to time.

1.2.32. MAINTENANCE STANDARD:

Means the requirements for maintaining, repairing, and renewing the Facility:

- a. As set forth in this tender document;
- b. Required pursuant to applicable Law;
- c. As may be necessary for keeping the facility in a satisfactory working condition such that the Facility will continuously comply with the Operation Standard; and
- d. As may be necessary to ensure that the Facility shall continuously be in an optimum working condition and state in relation with the lifetime of the Facility.

1.2.33. MATERIALS:

Means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply (only materials if any) to be supplied by the Contractor under the Contract.

1.2.34. MATERIAL SUPPLIER:

Means the person who supplies goods or services. A supplier may be distinguished from a contractor or subcontractor, who commonly adds specialized input to deliverables also called vendor.

1.2.35. MONTH:

Means from the beginning of a given date of calendar month to the end of preceding date of the next calendar month.

1.2.36. O & M MANUAL:

Means the final Manual for the Operation and Maintenance of the Facility to be prepared in accordance with the requirements of Bid Documents by the contractor. Bidder shall provide this at the time of commissioning of the Project.

1.2.37. ONLINE :

Any activity that is done on website is referred as 'online' activity for e.g., Submission of Bid online would mean that technical & price Bid has to be submitted on website.

1.2.38. OFFLINE :

Any activity that is done in conventional route is referred as 'Offline' activity for e.g. "Submission of Tender fee, Earnest Money Deposit , Registration Certificate, Solvency Certificate, etc in Offline mode" would mean that the tender fee, Earnest Money Deposit, Registration Certificate, Solvency Certificate etc is to be Submitted to the Office of the concerned Executive Engineer physically.

1.2.39. OPERATION AND MAINTENANCE OBLIGATIONS:

Mean the obligation of the Contractor pursuant to the agreement to operate and maintain the facility on and from the start date of O&M until the date of completion of this Agreement.

1.2.40. OPERATION AND MAINTENANCE PERIOD:

Means the time period after the issue of Successful Commissioning Certificate and continuing for the term of the Agreement.

1.2.41. OPERATION AND MAINTENANCE COST:

Means the amount agreed upon by the Employer to the Contractor, towards fulfilment of the Contractor's Operation and Maintenance Obligations.

1.2.42. OPERATION STANDARD: Means

- The Performance Guarantees;
- All applicable Laws;
- All of the requirements, policies and procedures set forth in the O & M Manual
- All other operational requirements set forth in this Agreement.

1.2.43. PERFORMANCE GUARANTEES:

Means the List of Guarantees offered / provided by the Contractor in his Bid Submission pursuant of the Bid Documents.

1.2.44. PERMANENT WORKS:

Means the works to be designed and executed by the Contractor under the Contract.

1.2.45. PIPE SUPPLIER:

Means the person that supplies pipes.

1.2.46. RUPEE:

Means Indian National Rupees (INR)

1.2.47. SCANNED COPY :

Electronic Copy of any document generated using a Scanner is called scanned copy.

1.2.48. SITE:

Means the specific areas / lands and other places on, under, in or through which, the works are to be executed or carried out and any other lands or places provided by the owner for the purposes of the contract together with such other places as may be specifically designated in the Contract or subsequently approved as forming part of the site.

1.2.49. SYSTEM :

Means the computer which hosts the website (<https://tender.nprocure.com>), using which Bidder participates in the tendering process.

1.2.50. SUBSTANTIAL COMPLETION:

Substantial Completion of the work means when the work or designated portion thereof is sufficiently completed in accordance with the contract except for any minor outstanding works and defects which will not substantially affect the use of works or section for their intended purpose.

1.2.51. TAKING OVER:

Means, the Owner shall take over the project after contractual completion of the O&M period and meeting all contractual obligations, Terms & Conditions as agreed by the contractor.

1.2.52. TEMPORARY WORKS:

Means all temporary works of every kind required for successful execution of the Contract.

1.2.53. TESTS ON COMPLETION:

Means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out (Test on Completion) before the works or a section (as the case may be) are taken over by the Employer.

1.2.54. TRIAL RUN PERIOD:

Trial run period for the work is 1 months of the entire scheme including achievement of prescribed performance parameters.

In the event of non-achievement of prescribed parameters within a period of 3 months, specified above the trial run period could be extendable to a period till the performance parameters are achieved. During the trial run period the contractor shall be responsible for the maintenance of the entire scheme including all staff, labour, material, power etc. repair of any defects/ replacement of the defective material used at the cost at his own cost.

1.2.55. UPLOAD :

The process of transferring electronic document from Bidder's computer using internet connection to the website (<https://tender.nprocure.com>) is called uploading.

1.2.56. EXECUTIVE ENGINEER :

Means the Executive Engineer the overall in charge of the works.

1.2.57. **WEEK:**

Means seven consecutive days.

1.2.58. **WORKS:**

Means the works / action to be executed in accordance with the contract.

1.3. BID INVITATION:

Means the call / invite by The **Bhavnagar Municipal Corporation** (hereinafter referred to as "the Employer" or BMC) from all interested and eligible bidder's for Water Supply Schemes as per Tender Notice.

1.4. DOWNLOAD OF TENDER DOCUMENTS:

The tender documents are available in electronic form, from the website <https://tender.nprocure.com>. Interested bidders can view these tender documents online and can download tender documents.

1.5. Particular Provisional

The particulars of the proposed works given herein as well in the accompanying brief note are provisional and must be considered only as advance information to assist bidder.

1.6. Present Status of the Work:

This is a proposed plant along with facilities, needs to be designed and executed as per the specifications and BOQ etc.

2.0 Time of Performance:

The successful bidder will be expected to complete the works as per Sr no. 7 of tender notice from the date of Letter of Intent.

The O&M time period shall be (**As Mentioned in Tender Notice Sr No 8**) (including defect liability period), from the date of issue of Successful Commissioning Certificate.

3.0 Project Implementing Agency:

The "Bhavnagar Municipal Corporation " shall be the project- implementing agency. This contract shall be administered and managed by the "**Executive Engineer (Drainage Department) Bhavnagar Municipal Corporation. Sir Mangal Sinhji Road, Near Kalanala, Bhavnagar**, for and on behalf of Bhavnagar Municipal Corporation and shall act as the "Engineer In-charge."

4.0 Allocation of Risk & Responsibilities:

4.1 Contractor:

The preliminary designs and details contained in the bid documents are based on limited and indicative field data as available with the Employer at the time of preparation of the bidding documents. Bidder shall be responsible to verify/ examine/ check and make his own assessment of the site, site data, soil data and the schematic details shown in the bid documents based on his own investigations and/ or additional surveys, if required, at bidder's own cost.

The contractor shall be responsible to make good and bring to original position road and land surface, etc. damaged during laying of pipelines and construction of structures or while carrying out any activities related to this contract, at his cost.

The Contractor shall be responsible for all the damages that may occur during the execution of the work, to the underground cables, power lines, telephone lines, other water/sewer lines and other infrastructure facilities etc. while executing the works under this contract and shall bear all costs relating to repairs / replacements.

- 4.2 The contractor shall be responsible for failure of any components of the works executed by him during the full period of contract and the defect liability period. The contractor shall have to replace defective/ damaged/non-standard components of the executed works as may be identified by the engineer in charge at the cost of the contractor.

The Contractor will prepare and present interim/running and final bills.

The Contractor shall be responsible for the safety and performance of all civil and other structure up to the end of period of defect liability period. The damages/defects identified by the "Engineer in charge" shall be made good, as per Standards, by the contractor at his cost and risk. In case of collapse of structures in part or full replacement/ reconstruction shall be done by the contractor at his cost and risk.

The Employer:

- a) The **Bhavnagar Municipal Corporation** assures all participants for the contract that, adequate financial resources are available to cover the financial requirements and funds are available to meet the disbursement needs of the construction contracts in accordance with the provisions of tender documents.

All the material shall be inspected by Bhavnagar Municipal Corporation internal system and/or through Third Party Agency appointed by the board.

BMC will provide indicative drawings and design parameters as may be required for works to be designed by the contractor.

Bhavnagar Municipal Corporation will approve and pay all interim / running / final bills presented by the Contractor after due verification against the provisions of contract.

Statutory charges and other charges such as fees, insurance, damage, NOC etc. will be in the scope of Contractor. Statutory clearances and permissions shall be in the scope of Contractor. BMC will only provide necessary support to the Contractor during coordination with respective agencies. The responsibility and liability of statutory clearances lies with the Contractor. No claim for extension of time will be entertained in this regard.

The BMC will make available land for laying the pipeline & will be responsible for payment of crop compensation etc. in case of laying the pipeline in private/ government land. However, once clearance/ possession is obtained and established through mutual consent of the owner, its day-to-day management on site shall be the responsibility of the contractor for which Bhavnagar Municipal Corporation shall provide only necessary help and assistance.

- b) All bids are to be completed and returned to the Employer in accordance with these Instructions to Bidders.
- c) A copy of the available reports and data has been kept for reference in the office of: (Name, Address, Contact Person & nos. of Executing Authority as per appendix to bid details)

6. ONE BID PER BIDDER:

Each bidder shall submit only one bid either by himself, or as a partner in a joint venture. A bidder who submits or participates in more than one bid under this proceed will cause all those bids to be rejected.

7. COST OF BIDDING:

The bidder shall bear all costs associated with the preparation and submission of its bid, up to acceptance of the offer. The Employer will in no case be responsible or liable for those costs.

8. SITE VISIT:

8.1 The bidder is advised to depute a suitable team to visit and examine the Site of Works and its surroundings for fully understanding of the job and ascertain the difficulties that may be encountered during execution of the works and for obtaining for himself, on his own responsibility, all information that may be necessary for preparing the bid and entering into the Contract. The cost of visiting the Site shall be entirely at bidder's own expense.

8.2 COMMUNICATION:

8.2.1. AIRPORTS:

Ahmedabad is the nearest International Airport from the site, Baroda is the nearest domestic Airport from the site of work.

8.2.2. Railway:

The Railway station is at Surat, Vadodara, Ahmedabad, Mumbai and Delhi are connected by B.G. Railways. All the district places of the state are connected by railways.

8.2.3. Roads:

Express highway is passing from Ahmedabad to Vadodara. National Highway 8 A, 8B & 8C are passing in Gujarat State. All the districts and taluka places including cities are connected with well-defined road networks.

9 DETAILS OF APPROACH

Approach to the site of works: The bidder has to make own arrangements for approaching the site

10 GENERAL FACILITIES

10.1. Hotel/ Guest House Facilities:

At Bhavnagar hotels up to Three-star standard and Government Circuit house are available. The Govt. Circuit houses are available at all district places.

10.2. Housing:

The Bhavnagar Municipal Corporation has not envisaged any provision of house colony for contractors. The contractor, therefore, has to make his own arrangement for housing his staff and labourers.

10.3. **Marketing facilities**

Marketing facilities for day-to-day needs are generally available. Special & major marketing centres are in nearby cities Ahmadabad, Rajkot, Vadodara, Anand etc.

10.4. **Water Supply**

The charges and expenditure for arrangement and usage of water shall be borne by the Contractor during construction phase and Operation and Maintenance phase.

10.5. **Medical Aids**

Government and private Hospital facilities are available at all districts. However, the contractor will have to make own arrangement for medical services for his labour and staff.

10.6. **Electric Power**

The contractor will have to arrange with Gujarat Electricity Board, Gujarat for his power requirements during construction phase & Trail run. All charges for the use of power including maintenance shall be borne by the contractor and paid directly to the concerned authorities. He shall comply with all the requirements for purchase and use of electric power. During Operation and Maintenance, power charges will be reimbursed by the BMC to the extent of maximum consumption decided by Engineer-In-Charge.

10.7. **Post, Telegraph and Telephones**

Post and Telephone services are available for public use at all district places.

10.8. **Supply of Diesel, petrol and Oil**

Petrol and diesel pumps are installed by private agencies in all district places. The contractor shall have to make his own arrangement for procuring the lubricants required by him.

11 **CLIMATE AND WORKING SEASON**

11.1. **Temperature**

Gujarat State has tropical climate. The daily minimum temperature ranges from 5° Celsius in December- January to 27° Celsius in April-May. The daily maximum temperature varies from 30 Degree Celsius in December- January to 47 Degree Celsius in April –May.

11.2. Rainfall

Average annual Rainfall ranges from less than 500 mm the North West region to over 2000 mm in the South, with most part of the State receiving 200mm to 1000mm of rainfall. About 95% of rainfall occurs during the months June to September leaving remaining period of the year almost dry.

11.3. Working Season:

Since rainfall is spread over the period starting from middle of June to the end of September, It is generally not contentions and intense except for few days.

The above information of Climate of the project area is given only as helping information in good faith and BMC does not carry any liability for providing this information. The interested parties may refer the reports and forecast issued by the Indian Meteorological Department or other weather agencies for their use.

B. BIDDING DOCUMENTS

12. CONTENT OF BIDDING DOCUMENTS

12.1 The bidding documents are those stated below, and should be read in conjunction with any Addenda issued there to in accordance with Clause 14.

VOLUME: I	<ul style="list-style-type: none">• Tender Notice• Technical Bid
VOLUME – II	<ul style="list-style-type: none">• General conditions of Contract (GCC)
VOLUME – III:	<ul style="list-style-type: none">• Extent of works• Technical Specification (Civil) & (E&M)• Item Wise Specification• Data sheet
VOLUME –IV	<ul style="list-style-type: none">• Price bid• Schedule B
VOLUME-V	<ul style="list-style-type: none">• Bid Drawings
VOLUME-VI	<ul style="list-style-type: none">• Conditions of Contract for O & M

12.2 The bidder is expected to examine carefully the contents of the Bidding documents. Failure to comply with the requirements of bid submission will be at the bidder's own risk. Pursuant to **Clause 28** under “**E. Opening of Tender**” bids which are not

substantially responsive to the requirements of the bidding documents will be rejected.

13 CLARIFICATION OF BIDDING DOCUMENT:

A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by fax (hereinafter the term "fax" is deemed to include electronic transmission such as facsimile, cable and telex) at the Employer's address indicated in the Invitation for Bids. The Employer will respond to any request for clarification, which it receives earlier than 4 days prior to Pre-bid meeting. Copies of the Employer's response, including a description of the enquiry, will be communicated on **tender.nprocure.com**.

14. AMENDMENTS OF BIDDING DOCUMENTS:

14.1 At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder modify the bidding documents by issuing amendment.

14.2 Any addendum/amendment thus issued shall be part of the bidding documents pursuant to Sub-Clause 12.1, and shall be communicated on **tender.nprocure.com**

14.3 To afford prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may extend the deadline for submission of bids, in accordance with Clause 26, Submission of Tender.

14.4 All amendments and modifications issued by the Employer shall be deemed to be integral part of the contract to be signed with the successful bidder.

C. PREPARATION OF BIDS

15. LANGUAGE OF BID:

The bid, and all correspondence and documents, related to the bid, exchanged between the bidder and the Employer shall be written in the English language. Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant passages in the English language, in which case, for purposes of interpretation of the bid the English translation shall prevail.

16. DOCUMENTS COMPRISING THE BID:

16.1 The bid submitted by the bidder shall comprise two envelopes submitted simultaneously, one containing only the "**Technical Proposal**" and the other the "**Price Proposal**".

16.2 The technical proposal shall contain the following;

- (i) Bid Form for Technical Proposal and Appendix to Technical Proposal;

- (ii) Power of Attorney
- (iii) Information on Qualification
- (iv) Confirmation of Eligibility
- (v) Schedule of Major items of equipment
- (vi) Schedule of major items of Constructional plant
- (vii) Schedule of key personnel
- (viii) Schedule of compliance with the bidding documents
- (ix) Schedule of construction facilities
- (x) Schedule of construction method
- (xi) Any other material required to be completed and submitted by bidders in accordance with these instructions to bidders.
- (xii) Form of Bid Security

16.3 The price proposal shall contain the following;

- (i) Bid form for price proposal and Appendix to price proposal;
- (ii) Schedule of prices:
- (iii) Schedule of Payment
- (iv) Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders.

17. BID FORM & PRICE SCHEDULE:

The Bidder shall complete the Bid Forms and schedules furnished in the bidding documents in the manner and detail indicated therein, following the requirements of Clause 15 and Clause 16.

18. BID PRICES:

18.1 Unless specified otherwise in Employer's requirements, Bidders shall quote for the entire facilities on a "single responsibility" basis such that the total bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the bidding documents in respect of the design, manufacture, including procurement and subcontracting (if any), delivery, construction, installation and completion of the facilities. This includes all requirements under the Contractor's responsibilities for testing, pre-commissioning and commissioning of the facilities and, where so required by the bidding documents, the acquisition of all permits, approvals and licenses, etc. services as may be specified in the bidding documents, all in accordance with the requirements of the Conditions of Contract.

18.2 The bidders shall have to give detailed rate analysis in justification of the prices as may be required by the employer as a part of the evaluation process, if so desired by the employer.

19. BID CURRENCIES:

The prices shall be quoted on fixed and firm price basis in Indian currency i.e. Indian currency (INR) Only.

20. BID VALIDITY:

20.1 Bids shall remain valid for a period of **180 days** from the last date of submission of bid.

20.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request that the bidders extend the period of validity for a specified additional period. The request and the responses there to, shall be made in writing. A bidder may refuse the request without forfeiting its bid security. A bidder agreeing to the request will not be required or permitted to modify its bid, but will be required to extend the validity of its bid security for the period of the extension, and in compliance with Clause 18 in all respects.

21 BID SECURITY:

21.1 The bidder shall furnish, as part of its bid with the technical proposal, a bid security amount as specified in the Tender Notice.

21.2 The bid security shall, at the bidder's option, be in one of the following form:

(a) A Demand Draft payable to the officer inviting bid as per tender notice and issued by short listed bank as per tender notice.

(b) Fixed deposit receipt pledged in the name of the officer inviting bid as per tender notice and issued by short listed bank as per tender notice and valid up to 28 days from the date of closure of the bid validity period of 180 days. **i.e. (Total of 180+28=208 days).**

(c) Unequivocal and unconditional Bank Guarantee in the prescribed format given in this document issued by short listed bank as per tender notice and valid up to 28 days from the date of closure of the bid validity period of 180 days. The format of the bank guarantee shall be in accordance with the sample form included in Section–IV as Form-19. Other formats may be permitted subject to the prior approval of the Employer. The bid security shall remain valid for 28 days beyond the original validity period for the bid and beyond any period of

extension subsequently requested under Sub-Clause 20.2. i.e. **(Total of 180+28=208 days)**

- 21.3 Any bid not accompanied by an acceptable bid security shall be rejected by the Employer as non-responsive.
- 21.4 The bid securities of unsuccessful bidders will be returned as promptly as possible.
- 21.5 The bid security of the successful bidder will be returned when the bidder has signed the Contract Agreement and furnished the required performance security.
- 21.6 Within 10 days from the date of issue of the letter accepting his tender, the successful Bidder shall furnish the required Security Deposit for performance and plus additional security if any for unbalanced bids in accordance with the condition of the Contract and attend the office of the Engineer In-charge for execution of the Contract documents. If he fails to furnish the Security Deposit for performance or to execute the Contract for the work offered to him, his EMD shall be forfeited and the Bidder may be disqualified from tendering for further works for three years.
- 21.7 The bid security may be forfeited;
- (a) If the bidder withdraws its bid, during bid validity period specified
 - (b) If any document submitted by the bidder are false and fraudulent
 - (c) If the successful bidder fails
 - i. To furnish security deposit in accordance with the relevant clause in the bid.
 - ii. To sign the contract with in time limit specified in the bid.
- 21.8 In case of forfeiture of EMD, Bidder shall be disqualified and shall not be allowed to bid for further works under Bhavnagar Municipal Corporation for three years.

22. ALTERNATIVE PROPOSALS BY BIDDERS:

Bidders are not permitted to give any alternative offer containing technical or other alternatives. Their bid proposals shall be in total conformity of the employer's requirement as described in the bidding documents.

23 PRE- BID MEETING:

- 23.1 The bidder or its official representative is invited to attend a pre-bid meeting, which will take place at:

Venue : As mentioned in Tender Notice

Date : As mentioned in Tender Notice

- 23.2 The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

- 23.3 The bidder is requested to submit any questions in writing or by cable, to reach the Employer not later than four day before the pre-bid meeting.
- 23.4 Minutes of the meeting, including the text of the questions raised and the responses given, will be transmitted without delay to all of the bidding documents. Any modification/ corrections/ amendments to the bidding documents shall be declared after the pre-bid meeting and shall be the listed as part of the minutes of the pre-bid meeting or separately thereafter as may be necessary. The pre bid minutes and the modifications /corrections/ amendments issued by the employer subsequent to the issue of bidding documents shall be signed with the successful bidder.
- 23.5 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

D. SUBMISSSION OF BIDS

24 METHOD OF TENDERING:

- 24.1. If the tender is uploaded by an individual, it shall be digitally signed by the individual.
- 24.2. If the tender is uploaded by a proprietary firm, it shall be digitally signed by the proprietor.
- 24.3. If the tender is uploaded by a firm, in partnership, it shall be digitally signed by all the partners of the firms or alternatively by a partner holding power of attorney for the firm in which case a certified copy of the power of attorney shall accompany the tender, a certified copy of the partnership deed, full name, current address of the firm, current addresses of all the partners of the firm shall also accompany the tender.
- 24.4. If the tender is uploaded by a limited company or a corporation, it shall be digitally signed by a duly authorized person holding the powers of attorney for signing the tender. Such limited company or corporation may be required to furnish satisfactory evidence of its existence before the contract is awarded. They should also furnish Articles of Memorandum of Association.
- 24.5. Each bidder shall submit only one bid for the particular work. A bidder who submits more than one bid in the particular work will be disqualified.
- 24.6. The joint Venture: (If applicable) is allowed as per Clause no. 34 of Section-II
- The Lead Partner shall submit complete information required in the forms pertaining to each firm in the group and state along with the Bid as to which of the firms shall have the responsibility for tendering and completion of the Contract document and furnish evidence admissible in law in respect of the authority assigned to such firm

on behalf of the group of firms for tendering and for completion of the Contract documents. Full information and satisfactory evidence pertaining to the participation and responsibility of each member of the group of firm in the Tender shall be furnished along with the tender. A certified copy of the Joint Venture Agreement in prescribed form (specified at Form-22) shall be submitted along with the Tender.

- 24.7. The tender documents uploaded in the name of an individual bidder shall not be used by a Joint Venture. Joint venture shall have to upload the tender document in the name of JV only, if he wants to apply.
- 24.8. Each bidder shall submit only one bid for the particular work. A bidder who submits more than one bid in the particular work will be disqualified.
- 24.9. All witnesses and sureties shall be person of status and probity their full name, occupation and addresses when they fill the vendor registration form provided in the website. www.gwssb.nprocure.com
- 24.10. In case at time of tender uploading, if any of the above information has changed then the Bidder shall correct the same by making the modification in his personal profile.

25 ACCOMPANIMENTS TO TENDER

The Bidder shall have to upload following documents which are digitally signed by Bidder's Digital Certificate with his tender.

- 25.1. Scanned Copy of the latest Income Tax Return with permanent account number (PAN) and Income Tax ward where assessed.
- 25.2. The bidder shall submit GSTIN along with other details required under GST Act to BMC the contractor shall be responsible for deposition of applicable GST to the concerned authority.
- 25.3. Scanned copies of client certificate showing, performance of the Bidder working with BMC/ GWIL / GWSSB or any employer for ongoing works as per prescribed Proforma mentioned in Section-III.
- 25.4. A scanned copy of declaration showing the details of all works completed and works on hand with the contractor and the value of works that remain to be executed.
- 25.5. Scanned copy of Registration or renewal receipt as approved contractor of concerned state Govt./ Railway/ CPWD/Government shall be submitted by bidder as per Volume I, Section II, Clause 1 General.
- 25.6. Scanned copies of the Power of Attorney duly authorized by a notary public, if power is delegated for signing the Bid to other person by the Bidder.
- 25.7. Scanned copy of E.M.D. in accordance with relevant clause in "Tender Notice" of

tender notice and the original shall also be submitted in physical form by RPAD/Speed Post.

- 25.8. Scanned Copy of the Solvency Certificate from Bank of required amount as per Tender Notice.
- 25.9. Scanned copy of Account payee Demand Draft for Tender Fee in accordance with relevant clause of Tender Notice, and also in physical form shall also be submitted by RPAD/Speed Post.
- 25.10. Scanned copy of all the prescribed Forms & Annexure mentioned in Section-III, also in physical form in separate sealed cover by RPAD/Speed Post in the office of The Executive Engineer as mentioned in Tender Notice.
- 25.11. Scanned copy of the detailed statement of the turnover (Engineering Works Only) of last seven completed financial years audited and certified by the Chartered Accountant.
- 25.12. The bidder should submit undertaking on non judicial stamp paper of ₹300/- duly notarized regarding document submitted, are true. BMC would have the right to forfeit the EMD and black list to the bidder if any of the information given by the bidder is found faulty or incorrect or misleading.
- 25.13. If the Bidder Firm is a member of a Group of Companies (with a common name), scanned copies of all relevant documents clearly indicating the stake of the bidding Firm in the equity of each firm of the Group, Turnover, Net Tangible Worth and Cash Flow of each company wherein the stake of the Bidding Firm is 51% or more in terms of equity.
- 25.14. All MOU's shall be on a Non Judicial stamp paper of appropriate value duly notarised and signed by respective authorised representatives.
- 25.15. Form of Pre-integrity pact
- 25.16. GST Registration certificate and details
- 25.17. Attested copy of Memorandum of Work in Brief
- 25.18. EPF Registration Certificate or ESIC certificate as applicable or Affidavit with bid subscribing on company letter head duly attested by Power of Attorney stating non-applicability of EPF/ESIC mentioning the reason.
- 25.19. CA Audited Balance Sheets to be attached separately.

Note: The above accompaniments should be included in List of Submittals, Form-O.

26. SUBMISSION OF TENDER:

- 26.1. The Bidder must submit online duly filled in the entire tender document i.e., technical bid and price-bid available on website the rate and the along with other details in Schedule B of tender document.
- 26.2. The bidder shall fill the required details/ data/ information in the prescribed form of tender document.
- 26.3. Tender in offline mode will not be accepted.
- 26.4. The tender i.e. Technical bid and Price bid, dully filled in shall be uploaded on tender.nprocure.com up to the date and time mentioned in the Tender Notice.
- 26.5. The employer at his discretion can extend the last date for submission of tender by amending the bidding document in which case all rights and obligations of the employer and bidder will thereafter be subject to the last date as extended. The bidder shall be responsible for extending the validity of tender accordingly, failing which his bid shall be rejected as non-responsive.
- 26.6. Bidders will have to submit F.D.R./DD/Bank Guarantee for Earnest Money Deposit and Demand Draft of tender fee in a separate sealed envelope and other technical documents in another sealed envelope. The documents shall be submitted by RPAD/Speed Post only to the designated officer, as mentioned in the Tender Notice & submission made by courier shall not be considered. Each cover must clearly be marked with the contents i.e. **“TENDER FEE & EMD”** and **“TECHNICAL BID DOCUMENT”**

27. LATE AND DELAYED TENDER:

As a rule the system will not accept any Tender after the due date and time and hence in case of E-Tenders there will be no late tender.

27.1 STATING OF RATES

The percentage above/below/at par at the end of Schedule – B must be submitted in words and figures only on the website. Amount in words will be automatically generated by system. Total amount of each item and the grand total in figures and the respective words will be automatically calculated by the computer and displayed.

E. OPENING OF TENDER

28. OPENING OF TENDERS

The Designated Officer of BMC will open the e-Tender on the date as mentioned in the tender notice, if possible in his office at the address specified in the Tender Notice. The intending Bidders, if they wish may participate in online Tender opening process and view the result on tender.nprocure.com To participate in online tender opening, bidder will have to log in with his user ID and password and click on “Mark

my attendance button” to view Tender result. For more details, please refer “Vendor Training Manual.”

1. Opening of Technical Bid:

The designated officer of Bhavnagar Municipal Corporation will open technical bid first at the address specified in the Tender Notice. The evaluation of Technical Bid will be done as per “**Clause F: Evaluation of Tender**”.

2. Opening of Price Bid:

The price Bid of ONLY qualified bidders shall be opened as decided here after.

The designated Officers of Bhavnagar Municipal Corporation will open each price bid on or after the date and time mentioned in the Tender or time and date pre-intimated to qualified bidders on and the print out of total amount quoted in Schedule B and the condition if any put forth by the Bidder. The Bidder can see his price bid as well as other Bidders’ entire price Bid who have participated in the E-Tender.

All Tenders will be opened online irrespective of the presence of the Bidder.

F. EVALUATION OF TENDER

EVALUATION & COMPARSION OF TECHNICAL PROPOSAL:

The Employer will carry out a detailed evaluation of the bids in order to determine whether the bidders are qualified and whether the technical aspects are substantially responsive to the requirements set forth in the bidding documents. In order to reach such a determination, the Employer will examine the information supplied by the Bidders and other requirements in the bidding documents, taking into account the following factors:

QUALIFICATION

The determination will take into account the Bidder's financial, technical, production capabilities and past performance; it will be based upon examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to Clause 24, as well as such other information as the Employer deems necessary and appropriate; and

An affirmative determination will be a prerequisite for the employer to continue with the evaluation of the technical proposal; a negative determination will result in rejection of the Bidder's bid.

TECHNICAL:

Overall completeness and compliance with the Employer's Requirements

29 EVALUATIONS OF TECHNICAL BIDS

29.1. The bidder shall be qualified on the basis of information furnished by the bidder in accordance with Clause-25 above, in support of his capability with reference to qualification criteria laid down.

29.2 Even though the bidder meets the above qualification criteria, he shall be disqualified if:

- a. The bidder had made misleading or false representation in the forms, statements and attachment submitted in proof of qualification requirements and/or
- b. A record of poor performance such as abandoning the work, not properly completing the contract, inordinate delays in completion, litigation history or financial failures etc.
- c. Bidder has been blacklisted by any Government/ Non-Government / Private agencies/ Organizations/ Institutions/ Government Undertakings and funding Agencies in the last 05 years.

The bidder should provide accurate information on litigation and/ or arbitration resulting from contract completed or under execution by him over the last five years. A consistent history of arbitration awards/ judgments against the applicant or any partner of a joint venture may result in disqualification for proposed work. If the details of litigation history are hidden by the applicant and later on it comes to knowledge of the employer the bidder shall be disqualified for the proposed work and other appropriate actions shall be taken against the bidder.

The bidder should submit undertaking on non-judicial stamp paper of Rs. 300/- dully attested by notary public regarding document submitted, are true. Board would have the right to forfeit the EMD and black list to the bidder if any of the information given by the bidder is found faulty or incorrect or misleading.

29.3 During the process of evaluation the Bhavnagar Municipal Corporation may visit and inspect the works carried out by the bidder in order to assess the performance of the work. The bidder shall have to make arrangement for inspection of work at the respective work site only. This shall also be considered for evaluation with reference to performance of the bidder.

29.4 Depending upon the actual bid capacity assessed and other qualifying requirements, the applicant will be qualified for the work. However, at the price bid evaluation stage, a careful check of the appropriate references with reference to the information submitted by the bidder will be done and in no case, a contract will be awarded to a bidder lacking in the financial criteria.

30. Evaluation of Price bid

- 30.1. Quoted Tender rates shall have to be reasonable and competitive to meet with the timely and satisfactory performance of the contract.
- 30.2 Reasonability of Tenders' proposed method and technique of construction, construction programme, sequence of components of the work and proposed resources assigned to the work shall be seen where it has been called for in the tender.
- 30.3. (a) If the Bid of the successful bidder is seriously unbalanced in relation to the estimated cost of the work/ item (s) to be performed under the Contract, Bhavnagar Municipal Corporation may require the bidder to produce detailed rate price analysis for any of all Items of the Bid of the quantities to demonstrate the internal consistency of this rate Price with the construction methods proposed. After evaluation of the rate analysis, the competent authority may require, that, the amount of the Performance Security set forth in "**Clause No.21 under Bid Security**" above of the contract be increased at the expense of the successful Bidder to a level sufficient to protect the Bhavnagar Municipal Corporation,, against financial loss in the event of default of the successful Bidder under the contract.
- (b) In respect of those items for which the quoted rates are more than 10% above the overall percentage of accepted tender, the payment of such items in the running bills shall be made at rate of that item which was used for the estimate plus or minus overall variation percentage of the accepted tender plus 5% of the estimated rate of that item. The balance amount as per accepted tender rate shall be withheld from the running bills and will be released as per R&B Department Circular no. PARCH/102008/ (61) dated 03-05-2013. No interest will be payable for such withheld amount. This shall be taken care by way of payment schedule and quoted rates need not be changed.
- (c) The contract performance for actual execution and the payments to be made for the work shall be based on such bid rates as per (a) and (b) above wherever applicable for the purpose of running account bills. However, the final payments shall be made based on the item wise quoted rates.
- (d) Any decision of Bhavnagar Municipal Corporation regarding the interim rates at which payment shall be made in accordance with the above Clauses shall be final and binding to the Bidder.
- (e) The application of the above clause (a) & (b) above shall be at the discretion of the employer.

30.4 As the work shall be executed on EPC contract basis on lump sum amount in the abstract of price schedule, however the contractor should have quoted the item wise rate in the breakup of price schedule for the purpose of running account bill. In case of variation of the quantities in any item which needs revision of rates in accordance with "**Clause No. 14, Volume-I (B)**", the revision of rate of the particular item shall not be considered more than the quoted rate of such item.

30.5. To assist in the examination, evaluation and comparison of Tenders, the Bhavnagar Municipal Corporation may ask the Bidders individually for clarification of their tenders including break up of work done. The request for clarification and the response shall be in writing but no changes in the price or substance of the tender shall be sought, offered or permitted.

31 Bhavnagar Municipal Corporation reserves the right to accept or reject any Tender without assigning any reason.

32. PROCESS TO BE CONFIDENTIAL:

Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process. Any effort by a bidder to influence the Employer's processing of bids or award decisions by any way may result in the rejection of the bidder's bid.

33 PRELIMINARY EXAMINATION OF TECHNICAL PROPOSAL:

The Employer will examine the bids to determine whether they are complete, whether the documents have been properly signed, whether the required security is included, and whether the bids are generally in order. Any bids found to be non-responsive for any reason or not meeting the minimum levels of the performance or other criteria specified in the bidding documents will be rejected by the Employer and not included for further consideration.

34.0 ~~JOINT VENTURE CONSORTIUM (JV)~~

~~Joint venture consortium of Maximum Two firms/ members / companies, as partners shall be allowed for the works.~~

~~All the Members of the JV shall be jointly and severally responsible for this Contract. The Member of the JV holding highest stake shall be the Lead Partner. The JV shall comply with the following requirements:~~

~~(a) — A Joint venture agreement must be submitted along with the documents in which minimum share of lead member shall have to be 60% and share of other members, individually shall not be less than 25%.~~

~~(b) — All the members of the Joint Venture firms shall have to collectively satisfy all the criteria mentioned.—~~

~~In joint venture both the members shall be an Indian citizen, Indian partnership firm or Indian private/ public limited company.~~

~~All the members of Joint Venture shall have registration as per Volume I, Section II, Clause I.~~

~~(c) — The individual members who join in JV shall have to give an undertaking that they will maintain status quo till the completion of the work is awarded to the JV Consortium, the same JV Consortium shall be maintained till the satisfactory completion of the work. This undertaking shall be submitted on Stamp paper ₹300/-. Duly signed by authorized signatory, which shall be notarized.~~

~~(d) — In case of Bidder participating as a Joint Venture, on his selection for award of contract, all the partners/members of the Joint Venture will have to sign the Contract with the employer and will be jointly and severally liable for performance of the contract. Award of Contract will be in the name of Joint Venture consortium which will be considered as “Legal Entity” as far as this Bid/ Contract is concerned.~~

~~(e) — The Bid, and in case of a successful bid, the Form of Contract Agreement, shall be signed with the name of Joint Venture which will be legally binding on all the partners;~~

~~(f) — Lead partner shall be declared as Prime Bidder authorized to be in charge; and this authorization shall be evidenced by submitting a Power of Attorney signed by legally authorized signatories of all the partners;~~

~~(g) — The member in charge shall be authorized to incur liabilities, receive payments and receive instructions for and on behalf of any or all partners of the Joint Venture and the entire execution of the contract including defect liability period;~~

~~(h) — All members of the Joint Venture shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms, and a relevant statement to this effect shall be included in the Authorization mentioned under (b) above as well as in the Bid Form and the Form of Contract Agreement (in case of a successful Bid); and,~~

~~(i) — A copy of the stamped and notarized agreement entered into by the Joint Venture partners shall be submitted with the Bid. Roles, responsibilities and financial stakes of all members of the Joint Venture consortium shall be clearly and unambiguously prescribed in the Joint Venture agreement. In case of non prescription, the JV agreement will be declared as invalid and the bid will be treated as non responsive.~~

~~(j) — In case of Financial Criteria, if bidder participate in Joint Venture, financial strengths of each of the JV members individually shall not be less than minimum qualifying criteria worked out in proportionate to their financial stakes in the JV.~~

~~In case of physical criteria, either of the JV members shall meet the qualifying requirement in any single completed project without taking into account their financial stake in the JV agreement.~~

~~Each JV member shall have required Registration, solvency certificate, project manager having 5 years experience, existence of company as per tender requirement. Each member shall satisfy these requirements separately.~~

~~(k) — The contractors participating in the name and form of a Joint Venture consortium shall have to clearly and unambiguously define the role, responsibilities and financial stake of each of the partners, the lead partner shall also have to be defined. On award of contract to such a Joint Venture consortium, each of the members of the Joint Venture consortium shall have to sign the Contract. Each member of the JV shall be jointly and severally responsible for the performance of the contract.~~

~~(l) — An original notarized copy of the agreement as prescribed in Form-22 entered into by the joint venture partners shall be submitted with the bid. It should also distinctly show the financial participation of each member of the joint venture and the responsibility of each member as regards planning and execution of the work.~~

~~(m) — In case of conflict between the terms in contract agreement and the Joint Venture documents, the terms in the contract agreement shall prevail.~~

~~(n) — The experience of the Sole Entity / Joint Venture only in India shall be applicable for WTP works in this bid.~~

35. DELETED

G. AWARD OF CONTRACT

36 SUCCESSFUL BIDDERS:

The Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive in terms of minimum qualification requirement and technical requirements to the bidding documents and who has offered the Lowest Evaluated Bid Price, provided that such bidder has been determined to be eligible & qualified in accordance with the provisions mentioned under “**Clause F. Evaluation of Tender**” in **Section-II**. A substantially evaluated responsive Tender is one, which conforms to all the terms, conditions and specifications of tender documents without material deviation or reservation. The material deviation or reservation is one,

- 36.1. Which affects in any substantial way the scope, quality or performance of the works.
- 36.2. Which limits in any substantial way inconsistent with tender documents, the Employer’s ‘right’ or the Bidder’s obligations to the contractor.
- 36.3. Whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive tender.

37 EMPLOYER’S RIGHT TO ACCEPT ANY BID OR TO REJECT ANY OR ALL BIDS:

- 37.1. Those Tenders which do not have Digital Signature attached shall be rejected.
- 37.2. Tender without Earnest Money Deposit(EMD), will be treated as non-responsive and will be out rightly rejected.
- 37.3. Notwithstanding the above, the Bhavnagar Municipal Corporation reserves the rights to accept or reject any bid or to cancel the Bidding process and reject all Bids at any time prior to award of contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders on the grounds of the competent authority's action.
- 37.4. In addition to the above, the Tender will also be liable to be rejected out rightly if, the Bidder or in the case of a firm, each partner or the person holding the Power of Attorney thereof does not digitally sign.

38 NOTIFICATIONS OF AWARD:

- 38.1 Prior to the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder by fax, confirmed by registered letter, that its bid has been accepted. This letter (hereinafter and in the Conditions of Contract called the “Letter of Intent”) shall name the sum which the Employer will pay the Contractor in consideration of the execution, completion and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called “the Contract Price”).

- 38.2 The notification of award will constitute the formation of the Contract.
- 38.3 Upon the furnishing by the successful bidder of a performance security (and domestic preference security where required).

39 SIGNING OF CONTRACT AGREEMENT:

- 39.1 At the same time that he notifies the successful bidder that its bid has been accepted, the Employer will send the bidder the Form of Contract Agreement, incorporating all agreements between the parties.
- 39.2 Within 15 days of receipt of the Form of Agreement, the successful bidder shall sign the Form and return it to the Employer.
- 39.3 As soon as the work is awarded and Letter of Award (LOA) is issued to the contractor, a tripartite agreement between Urban Local Bodies (ULB), Bhavnagar Municipal Corporation (BMC) and contractor shall be executed on ₹300/- non judicial stamp paper and duly notarized by notary public. Form 27 in Volume I is the proforma for tripartite agreement.

40 PERFORMANCE SECURITY:

- 40.1. The successful bidder shall have to pay Performance Security in the form of Unequivocal bank guarantee issued by any shortlisted bank as per Notice Inviting Tender having branch at Ahmedabad or Bhavnagar and the same shall become refundable as per Clause No. 01 under General Conditions of Contract.

41 CORRUPT OR FRAUDULENT PRACTICES:

- 41.1 Bhavnagar Municipal Corporation requires that bidders/suppliers/contractors have followed the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy:

(a) Defines for the purposes of this provision, the terms set forth below as follows:

- (i) **“Corrupt practices”** means behaviour on the part of officials in the public or private sectors by which they improperly and unlawfully enrich themselves and/or those close to them, or induce others to do so, by misusing the position in which they are placed, and it includes the offering, giving, receiving, or soliciting of anything of value to influence the action of any such official in the procurement process or in contract execution; and
- (ii) **“Fraudulent practice”** means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the determination of the Borrower, and includes collusive practice among bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the borrower of the benefits of free and open competition;

(b) Will reject a proposal for award if it determines that the bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

(c) Will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract if it at any time determines that the firm has engaged in corrupt and fraudulent practices in competing for, or in executing, a contract.

If at any stage it is found that bidder had hidden material information or had submitted information which is false and fraudulent shall be debarred from bidding in Bhavnagar Municipal Corporation tender for three years and EMD shall be forfeited. The matter shall also be brought to notice to the registration authority of the contractor.

42 GENERAL RULES AND DIRECTIONS:

42.1. No receipt for any payment alleged to have been made by a Contractor in regard to any matter relating to this tender or the contract shall be valid and binding on BMC unless it is signed by the Engineer-in-Charge.

42.2. The measurements of work will be taken according to the usual method in use in BMC and no proposal to adopt alternative methods will be accepted. The decision of the 'Engineer-in-Charge as to what is the usual method in use in the BMC, will be final.

42.3. Under no circumstances shall any contractor be entitled to claim enhanced rate for any item covered in this Contract except price variation for specified items as per contract.

42.4. The Contractor shall not be permitted to tender for the work in which his near relative is working in that Division or its sub-division as an Engineer of any category, Divisional Accountant, Store Keeper, and in the Circle Office as a Superintending Engineer Controlling that division as on date when Tender is submitted.

(Note: By the term "near relative" it is meant wife, husband, parent, and grandparent)

42.5. The contractor shall compulsorily furnish his latest address (es) including the latest address of his partners and place(s) of filing his/their income tax returns along with the tender (in the annexure form appended hereinafter). Any changes, if occur, in such address, during the tenure of contract, the latest address (es) shall invariably and forthwith be intimated by the Contractor to the concerned Engineer-in-Charge.

42.6. Receipt for payment made on account of the work, when executed by a firm shall be signed by all the partners except where the contractors are described in their tender as firm in which case the receipt shall be signed in the name of the firm by one of the partners or by some other person having authority to give effectual receipts for the firm.

42.7. Every Blank (fields) in the Tender document (Forms, Schedule, etc.) must be filled up by the Bidder and shall be submitted online.

42.8. Erasures and corrections:

Persons tendering are informed that no erasures or alternations by them in the text of document downloaded from website will be allowed and such erasure and alterations will be disregarded. If there is any error in writing, Bidder can edit the same and correct it. Please refer to the Vendor Training Manual.

42.9. The contract will normally be made within 180 days from last date of receipt of Tenders.

43.0 DECLARATION FORM: (FORM-H)

43.1. In conjunction to Sub Clause 'C' under "29. Evaluation to Technical bids" the bidder should submit undertaking as per Form-H on non-judicial stamp paper of Rs.300/- duly attested by notary public regarding document submitted, are true. BMC would have the right to forfeit the EMD and blacklist the bidder if any of the information given by the bidder is found faulty or incorrect or misleading.

44.0 REQUIREMENTS OF A BIDDER

44.1 The applicant in the same name and style shall be a well-established Civil/Mechanical/Electrical (as per type of the tender) Engineering Contractor and shall have Registration in the required class for the work. The agencies whose contracts have been terminated on account of non-performance/poor performance in any work and debarred contractors will not be eligible for this Tender.

44.2 COMPETENCY OF TENDER: -

Contract will be awarded to responsive Bidders on the basis of prequalification criteria and evaluation of price-bid accordingly.

44.3 The Bidders/Bidders are required to deploy the necessary machineries/ equipment's (by owning/ hiring/ leasing) for the execution of work as specified in Clause 3.0, Section-III of this Volume

44.4 The Bidder shall employ Project Manager, Engineers, technicians and other key personnel and other Civil/Mechanical/Electrical Technical Staff as specified.

45.0 SUPPORTING DOCUMENTS:

45.1. The bidder must provide by uploading evidence of having adequate experience and performance which include supporting certificate or report relating to physical, financial, technical and other capability of the bidder from the respective clients in their original language along with certified translation of all relevant portions of the information about the financial capacity in Indian Rupees Only.

45.2. MACHINERIES

The work of Sewage Treatment Plants will require sufficient numbers of equipments like hauling equipment, allied equipments, and other such machinery tools and plants required for the smooth execution of the work. Bidder should have sufficient machinery which is required for execution.

The list of machinery as available with contractor or intended to be acquired should be furnished invariably by the bidder with the documents. Other machinery specifically available but under use or to be used for other project could be listed in addition.

VOLUME – I

**SECTION-III: QUALIFICATION CRITERIA & EVALUATION
PROCEDURE**

QUALIFICATION CRITERIA & EVALUATION PROCEDURE

A. GENERAL

1.0 GENERAL:

All information requested for in the down loaded forms should be furnished against the respective columns in the forms in electronic formats. If information is nil it should also be mentioned as nil or no such case. If any particular query is not applicable in case of the applicant, it should be stated as not applicable. However, the tender/ Bidders are cautioned that not giving complete information called for in the tender Documents in the form required or not giving it in clear terms or making any charge in the prescribed forms may result in the Bidder being summarily disqualified.

- 1.1 The tender's/ Bidder's name shall appear on each page of the prescribed Proforma.
- 1.2 Reference, Information and certificates from the respective clients certifying suitability, technical know-how or capability of the Bidder shall be signed by that client, in full with his name underneath in block letter and designation in that organization.
- 1.3 No further information will be entertained after submission of Tender Document unless it is called for by the BMC.
- 1.4 Any effort by a Bidder / Bidder to influence the BMC in the process of examination, Clarification, evaluation of Tender and in decision concerning qualification, may result in disqualifying the Bidder.
- 1.5 The successful per-qualification made in the case of any Bidder for any other work of BMC will not be considered valid for the present work.
- 1.6 The time for completion of the work is 30 Months from the date of 'Notice to Proceed'.
- 1.7 The intending Bidder shall get himself registered with nproucre.com for obtaining his unique identification number and digital signature required for participating in the bid.
- 1.8 The bids received under this single stage, two envelope procedure, shall be assessed and evaluated based on the qualification criteria and evaluation procedure prescribed hereunder.

2.0 LIST OF ACCOMPANIMENTS:

Bidder shall include following accompaniment to tender documents while submission.

2.1 Letter of transmittal (Scanned Copy)

2.2 **Power of attorney:**

A power of attorney on non-Judicial stamp paper of appropriate value duly notarised by a notary public, if power is delegated for signing the bid to other persons by applicant. (Scanned Copy)

2.3 **Certificate of registration:**

A Certificate of registration as approved contractor of concerned State Government/ Railway/CPWD/ Government bodies. The applicant(s) who are registered with other Government (State/Central), Board, Corporation, and Government Undertaking / Organizations of state & central government including all Public Sector Units shall submit proof of application made for registration for **“AA” class** in Gujarat State (Scanned copy).

2.4 Supporting document:

Every blank (Fields) in the tender documents (Forms, Schedules, etc.) must be filled by the Bidder and submitted online. Tender forms which are not completed will not be accepted online use of dash (-) is not permitted. Please write “Not applicable” or “Nil” as and where required by Bidder.

SL. NO.	FORM NO.	DESCRIPTION OF PROFORMA
1	Form-0	List of Submission
2	-	Proforma for "Letter for submission of tender".
3	Form-1	Details of organization structure of the bidder
4	Form: 2	Details of Personnel
5	Form: 3	Details of Machinery Equipment's and work Plan
6	Form: 4	Information relating to Financial Criteria
7	Form-5	Financial data
8	Form-6	List of works already completed by the Bidder
9	Form-7	Details of works on hand with Bidder
10	Form-8	Details of experience of completed work (similar nature)
11	Form-9	Additional Information and Litigation History / Debarment / Blacklisting
12	Form-10	Information for tenders submitted but not awarded
13	Form-11	Certificate for experience of work
14	Form-12	Joint Venture data (If applicable)
15	Form-13	Personnel/ staff proposed for the project
16	Form-14	Curriculum Vitae of Project Manager and all key Technical Staff
17	Form-15	Proposed site organization and Management
18	Form-16	Details of experience for physical qualification criteria
19	Form-17	Approach & Methodology with conceptual design & supporting calculations of the system.
20	Form-18	Form-H (Declaration)

SL. NO.	FORM NO.	DESCRIPTION OF PROFORMA
21	Form-19	Proforma for Bank Guarantee (EMD)
22	Form-20	Work wise details of work completed/ in progress by the contractor.
23	Form-21	Proforma for Performance bond/ Performance guarantee Proforma for bid security
24	Form-22	Proforma for Joint Venture Agreement (If Applicable)
25	Form-23	“Assured Pipe Supply Declaration” (MOU with Manufacturer of DI pipe)
26	Form-24	Proforma for memorandum of understanding (MOU) with pipeline supplier (If Applicable)
27	-	Site visit certificate - To be submitted on company’s letter head duly sealed and signed by PoA.
28	-	MoU for engagement of Agency for specialized work to be included in the Tender Form (if applicable)

3.0 ELIGIBILITY FOR QUALIFICATION:

- 3.1 The Bidder in the same name and style shall be a well-established Civil Engineering contractor with at least 5 (Five) years’ experience and capability for construction of all types of Civil / Mechanical / Electrical Engineering works.
- 3.2 The Bidder in the same name and style must give evidence of having adequate experience in mobilizing equipment and personnel for large value contracts and in the deployment of heavy construction equipment for the type of work described earlier.
- 3.3 The Bidder must have adequate staff and equipment for carrying out work in accordance with time schedule.
- 3.4 The Bidders/Bidder must have a Project Manager with not less than 5 (Five) years’ experience in managing construction in the field of Civil Engineering works as

mentioned in Clause 3.1 and similar work, along with minimum number of engineering, technical and other key personnel with adequate experience in civil engineering work as under:

(1)	Project Manager (Degree engineer in any discipline with minimum 8 years of experience)	1 no.
(2)	Process Engineer with Masters Degree in Environmental Engineering (5 years experience)	1 no.
(3)	Civil Engineers (Degree holders)	4 Nos.
(4)	Mechanical Engineers (Degree holders)	1 No.
(5)	Electrical Engineer	1 No.
(6)	Supervisors (Diploma holders)	4 Nos.
(7)	Technical Assistants (Diploma / ITI)	4 Nos.

Note:

- i. If sufficient staff does not exist at the time of bidding, an undertaking for employing the necessary staff shall be given by the Bidder.
 - ii. Successful Bidder shall deploy minimum key Personnel's mentioned above during execution of work at site.
- 3.5. The Bidder must provide evidence of having adequate experience. The Bidder should upload the digitally signed scanned copies to supporting certificate, reports relating to physical, financial, technical, machinery and other capability of the applicants in their original language along with certified translation of all relevant portions of the certificate/reports in English duly attached with their Digital Signature. The applicant should upload the financial capabilities in Rupees only.
- 3.6 The Bidders are required to upload digitally signed scanned copies along with their applications certificates obtained from the concerned authorities/ employers towards proof.
- 3.7 Qualification of the bidder:
- To be qualified for award of Contract, bidders shall:
- (a) Submit a written power of attorney authorizing the signatory of the bid to submit the bidder;

- (b) Submit Qualification requirements specifying financial capacity, technical capacity, minimum acceptable levels with regards to Bidder's experience in relevant projects and other relevant factors such as work in hand, future commitments, and litigation history as given and described in the **Appendix 1** to Instruction to Bidders.
- (c) Submit proposals regarding work methods, scheduling and re sourcing which shall be, provided in sufficient detail to confirm the bidders' capability to complete the works in accordance with the specifications and the time for completion.
- (d) Submit Memorandum of Understanding (MoU) with pipe manufacturer clearly stating the terms & conditions of the MoU. Such MOU shall not be amended or modified without prior consent from BMC during the period of performance of contract; BMC shall not allow such change except for special reasons in the interest of expeditious implementation of the project.

3.8 If the bidder is joint venture

- (a) In case of bidder participating as a Joint Venture, on his selection for award of contract, all members of the Joint Venture will have to sign the contract with the Employer and will be jointly and severally liable for performance of the contract/ Award of contract will be in the name of Joint Venture consortium which will be considered as "Legal Entity" as far as this bid/contract concern.
- (b) The bid, and in case of a successful bid, the Form of Contract Agreement, shall be signed with the name of Joint Venture which will be legally binding on all partners;
- (c) One of the partners shall be declared as Prime Bidder authorized to be in charge; and this authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners;
- (d) The partner in charge shall be authorized to incur liabilities, receive payments and receive instructions for and on behalf of any or all partners of the joint venture and the entire execution of the Contract;

- (e) All partners of the joint venture shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms, and a relevant statement to this effect shall be included in the Authorization mentioned under (b) above as well as in the Bid Form and the Form of Contract Agreement (in case of a successful bid); and
- (f) A copy of the Stamped and notarized agreement entered into by the joint venture partners shall be submitted with the bid. Roles, responsibilities and financial stakes of all members of the Joint Venture consortium shall be clearly and unambiguously prescribed in the Joint Venture agreement. In case of non-prescription, the JV agreement will be declared as invalid and the bid will be treated as a single bidder, in the name of bidder, who has purchased the bid documents.

Note: In addition to the above JV conditions mentioned in "Clause 34. Joint Venture Consortium" shall also be referred.

- 3.9 Bidders shall also submit proposals of work methods and schedule, in sufficient detail to demonstrate the adequacy of the bidders' proposals to meet the Employer's Requirements.
- 3.10 All guarantees shall be in the name of the joint venture if the bid is submitted in the form of a joint venture.

4.0. MINIMUM PRE- QUALIFICATION CRITERIA:

To qualify, each bidder in the same name and style should have achieved the following performances:

4.1. List of Mandatory documents to be submitted

- a. **Registration**
- b. **EMD/Bid Security /Tender Fee**
- c. **Solvency Certificate**
- d. **Turn Over**
- e. **Bid Capacity**
- f. **Document supporting similar nature of work & Financial and physical criteria.**

If bidder fails to submit above documents or mandatory criteria are not fulfilled, bidder shall be considered as not qualified and their financial bid shall not be open. To qualify, each bidder in the same name and style should have achieved the following performances:

a. **Registration:** As per Section: II, Instruction to Bidder, Clause 1

b. **EMD and Tender Fees** As per Mentioned in tender notice.

C. Solvency Certificate

Bank Solvency of minimum **Rs. 2,94,00,666.00/-** Solvency Value Certificate of the organization should be of current calendar ie. 2023-2024 Year issued by Nationalized Bank or Bank listed as per latest GR of. Finance Department

FINANCIAL

4.2.1 TURNOVER:

Bidder must have achieved minimum average annual financial turnover (at current price level) from contract receipt of works (in all classes of civil engineering construction works only) of **Rs. 7,35,01,666.00/-** in last three financial years, from April 2020 to March 2023

Note: The details pertaining to turnover for the year April 2020-2021 to March 2023-2024 shall be certified by Chartered Accountant on his own letter head and duly attested.

4.2.4 SIMILAR NATURE OF WORK:

The bidder must have completed similar nature of work i.e., Water supply Projects / Drainage/Sewerage Project within last seven financial years i.e., from April 2017-18 to March 2023-24 and up to one month prior to last date of submission of the bid of value not less than:

One Contract 80% of Estimated Cost Or equal to **Rs. 11,76,02,665.60/-**

Or

Two Contract 50% of Estimated Cost Or equal to **Rs. 7,35,01,666.00/-**

Or

Three Contract 40% of Estimated Cost Or equal to **Rs. 5,88,01,332.80/-**

4.2.3 AVAILABLE BID CAPACITY

The Bidder who fulfils the qualifying criteria mentioned above shall be qualified only if he fulfils the requirement of bidder's capacity. The bidding capacity of any tender/ Bidder is required to be more than or equal to the estimated cost of the work i.e., **Rs. 14,70,03,332.00/-**-The bidder's capacity shall be computed as shown below.

$$\text{Available Bid Capacity} = [(A \times N \times 2.0) - B]$$

Where:

A	=	Maximum value of construction works executed in any one year during the last Five years updated at the financial year updated at 2023-2024 Price level.
B	=	Value of the existing commitments as on date of bid submission for works (complete or partial) to be completed in the next 2 year (24 Months) . The details shall be countersigned by the Executive Engineer or the equivalent officer of the employer on whose behalf the firm is carrying out the works. Also, declaration of financial liabilities, work on hand/completed projects on Rs.300/- non-Judicial stamp paper. In the case of a Joint Venture (If Applicable), parameters A and B shall be determined based on details pertaining to such partners who propose to undertake physical execution of work and in proportion to their participation/stake as specified in respective clause in the tender documents.
N	=	Years prescribed for completion of the work for which bids are invited. (2 Year) - (24 Months)

If the Tender has been invited as a Package/Slice Minimum aggregate required Bid Capacity shall be considered and accordingly the Bidder may qualify for less number of Packages/Slices. In case of individual Tenders (not invited in a single Basket) the Bidder may qualify for a particular work (based on his Technical Bid), but at the time of evaluation of Price Bid, if a greater number of such individual Bids are evaluated simultaneously, aggregate Bid Capacity shall be considered. In such a case, if the Bidder does not have adequate capacity for all the Bids in which his Bid is the lowest responsive Bid, he may be considered for a smaller number of Bids. Decision of the Employer based on the least cost

combination as may be the most advantageous to Competent authority shall be final and binding to all the Bidders.

Note to 4.1 Financial Criteria:

- I. The statement showing the value and details of completed works, existing commitments and ongoing works as well as the stipulated period of completion remaining for each of the work listed should be countersigned by the officer not below the rank of an Engineer-In-Charge.
- II. The certificate for past performance should be as per prescribed Proforma in Form-11...
- III. The Bidders are required to upload latest client's certificates in Form-11 (or in any format with yearly breakup) obtained from the concerned authorities/ employers towards proof of their having executed contracts satisfactorily along with their bids. The quantities involved should be certified by the top executive of the firm in the prescribed Proforma in Form-11 (or in any format with yearly breakup) of Volume-I.
- IV. Physical and financial performance of any work not supported by client certificate in Form-11 or in any form will not be considered for qualification.
- V. The Bidder should furnish the information about financial capability (similar nature of work) in Form-8 (To satisfy Financial Criteria 4.1.2). Bidders are required to substantiate the information by submission of appropriate client certificates (Form - 11).
- VI. The Bidder must provide by uploading evidence of having adequate experience. The bid should include supporting certificate or report relating to physical, financial, technical and other capability of Bidder in their original language along with certified translation of relevant portion of the certificate/ report in English. The Bidder should furnish the information about financial capability in Rupees only.
- VII. Depending upon the actual bid capacity assessed and other qualifying requirements, the bidder will be qualified for the work.
- VIII. The bidder is required to submit the declaration of his financial liabilities, work on hand/completed projects on ₹300/- Non-Judicial stamp paper. In case of false statement/ declaration the bidder shall be liable for penal action. Further, the details

furnished in the relevant form as per tender should be in line to the declaration by the bidder.

- IX. The criteria mentioned above at shall be evaluated based on the details submitted with the documents. Such bidder shall have to submit the details in the prescribed proforma which are applicable to them. Bidders should read the note under each Form/Annexure carefully and submit the details accordingly.
- X. Turnover of previous year and cost of completed / executed similar nature of work shall be given additional weightage to bring them to 2023-2024 Price level to account for price escalation as illustrated below::

Financial Year	Turnover/ Cost of Executed work	Turnover/Cost of Executed work at previous completed financial year's price level
2017-2018	G	1.77 x G
2018-2019	F	1.61 x F
2019-2020	E	1.46 x E
2020-2021	D	1.33 x D
2021-2022	C	1.21 x C
2022-2023	B	1.10 x B
2023-2024	A	1.00 x A

Note:

- i) Financial year means period beginning from the 1st April to 31st March 2020 of the next year.
- ii) The details pertaining to Turnover for the year 2017-18 to 2023-24 and the details pertaining to Net Cash Accrual, Net Worth and Net Working Capital for the year 2017-18 to 2023-24 shall be certified by Chartered Accountant on his own letter head and duly attested. The cost of material supplied by the Government/ Client shall not be taken into account for experience against Turnover & Similar nature of work

4.2. PHYSICAL CRITERIA:

The bidder must have successfully carried out minimum quantities of the following work in any one project during last Seven (7) i.e., 2017-18 to 2023-24 and up to one month prior to last date of submission of the bid.

4.3.1 PIPELINE:

A. Metallic Pipeline:

Procure, Lowering, Laying, Jointing, Testing and Commissioning of minimum length (as under) of metallic pipeline in any single project during last Seven (7) financial years i.e., 2016-17 to 2022-2023 and up to one month prior to last date of submission of the bid. If the pipeline work has been completed along with successful hydro testing, such works shall also be considered for the evaluation based on the facts and circumstances as certified by the client.

The material supplied by the client will not be considered for procurement purpose.

Type of Pipeline	Min. Diameter (In mm)	Min. Length (In Km)
Metallic	≥450 mm	1.36 Km

B. Non-Metallic Pipeline -

Procure, Lowering, Laying, Jointing, Testing and Commissioning of minimum length (as under) of Non-metallic (RCC NP 3 Pipe) pipeline in any single project during last Seven (7) i.e., 2017-18 to 2023-24 and up to one month prior to last date of submission of the bid. If the pipeline work has been completed along with successful hydro testing, such works shall also be considered for the evaluation based on the facts and circumstances as certified by the client.

The material supplied by the client will not be considered for procurement purpose.

Type of Pipeline	Min. Diameter (In mm)	Min. Length (In Km)
Non-Metallic	≥700 mm	1.0 Km

4.3.2 PUMPING MACHINERY:

The bidder must have experience of supply, installation, testing and commissioning of electro mechanical works not less than **92.0 KW** in single contract during last Seven (7) financial years i.e., 2016-17 to 2022-2023 and up to one month prior to last date of submission of the bid.

4.3.3 ELEVATED STORAGE RESERVOIR: (Not Applicable)

4.3.4 STORAGE SUMP (Not Applicable)

4.3.5 CONSTRUCTION OF INTAKE WELL: (Not Applicable)

4.3.6 WATER TREATMENT PLANT: (Not Applicable)

4.3.7 OPERATION & MAINTENANCE:

The bidder shall have successfully commissioned at least one similar project (as narrated above) with operation & maintenance for minimum 1 year after commissioning, inclusive of defect liability period, in single contract amounting to **Rs. 5,88,01,332.80** /- in last Seven (7) years from one month prior to last date of submission of bid.

Note: The amount of works shown above means project costs.

OR

The bidder shall have successfully completed operation and maintenance for minimum 1 year in single contract of similar nature (as narrated above) amounting to **Rs. 22,14,200.00**/- in last Seven (7) years from one month prior to last date of submission of bid.

Note to 4.3 Physical Criteria:

- I) The works for which bidder have not entered in to contract agreement will not be considered
- II) The above experience shall be within last Seven (7) i.e., 2017-18 to 2023-24 and up to one month prior to last date of submission of the bid for which Form -3A/11 must be submitted.
- III) Experience as sub-contractor shall not be considered.
- IV) The experience of works executed in Government (State/Central), Board, Corporation, and Government Undertaking /Organizations of state & central government shall only be considered for evaluation. The experience certificate from the client equivalent to not below the rank of Executive Engineer shall be considered. The experience of sublet works shall not be considered.
- V) All MOUs shall be on a Non judicial stamp paper of appropriate value duly notarized and signed by respective authorized representatives.
- VI) The Bidder/JV MEMBER/MOU partners contract should not have been terminated/blacklisted/debarred in any State Govt/ Municipal Corporations/ Central Govt./ Any state Govt Organization, Urban Local body and/or its

undertaking company or its SPV, Asian Development Bank/ World Bank or similar international funding agencies organizations due to delay in projects during last five years.

- VII) The works for which bidder have not entered in to contract agreement will not be considered.
- VIII) If the bidder claiming Technical/ Physical Eligibility Criteria for the works has completed any of the works in joint venture with any other company then, along with the experience certificates, the firm shall submit the joint venture agreement for that particular work. Experience certificates not accompanied by joint venture agreement shall not be considered for evaluation. The credit for the bidder which has completed a work in joint venture is allocated as follows:
- (1) If the bidder has completed the work as a member in the project, then the bidder can claim credit for the entire scope of the work in proportion to the stake (e.g., if the capacity of the ESR executed is 30 ML and if the firm has executed the project as member with a 40% stake then the firm can claim credit for (40% x 30 ML) 12 ML works. A statutory auditor certificate specifying the payments received for the project should be submitted. In the event of percentage participation in the project calculated through the statutory auditor certificate differs from the percentage in the Joint Venture Agreement, the percentage participation calculated through payments received shall be considered for evaluation purposes.

Note: The above condition shall also apply to Clause No. 4.2.4 'Similar Nature of work' under financial criteria.

- IX) The above experience shall be within last Seven (7) i.e., 2017-18 to 2023-24 and up to one month prior to last date of submission of the bid for which Form -3A/11 must be submitted.
- X) All MOUs shall be on a Non judicial stamp paper of appropriate value duly notarized and signed by respective authorized representatives.
- XI) Bidder should fulfil the following criteria mentioned under Clause 4.0, Minimum Qualifying Criteria. If not fulfilled, he will be out rightly rejected.

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**SECTION-IV: QUALIFICATION DATA SHEET
TO BE FILLED UP BY THE BIDDER**

**QUALIFICATION DATA SHEET
TO BE FILLED UP BY THE BIDDER**

The qualification questionnaire contains the following forms:

SL. NO.	FORM NO.	DESCRIPTION OF PROFORMA
1	Form-0	List of Submittals
2	-	Proforma for "Letter for submission of tender".
3	Form-1	Details of organization structure of the bidder
4	Form: 2	Details of Personnel
5	Form: 3	Details of Machinery Equipment's and work Plan
6	Form: 4	Information relating to Financial Criteria
7	Form-5	Financial data
8	Form-6	List of works already completed by the Bidder
9	Form-7	Details of works on hand with Bidder
10	Form-8	Details of experience of completed work (similar nature)
11	Form-9	Additional Information and Litigation History / Debarment / Blacklisting
12	Form-10	Information for tenders submitted but not awarded
13	Form-11	Certificate for experience of work
14	Form-12	Joint Venture data
15	Form-13	Personnel/ staff proposed for the project
16	Form-14	Curriculum Vitae of Project Manager and all key Technical Staff
17	Form-15	Proposed site organization and Management
18	Form-16	Details of experience for physical qualification criteria

SL. NO.	FORM NO.	DESCRIPTION OF PROFORMA
19	Form-17	Approach & Methodology with conceptual design & supporting calculations of the system.
20	Form-18	Form-H (Declaration)
21	Form-19	Proforma for Bank Guarantee (EMD)
22	Form-20	Work wise details of work completed/ in progress by the contractor.
23	Form-21	Proforma for Performance bond/ Performance guarantee Proforma for bid security
24	Form-22	Proforma for Joint Venture Agreement
25	Form-23	"Assured Pipe Supply Declaration" (MOU with Manufacturer of DI pipe)
26	Form-24	Proforma for memorandum of understanding (MOU) with pipeline supplier (If Applicable)
27	-	Site visit certificate - To be submitted on company's letter head duly sealed and signed by PoA.
28	-	MoU for engagement of Agency for specialized work to be included in the Tender Form (if applicable)

Note:

1. If necessary, additional sheets may be added to the forms. Each page of each form should be clearly marked in the right top corner as follows: Form-0, page 1; Form I, page 2, etc.
2. Some of the forms will require attachments. Such attachments should be clearly marked as follows: Attachment 1 to Form I, Attachment 2 to Form I, etc.

FORM- O

SR NO	LIST OF SUBMITTALS	CONFIRM IF SUBMITTED (YES/NO)	PAGE NO
1	Covering Letter Letter of transmittal (Scanned Copy)		
2	Power Of Attorney Power of attorney on Rs. 300/- non-judicial stamp paper duly notarised, if power is delegated for signing the bid to other persons by applicant. (Scanned Copy)		
3	Certificate Of Registration Certificate of registration as approved contractor of concerned State Government/ Railway/ CPWD/ Government bodies. The applicant(s) who are registered with other Government (State / Central), Board, Corporation, and Government Undertaking / Organizations of state & central government including all Public Sector Units shall submit proof of application made for registration for " AA " class in Gujarat State (Scanned copy).		
4	Permanent Account Number (PAN) And Income Tax Details Copy of the latest Income Tax Return with permanent account number (PAN) and Income Tax ward where assessed. (Scanned copy).		
5	Company Establishment Details Letter of Incorporation of the company (Individual or any member in case of JV/ consortium)		
6	List Of Work On Hand And Work Completed A scanned copy of declaration showing the details of all works completed and works on hand with the contractor and the value of works that remain to be executed. (List of Work on hand to be supported with non-judicial stamp paper of Rs. 300/ duly notarized).		
7	Earnest Money Deposit Scanned copy of E.M.D. in accordance with relevant clause in "Tender Notice" of tender notice and the original shall also be submitted in physical form by RPAD/Speed post		

8	Tender Fee	Scanned copy of Account payee Demand Draft for Tender Fee in accordance with relevant clause of Tender Notice, and also in physical form shall also be submitted by RPAD/Speed post		
9	Solvency Certificate	Scanned Copy of the Solvency Certificate from Bank of required amount as per Tender Notice.		
10	Undertaking Regarding Document Submitted, Are True.	The bidder should submit undertaking on non-judicial stamp paper of Rs. 300/- duly notarized regarding document submitted, are true.		
11	Joint Venture Agreement	Bidder (individual or any member in case of JV/ consortium) shall not have suffered bankruptcy/ insolvency during the last 5 years. For this Certificate of CA appointed by the bidder must be produced along with a self affidavit on non-judicial stamp paper of ₹300/- duly notarized		
12	Bidder Past Performance	The bidder, whose contracts are earlier terminated on account of poor performance in BMC works, will not be eligible. For this tender Self Declaration by bidders is required		
13	Supporting Document	Form-0 to Form-24		
14	MOU Allowed for Qualifying Criteria on Non Judicial Stamp Paper Of Rs. 300/- Duly Notarized	1-Pumping Machineries (If Applicable)		
		2-Water Treatment Plant (If Applicable)		
15	MOU to Be Submitted on Non-Judicial Stamp Paper Of Rs. 100/- Duly Notarized	1-Pipe Supply assurance (If Applicable)		
16	Other Documents	Schedule of construction method		

17		Work plan		
18		Schedule of Major items of equipments		
19		Schedule of key personnel		

Note: All submittals shall be numbered chronically and reference of page nos shall be mentioned in “**FORM-0**”. The same is to be uploaded online and submitted in physical form as well

LETTER FOR SUBMISSION OF TENDER

To

Executive Engineer (Drainage Department)
Bhavnagar Municipal Corporation
Bhavnagar

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING R.C.C. NP3 PIPE UPGRADATION OF SEWER COLLECTING SYSTEM AND EXISTING ROAD RESTORATION WORK AT VARIOUS LOCATION OF BHAVNAGAR MUNICIPAL CORPORATION, BHAVANAGR DISTRICT: BHAVNAGAR

Sir,

- 1 Having examined the details given in the invitation to Bidder for qualification and brief note, the condition of contract, Specification, Drawings and bill of quantities and Nos. for the execution of above-named work, we the undersigned, offer to execute and complete such works and remedy any defects therein in conformity with the conditions of contract, Specifications, Drawings, Bill of Quantities and quoted amount in accordance with the said conditions.
- 2 We hereby certify that all the statements made and information supplied in the enclosed forms and accompanying statements are true and correct.
- 3 We have furnished all information and details necessary for qualification and have no further pertinent information to supply.
- 4 We submit the certified solvency certificate of Rs. _____ Crores and authorize the Board to approach the Bank issuing the solvency certificate to verify the correctness thereof. We also authorize, Board to approach individuals, employers, firms and Corporation to verify our competency and general reputation.
We hereby apply for qualification for

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING R.C.C. NP3 PIPE UPGRADATION OF SEWER COLLECTING SYSTEM AND EXISTING ROAD RESTORATION WORK AT VARIOUS LOCATION OF BHAVNAGAR MUNICIPAL CORPORATION, BHAVANAGR DISTRICT: BHAVNAGAR

We undertake, if our Tender is accepted, to commence the works immediately after the receipt of the Engineer's notice to commence, and to complete the whole of the works comprised in the contract within the time stated in the Appendix to tender.

- 5 We agree to abide by this Tender for the period of 180 days from the last date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
- 6 We enclose here with fixed Deposit receipt / Deposit at call receipt / cross demand draft / Bank Guarantee amounting to (as per Tender Notice) Towards Earnest Money Deposit which is to be absolutely forfeited by Board should we not Deposit the amount of Security Deposit specified in the Clause 1, General Conditions of Contract, Volume-IB
- 7 We enclose..... DD in favor of BMC Ltd Bhavnagar & office name (as applicable) amounting to Rs. _____ towards tender fees.

- 8 Unless and until a formal Agreement is prepared and executed this Tender, together with your written acceptance thereof, shall constitute a binding contract between us.
- 9 We also submit a general description on the approach to the construction methods, technologies proposed etc. and the detailed Work Plan proposed for execution.
- 10 We submit the following certificates in support of our suitability, technical know-how and capability for having successfully completed the following works.

Sr. No.	Works
Client / owner	
Bhavnagar Municipal Corporation	
Bhavnagar	

- 11 We hereby confirm that there are no deviations to the terms & conditions of the contract and we are liable for execution of this contract in accordance with the stipulated conditions of the contract.
- 12 We understand that you are not bound to accept the lowest or any tender you may Receive. Dated this _____ day of _____ (Year) Signature _____ in the capacity of _____ Duly authorized to sign tender for and on behalf of _____
- 13 We are enclosing herewith "Form H"
- 14 Irrespective of whatsoever has been stated to the contrary anywhere else in our offer no technical deviations have been taken and the entire work shall be performed as per your specifications and Tender documents.

Signature of Applicant.

(NAME IN BLOCK CAPITALS)

Address

Seal of Applicant

Date of submission

Witness _____

Address _____

Occupation _____

Enclosures:

FORM - 1

DETAILS OF ORGANIZATION STRUCTURE OF THE BIDDER

1.	Name of Bidder	
2.	Nationality of Bidder	
3.	Office address Telegraphic Address Telephone Number Fax Number E-mail address.	
4.	Year of Establishment	
5.	Location of Establishment	
6	Bid is submitted as a) An individual b) A proprietary firm c) A firm in partnership d) A limited Company or Corporation e) A Group of Firms / Joint Venture (if applicant is of category "F" give complete information in respect of each other). f) A Group of Companies	
7.	Attach the Organization chart showing the structure of the organization including the names of the Directors and Position of officers	
8.	Number of years of experience a) as a prime contractor (Contractor shouldering main responsibility) i) in own country ii) other countries (Specify countries) b) in a joint venture i) in own country ii) other countries (Specify countries)	
9.	For how many years has your organization been in business of Civil Engineering works under its present name? What were your fields when your organization was established?	
	Whether any new fields have been added in your organization? and if so, when?	
10	Whether you were required to suspend construction for a period of more than six months continuously after the work was started? If so, give the name of project and reasons thereof.	
11	Have you ever left the work awarded to you incomplete? (If so, give name of project and reasons for not completing work)	
12	In how many of your projects penalties were imposed for delays? (Please give details)	

13	In which fields of civil engineering construction do you claim specialization and interest?	
14	Give details of experience in water supply projects, pipe laying works, installation of large capacity of pumps etc- with modern technology and quality control.	
15	Give details of experience for construction of large water supply and sewerage projects.	
16	Give details of experience in using heavy earth moving machinery, machineries for pipe laying and installation of pumping machinery	
17	Give details of testing laboratory, if any.	
18	In how many of your works cases of litigations have arisen?	
19	If the applicant intends to enter into a Joint Venture for the project, please give the following information otherwise state.	N/A

FORM – 2
DETAILS OF PERSONNEL

Give details of key Technical and Administrative Personnel who could be assigned the work in the following Proforma.

A)	1) Details of the Board of Directors Name 2) of the Director Address Organization of 3) the Board of Director				
B)	1) Key Technical and administrative Personnel and Consultants Individual's 2) Name Professional Qualification 3) Present position in the firm 4) Professional experience and details of 5) works carried out No. of years worked 6) with the applicant. 7) Languages known Additional information				
(C)	Key Technical, Administrative Personnel				
	Sr. No.	Key Personnel	Nos.	Professional Experience	Qualification
	1.	Project Manager (Civil)			
	2.	Electromechanical Engineer			
	3.	Site Engineer			
	4.	Technical Assistant			
(D)		Skilled and other labor (indicate number category wise) 1) Skilled labor 2) Other labor			

FORM – 3
DETAILS OF MACHINERY EQUIPMENTS AND WORK PLAN

Plant & Equipment's Owned & Proposed for the Project

Name of Applicant or partner of a joint venture:
--

The Applicant will provide adequate information to demonstrate clearly that it has the capability to meet the requirements for each and all items of equipment listed in the Employers requirements. A separate Form-3 will be prepared for each item of equipment proposed by the Applicant. For each item of equipment, the applicant should attach a copy of ownership certificate or lease agreement.

Name of Equipment		
Equipment information	1. Name of manufacturer	2. Model and power rating
	3. Capacity	4. Year of manufacture
Current status	5. Current location	
	6. Details of current commitments	
Source	7. Indicate source of the equipment <input type="checkbox"/> Owned <input type="checkbox"/> Rented <input type="checkbox"/> Leased <input type="checkbox"/> Specially manufactured	

Omit the following information for equipment owned by the **J/V partner**.

Owner	8. Name of owner	
	9. Address of owner	
	Telephone	Contact name and title
	Facsimile	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the Project	

FORM - 4

INFORMATION RELATING TO FINANCIAL CRITERIA

Name of Applicant or partner of a joint venture:

All individual firms and all partners of a joint venture are requested to complete the information in this form. The information supplied should be the annual turnover of the Applicant (or each member of a joint venture), in terms of the amounts billed to clients for each year for work in progress or completed.

Use a separate sheet for each partner of a joint venture.

Applicants should not enclose testimonials, certificates, and publicity material with their applications; they will not be taken into account in the evaluation of qualifications.

Annual turnover data for the last three financial years i.e. to (Rs. In lacs)

Year	Turnover	Net cash accrual	Net worth	Annual income from contracting	Annual income from other sources
[A] Lead partner:					
[B] Joint Venture Partner:					

Note: The declared figures as mentioned above shall be supported with balance sheet certified by Chartered Accountant and duly notarized for the respective financial year.

FORM - 5
FINANCIAL DATA

(Give details separately for each member in case of a joint Venture.)

1)	Name of Firm	
2)	Name of Partner / Director	
3)	Capital (a) Authorized (b) Issued and paid up	
4)	Furnish Balance sheet and profit and loss statement with Auditor's Reports and Income Tax assessment orders for last Three (3) financial years. It should, interlaid include the following information i) Working Capital ii) Foreign Investment iii) Turnover for the last three (3) financial year, the contract receipts for Civil Engineering works (Furnish reference page number to balance sheet attached)	

Sr. No.	Year	Turnover (Rs in Crores)	Reference page No. to balance sheet or other documents
(I)			
(II)			
(III)			
(IV)			
(V)			
(VI)			
(VII)			

GROSS INCOME IN THE LAST Seven FINANCIAL YEAR

Sr. No.	Year	Gross Income (Rs in Crores)	Reference page No. to balance sheet or other documents
(I)			
(II)			
(III)			
(IV)			
(V)			
(VI)			
(VII)			

6.	Maximum gross income from contract works during last three (3) financial year	
7.	What is the maximum cost of the project that has been handled? (Please give details)	
8.	Have you ever been denied tendering facilities by any Government / Government Undertaking Organisations / Public sector under taking etc.? (If Yes, Please give details)	
9.	List your sources of finance	
10	Amount of financial soundness certified by Bank. (Attach copy of certificate)	
11.	Name and address of Bank from whom reference can be obtained	
12.	Have you ever been declared bankrupt? (If yes, please give details)	

Note: Firms owned by individuals, and partnerships, may submit their balance sheets certified by a registered accountant, and supported by copies of tax returns. Attach Certificate(s) issued by any Bank or Financial Institution for available credit to the Lead partner and joint venture partner.

SIGNATURE OF BIDDER

FORM-6

List of works already completed by the bidder during last 7 financial years i.e. From..... to..... & up to one month prior to last date of submission of the bid

S r. No.	Na me of wor k	Pla ce/ Dis t./ Sta te	Tend ered amou nt Rs. In Lac	Cost on compl etion Rs. In lac	Dat e of start ing	Origi nal time limit in mont hs	Exten ded time limit in month s	Time taken in mont h to comp lete the work	Actual date of comple tion	Reason for delay in comple tion	Rema rks
1.	2.	2a.	3.	4	5a	5b.	5c.	5d.	5e	6	7

Note: Necessary completion certificate showing the year wise breakup of amount of work done from concerned officers shall be attached with the tender.

Date:

Signature of the Bidder.

FORM-7

DETAILS OF WORKS ON HAND WITH BIDDER

Work performance and Value of the existing commitments (Work on Hand) as on the date of bid submission for works (complete or partial) to be completed in the next years (Project Duration In Years) (In separate form for each work)

(Give details separately for each member in case of a joint Venture.)

1)	Name of Work	
2)	Agreement No. & Date	
3)	Country and Location	
4)	Client's Name and Address	
5)	Tendered Cost of work (Rs. in Lacs)	
6)	Brief description of works including principal features and quantity of main items.	
7)	Details of work on hand i) Date of Starting ii) Percentage of Physical completion iii) Amount billed for the work completed iv) Cost of work remaining to be executed v) Stipulated date of completion vi) Anticipated date of completion.	
8)	Name of Applicant's Engineer-in-Charge with Professional Qualification.	
9)	Explain for non-completion of work within stipulated time limit if so.	
10)	Whether any Penalties / Fine / Stop notice / Compensation/ Liquidated Damages imposed? (Yes or No), (If Yes, give amount and explanation)	

11)	Details of Litigation / Arbitration cases, if any pertaining to ongoing works.	
12)	Attach Client's certificate for the details furnished in the Form-3A/ Form-11 (Not below the rank of Executive Engineer or equivalent).	

SIGNATURE OF BIDDER

Note: Necessary certificates showing the year wise breakup of amount of work done from the officer concerned shall be attached with the tender.

FORM – 8

DETAILS OF EXPERIENCE OF COMPLETED WORKS (SIMILAR NATURE)

Give details of the similar type of work completed during last seven (7) financial year from i.e. to & up to one month prior to last date of submission of the bid in the following Proforma. (Separate form for each work)

(Give details separately for each member in case of a joint Venture.)

1)	Name of Work	
2)	Agreement No. & Date	
3)	Country and location	
4)	Client's Name and Address	
5)	Total Tendered cost of work (Rs. in Lac)	
6)	Cost of completed work	
7)	Brief description of works including principal features and quantity of main items.	
8)	Annual achievement (duly supported by certificate from Engineer- In -Charge) a) Of key quantities, total physical output of last seven (7) financial year (Separately for each item) (For EPC contract for Water Supply Projects /Drainage/ Sewerage Projects) b) Financial Output in Rupees (Cost of Work) (Including cost of materials supplied by the client)	
9)	Period of completion (a) Originally stipulated time limit. (b) Date of starting (c) Stipulated date of completion	

	(d) Extended time limit if any, Actual time taken to complete the work. Reasons for non-completion of work in stipulated time limit / extended time limit if so.	
	(e) Actual Cost of Work Done	
10)	Name of applicant's Engineer - in -charge of the work and his educational qualification	
11)	Were there any Penalties/ Fines / Stop notice / Compensation / Liquidated Damage imposed? (Yes or No. If yes, give case wise details)	
12)	Give the details of Annual Financial Performance and your experience in execution in mobilizing Lift Irrigation, Pipeline Project	
13)	Details of Litigation / Arbitration cases, if any pertaining to work completed.	
14)	Attach Client's certificate in Form-3A (Not below the rank of Executive Engineer or equivalent)	

SIGNATURE OF BIDDER

(*) If the information is hidden or misleading by the bidder, he shall be disqualified for the Tender and debarred for three financial years.

FORM - 9

**ADDITIONAL INFORMATION AND LITIGATION HISTORY / DEBARMENT /
BLACKLISTING**

Name of Applicant :

1. PLEASE DESCRIBE:

Company's history of litigation or arbitration / Debarment / Blacklisting from contract executed in the last ten years or currently under execution. Please indicate for each case the year, name of employer, cause, matter in dispute, disputed amount, and whether the award was for or against the company.

2. Please add any further information that you consider to be relevant to the evaluation of your application. If you wish to attach other documents, please list below:

SIGNATURE OF BIDDER

FORM – 10

INFORMATION FOR TENDERS SUBMITTED BUT NOT AWARDED

- a) Please add any further information which the applicant considers relevant in regard to his capabilities.
- b) Please give a brief note indicating by applicant considers himself eligible for qualification for the work.
- c) List of works for which tender have already submitted to the client but not awarded

Sr. No	Name of Work	Estimated amount (In Crores Rs.)	Date of Submission of Offer	Name of Client	Likely date of award	Position with ref. to lowest bid.

Note: Giving additional information as per (a) and (b) shall not automatically lead to prequalification.

SIGNATURE OF BIDDER

FORM – 11
CERTIFICATE FOR EXPERIENCE OF WORK

This is to Certify that M/s _____ was awarded the work of _____ (Agreement / contract No. & Year ____). As individual / in a Joint Venture with _____ other details of the work are as under.

1(a)	Name of Joint Venture (If applicable)	
1(b)	-Office address. -Name of state -Telegraphic address - Telephone number with STD code -Fax number. -E-mail address.	
2)	Percentage of share of the agency as per Joint Venture agreement (If applicable)	
3)	Tendered amount Rs. in Lac.	
4)	Actual cost of work completed, including price escalation	
5)	Time Limit in months	
6)	(A) Actual date of starting. (B) Stipulated date of completion	
7)	Actual / expected date of completion	
8)	Whether any fine imposed for not carrying the work as per stipulated time Schedule? (If Yes please give details)	
9)	Execution of pipe line work, type of pipe, diameter in mm & length in kms	
10)	Execution of Elevated storage with capacity and ground storage with capacity in million liters	
11)	Execution of pumping machinery in KW (excluding standby)	
12)	Execution of treatment plant, type and capacity in mld	
13)	Execution of intake arrangement, head regulators and other similar structures, capacity in mld.	

Note :

- 1 The agency has carried out the work timely/ late and satisfactorily/ unsatisfactorily.
- 2 Details of quantities of main items of similar nature of work shall be given in the respective column.

SIGNATURE OF ACCOUNTANT

NAME OF ACCOUNTANT

DATE:

PLACE:

SIGNATURE OF ENGINEER-IN-CHARGE

NAME AND SEAL OF ENGINEER-IN-CHARGE

DATE:

PLACE:

FORM - 12

JOINT VENTURE DATA

A copy of the joint venture agreement must be attached to Form-4. In case the joint venture agreement is not acceptable, the joint venture may be requested to modify the agreement accordingly. Failure to submit a modified Joint venture agreement within twenty-one days upon receipt by the applicant of the request for modification will disqualify the applicant for further consideration.

Names of all partners of a joint venture		Financial Stake of A firm (In Percentage)
Partners	Name of Firm	
1. Lead partner		
2. Partner		

FORM - 13
PERSONNEL / STAFF PROPOSED FOR THE PROJECT

Name of Applicant or partner of a joint venture

For specific positions essential to contract implementation, applicants should provide the names of at least two candidates qualified to meet the specified requirements stated for each position. The data on their experience should be supplied in separate sheets using one Form-14 for each candidate.

1.	Title of position: Project Manager
	Name of prime candidate:
	Name of alternate candidate:
2.	Title of position: Water Supply Engineer
	Name of prime candidate
	Name of alternate candidate
3.	Title of position: Electro Mechanical Engineer
	Name of prime candidate
	Name of alternate candidate
4.	Title of position: Site Engineer and Technical Assistant (Diploma/ITI) Engineer
	Name of prime candidate
	Name of alternate candidate

Note: Attach **Manning (Personnel) Schedule** stating each personnel's roles and responsibility for work to be carried out for the project.

FORM - 14
CURRICULUM VITAE OF PROJECT MANAGER & ALL KEY TECHNICAL
PERSONNEL's

Name of Applicant or partner of a joint venture

Proposed Position:		Candidate <input type="checkbox"/> Prime <input type="checkbox"/> Alternate	
<i>Candidate information</i>	1. Name of candidate		2. Date of birth
	3. Professional qualifications:		
<i>Present employment</i>	4. Name of employer		
	Address of employer:		
	Telephone:		Contact (manager / personnel officer):
	Facsimile:		Telex:
	Job title of candidate:		Years with present employer:

Summarize professional experience over the last ___ years, in reverse chronological order. Indicate particular technical and managerial experience relevant to this Project.

From	To	Company / Project / Position / Description of relevant technical & managerial project specific experience

FORM - 15

PROPOSED SITE ORGANIZATION & MANAGEMENT

Name of Applicant or partner of a joint venture

- A. Preliminary Site Organization Chart at HO level & at field level:
- B. Narrative Description of Site Organization & Project Management Chart
- C. Description of Relationship between Head Office and Site Management¹
- D. Description of Approach & Methodology to carried out work of this project.

Note: Indicate clearly which responsibility and what authority will be delegated to site management.

FORM – 16

DETAILS OF EXPERIENCE FOR PHYSICAL QUALIFICATION CRITERIA

Sr. No.	Name of work	Cost of work in Rs. Lakhs	Work completed/ in progress	Particulars of item	Unit (MLD)	WTP Capacity	Remarks

Note: For each experience criteria Form-11 shall be submitted by the contractor duly signed by the employer

FORM – 17

Approach and Methodology with Conceptual Design and Supporting Calculations of the System

Bidder may submit their work plan, details methodology with Conceptual Design and Supporting Calculations of the System to be adopted for this work.

SIGNATURE OF THE BIDDER

FORM-18

PROFORMA FOR LETTER OF UNDERTAKING (FORM-H)

**(TO BE EXECUTED ON NON-JUDICIAL STAMP PAPER OF Rs. 300/- AND
SUBMITTED BY THE TENDERER ALONG WITH HIS TENDER IN A SEPARATE
COVER)**

To,

Executive Engineer (Drainage Department)
Bhavnagar Municipal Corporation
Bhavnagar

Dear Sir,

- i. I/We hereby declare that I/We have visited the site and fully acquainted myself / ourselves with local situations regarding materials, labour and other factors pertaining to the work before submitting this tender.
- ii. I/We hereby declare that I/We have read the Tender Documents published on website tender.nprocure.com and accordingly submitted online price Bid for the work of -----

- iii. I/We hereby declare that I/We have carefully studied the conditions of contract and specifications and other documents of this work and agree to execute the same accordingly.
- iv. I/We hereby declare that my/our near relatives are not working in in this GUDM/BMC or in its BMC as an Engineer of any category, Divisional Accountant, Store Keeper as on today.
- v. I/we hereby declare that I/we are not declared ineligibility for corrupt or fraudulent practices issued by the central/state govt. In accordance with **Sub Clause No. 41 Corrupt or Fraudulent Practices** or not in the list of black listed contractors announced by GWSSB/ GWIL / Govt of Gujarat or its Public Sector Undertakings, Government of India, Other states Government or Public Sector Units.
- vi. I/ We hereby submit our tender and undertake to keep our tender valid for a period of 180 days from the date of opening of tenders i.e. up-to ----- . I/We shall not vary/ alter or revoke my/ our tender during the validity period of tender. This undertaking is in consideration of **Bhavnagar Municipal Corporation** agreeing to open my/ our tender, consider and evaluate the same for the purpose of award in

terms of provisions of tender documents. Should this tender be accepted, I/ We also agree to abide by fulfill and comply with all the terms and conditions and provisions of the above-mentioned tender documents.

- vii. I/We also declare that the bid duly filled in online and digitally signed and the required Earnest Money Deposit, Tender Fee and other required documents (scanned copy submitted online) will be handed over in physical form to the **by RPAD/Speed Post/ Hand Delivery only.**

If this declaration is found to be incorrect then without prejudice to any other action that may be taken I/we shall be debarred from bidding in Bhavnagar Municipal Corporation tender for three years and my/our security deposit may be forfeited by Bhavnagar Municipal Corporation in full & the tender, if any, to the extent accepted, may be cancelled.

Signature along with seal of the Company

(Duly authorised to sign the tender on behalf of the Bidder)

Name:

Designation:

Name of Company (BLOCK LETTERS)

WITNESS :

Signature :

Date :

Date :

Postal Address :

Name & Address :

Telephone/Fax No.

Form-19
FORM OF BANK GUARANTEE
(Earnest Money Deposit)

Whereas M/s (herein after called the Tenderer) is desirous and prepared to tender for work in accordance with Terms & Conditions of Tender Notice of (financial year) dated and whereas We, Bank; agree to give the Tenderer a guarantee for the Earnest Money Deposit.

1. Therefore, we hereby affirm that we are Guarantors on behalf of the Tenderer upto a total of Rupees(i.e. Rs.....) and we undertake to pay the BMC Ltd.,Bhavnagar upon his first written demand and without demur, without delay and without necessity of previous notice of individual or administrative procedure and without necessity to prove the bank the defects or shortcomings or debit of the contractor any sum within the limit of Rupees.....
2. We further agree that the guarantee here in contained shall remain in full force and effective during the period that would be taken for the acceptance of the tender. However, unless a demand or claim under this guarantee is made only in writing on or before the We shall be discharged from all liabilities under the guarantee thereafter.
3. We undertake not to revoke the guarantee during its currency except with the previous consent of the Executive Engineer , in writing.
4. We lastly undertake not to remove the guarantee for any change in constitution of the Tenderer or the Bank.

Signature and Seal of the
Guarantor Bank:

Address:

Date:

Form-20 (Form-3A)

WORK WISE DETAILS OF WORK COMPLETED/ IN PROGRESS BY THE CONTRACTOR

1. Name of Contractor :
2. Name of Work :

3. Estimated Cost of Work Put to Tender :

4. Tendered Amount :

5. Date of starting of the work :

6. Date of completion of the work :
(As per contract agreement)

7. Actual Date of Completion of Work :
8. Amount of work done upto :
9. Brief history of the work :

Sr. No.	Particular	Unit	Qty.

- 10 State whether details as above given by the contractor correct, if not as to what is the correct information. :

- 11 State whether the contractor has executed the work in progress satisfactory as per specification/ has completed the work, satisfaction, if any give the correct position of the work. :

Form-21

PERFORMANCE GUARANTEE

(See clause No. 1)

(The date of this bond must not be prior to the date of the instrument in connection with which it is given) _____

Principal (Contractor) _____

Surety (Nationalized Bank) _____

Sum of bond (express in words and figures) _____

Contract No. and date of contract _____

KNOW ALL MEN BY THESE PRESENTS THAT WE, THE PRINCIPALS AND SURETY above named are held and firmly bound unto the _____ hereinafter called the Employer in the amount stated for payment of which' sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents subject to the provisions of which the aforesaid Contractor on demand and without demand on a claim being made by the Employer.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the principals have entered in to a contract with the Employer numbered and 'dates as shown above and hereto _____ attached _____ for _____ the _____ execution _____ of work _____

NOWHEREFORE, if the Principal shall well and truly perform and fulfil all the undertakings, covenants, terms, conditions and agreements of said contact during the original terms of the said Contract and any extensions thereof that may be granted by the Employer with or without notice to the surety and during the life or any guarantee required under the contract and shall also well and truly perform and fulfil all the Undertakings, covenants, terms, conditions and agreements of any all duty and unduly authorized modifications of said Contract that may hereafter be made, notice of which modifications to the surety being hereby waived or shall pay over, make good and reimburse to the Employer all loss and damages which the employer may sustain by reason of failure or default on the part of said Principal so to do.

We _____ further agree that the guarantee herein Contained shall remain in full force and effect during the period that would be taken for the validity of the said Contract, and that it shall continue to be

enforceable till all the dues of the employer under or by virtue of the Contract have been fully paid and its claims satisfied or discharged or till the Employer certifies that the terms and conditions of the Contract have been fully and properly carried out by the said Contractor and accordingly discharges the guarantee. Failing which Employer is at liberty to forfeit the performance Security and recover the amount by way of invocation/encasement. Unless a demand or claim under this guarantee is made on us in writing on or before the _____ we shall be discharged from all liability under this guarantee thereafter.

IN WITNESS WHERE OF, the above bounded parties have executed this instrument under their several seals on the date indicated above the name and corporate seal, of each corporate party being hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing body.

In the presence of witness _____ individual

Principal

1. _____ as to _____ (seal)

2. _____ as to _____ (seal)

3. _____ as to _____ (seal)

4. _____ as to _____ (seal)

By _____ affix Corporate Seal

Attested

Corporate Surety

Business address

Affix by _____ Corporate Seal

Title _____

For and on behalf of the Employer

Form-22

JOINT VENTURE AGREEMENT

(To be notarized on stamp paper of appropriate value)

(1) The Joint Venture agreement made and entered into at _____(place) on _____ day of _____(YEAR) by and between.

- a. Firm A (Name with address of the registered office)
- b. Firm B (Name with address of the registered office)

(2) Definitions: In this deed the following words and expressions shall have the meaning set out below.

- a. "The Employer" shall mean BMC.
- b. "The Works" shall mean _____
_____(Name of work) which is more particularly described in the pre-qualification and tender documents issued thereof by the Employer.
- c. "The Tender" shall mean the Tender to be submitted by Joint Venture to the Employer for the work /works.
- d. "The Contract" shall mean the contract entered /to be entered into between the Joint Venture and the Employer for the works.

(3) Joint Venture (J.V):

The Parties hereto declare that they have agreed to form a Joint Venture for the purpose of submitting the pre-qualification Application/ tender document initially and then tender and if successful for the execution of the works as an integrated Joint Venture. The parties are not under this agreement entering into any permanent partnership of Joint Venture to tender or undertake any contract other than the subject works. Nothing herein contained shall be considered to constitute the parties of partners to constitute either Party the agent of the other.

(4) Witnesses: Whereas Gujarat Urban Development Company Limited as BMC. Employer has invited tenders from intending bidders and the Board has permitted a group of firms (not exceeding three) forming a Joint Venture to eligible to be a bidder. And whereas _____ party of the first part and _____ party of the Second part/third part(if applicable) are desirous to enter into a Joint Venture in the nature of partnership engaged in the joint undertaking for the specific purpose of execution of the work of constructing _____ and whereas Parties of the first and Second part /third part(if applicable) reached understanding to submit pre-qualified/ tender, if pre-qualification, and to execute the contract if awarded;

This agreement witness as follows.

- (a) The parties do not enter into an agreement of any permanent partnership of Joint Venture to tender or undertake any Contract other than the specified above;
 - (b) That the operation of this Joint Venture firm concerns and is confined to the work of _____ of Board
 - (c) The name of the Joint Venture firm for convenience and continuity shall be
 - (d) The Address of Joint Venture for communication shall be as under.
 - (e) The Joint Venture shall jointly submit pre-qualification application on the above name according to all terms and conditions stated in the relevant instructions contained in the bid documents.
 - (f) That this Joint Venture shall regulate the relations between the parties thereto and shall include without being limited to them the following conditions.
 - (1) _____ firm shall be the lead company in charge of the Joint Venture for all intents and purpose.
 - (2) In case the said work is awarded to the Joint Venture, the partners of the Joint Venture will nominate a person with duly notarized power of Attorney on stamp paper, who will represent the Joint Venture with the authority to incur liabilities, receive instructions and payments, sign and execute the contract for an on behalf of the Joint Venture,
 - (i) All the (Maximum Three) parties agree to make financial participation and to place at disposal of Joint Venture the benefits of its individual experience, technical knowledge, skill and shall in all respect bear its share as regards planning and execution of the work and responsibilities including the provision of information, advice and other assistance required in the Joint Venture and participation shall be in proportion of, Firm –A.....% and Firm - B.....%
 - (ii) All rights, interests, liabilities, obligations work experience and risks (and all net profits or net losses) arising out of the contract shall be borne by the parties in proportion to their shares. Each of the parties shall furnish its proportionate share in any bonds, guarantees, sureties required for the works as well as its proportionate share in connection with the works. The share and participation of the two/three partners in working capital and other financial requirements shall be in ratio as mentioned above.
- (5) Internal responsibilities and liabilities:**
- (a) The division of individual scope of work may be worked out mutually by the parties but the party shall be jointly and severally liable to the employer for the whole work.
 - (b) The parties specifically undertake to carry out their separate works in full compliance with the contract with the employer. Each party shall be responsible jointly and severally for consequences if any arising out of defective or delayed execution of works which falls within the individual's party's area of responsibility and/ or it has been caused due to acts

and /or omission of the concerned party.

- (c) The parties jointly and severally agree to replace modify or repair any defect in their respective portions of works in accordance with the terms and condition of the contract with the employer.
- (d) The parties jointly and severally shall indemnify and hold harmless to each other against any claim made by the employer or any other third party for injury, damage, loss or expenses is attributed to the breach /non-performance of his responsibilities by the indemnifying party in accordance with the agreements and /or contract with the employer.
- (e) None of parties have joined in any other Joint Venture for the said works.

(6) Responsibilities and liabilities of Joint Venture towards the employer:

- (1) Parties hereto shall be jointly and severally liable and responsible for the acts, deeds and things done or omitted to be done in respect of the execution of the contract and for any financial liability arising there from.
- (2) Parties hereto shall be jointly and severally responsible to the Employer for the execution of the works in accordance with the contract conditions;
- (3) Parties hereto shall be jointly and severally indemnifying to the Employer against any claim made against the employer or any other third party for any injury, damage or loss which may be attributed to the breach of the obligations under the contract pursuant to the contract.

(7) Site management:

- (a) The execution of the work on the site will be managed by a Project Manager appointed by the Joint Venture and who will report to the _____(J.V.) the project manager shall be authorized to represent the Joint Venture on site in respect of matters arising under the contract.
- (b) The _____ (Name of the J.V.) shall be jointly and severally liable to the employer for the execution of the contract commitment in respect of the works in accordance with contract conditions.

(8) Termination of the Agreement:

This agreement shall be terminated in the following circumstances.

- (a) The employer awards the contract for the work to the other Bidder.
 - (b) The employer cancels the work to award the contract.
 - (c) On completion of the defect liability period as stipulated in the contract agreement of the works and all the liabilities thereof are liquidated.
- (9)** No partner has right to assign any benefits, obligation of liability under the agreement to any third party without prior written consent of the other partner as well as Board

(10) Financial matter:

- (a) Bank Account in the name of the Joint Venture will be opened with any scheduled or nationalized Bank to be operated by an individual signatory as decided mutually by the

Joint Venture partners.

- (b) All the partners shall be responsible to maintain or cause to maintain proper Books of accounts balance sheet and profit and loss account as to the state of affairs of the firm as at the end of the financial year and as to the profit and loss made or incurred by the firm for the year ended on that date, respectively shall be prepared and the same shall subject to audit by a Chartered Accountant.
 - (c) None of the party shall be entitled to make any borrowing on behalf of the Joint Venture without express prior written consent of the other party.
 - (d) Bank guarantee for the application /execution of the work shall be provided jointly from a bank acceptable to the employer.
- (11) Negotiation:** Any negotiation of agreement between the parties hereto and the employer subsequent to the submission of the tender and prior to award, shall take place only with consent of each of the parties who shall be represented at the such negotiation by one or more representative(s) duly empowered to make such negotiation or agreement.
- (12) Legal jurisdiction:** All questions relating to validity interpretation of this agreement shall be governed by the law of India and shall be subject to jurisdiction of High court at AHMEDABAD.
- (13) Settlement of disputes:** Any dispute in interpretation of any condition mentioned herein shall be referred to an arbitrator/tribunal by mutual consent of the partners and such proceedings shall be governed by Gujarat Public Works contract disputes tribunal act of 1992 and as amended from time to time. The award of arbitrator shall be final and binding on the party hereto. Neither the obligation of each party here to the performance of contract nor the execution of work shall stop during the course of arbitration proceeding or as a result thereof.
- (14) Insurance:**
- (a) The Joint Venture through the parties individually shall take such insurance in connection with the work in accordance with the tender condition as acceptable to the employer.
 - (b) The cost of the insurance premium paid by the Joint Venture shall be borne and paid by the parties in proportion to the respective shares of work. Other insurance taken individually by the parties shall be fully borne by the respective parties.
- (15)** No change shall be made in this agreement without prior written consent of the employer and other party. However, if the employer directs the parties to make changes in the agreement so as to fulfill tender conditions the parties discuss with employer and mutually agreed such changes required to be made in the agreement.

(16) Default and withdrawals from the Joint Venture.: In case that either party fails to observe the provision stipulated in this agreement withdrawal from the Joint Venture, Loss and/or expenses incurred by other party due to such default and /or withdrawals shall be fully compensated by the party who has defaulted.

(17) All matter relating to or arising due to this agreement shall be treated as confidential and shall not be disclosed to any other party. In witness whereof the parties have caused their duly authorized representatives to sign below.

Witness:

- 1 Signed for and on behalf of firm-A
- 2 Date Seal

Witness:

- 1 Signed for and on behalf of firm-B
- 2 Date Seal

Form-23 (If Applicable)

“Assured Pipe Supply Declaration” (MOU with Manufacturer of DI pipe)

In the interest of timely completion of the Project, after discussions and getting assurance from the manufacturer, the following schedule is proposed in order to meet the milestones and desire target of the Projects.

Name of the Pipe Supply Firm	Location of Manufacturing Unit	Size of Pipe		Quantity (In MT)	Assured date of delivery at site (zero date starts from date of work order)
		Diameter (In mm) (FID)	Length (In Km)		

Total number of days for supply of pipe shall be 120 days from the date of work order. We hereby declare that the supply of pipes for the Project will be ensured by us (within 120 days) as per the above-mentioned schedule. We are aware, that, in case the above schedule is not met with by us, we shall be liable for paying the Liquidated damages as prescribed in the tender documents for non-fulfillment of assured supply of pipes.

Authorised Signatory of the Contractor

Authorised Signatory of the Manufacturer.

FORM - 24 (If Applicable)

MEMORANDUM OF UNDERSTANDING (MOU)

This MEMORANDUM OF UNDERSTANDING hereinafter referred to as MoU made on ___ Day _____(month and year) at _____ by and between.

(Name and Pipe Manufacturer with address) _____, represented by _____ Authorized Signatory, which expression shall unless repugnant to the subject or context include its administrators, Successors and assigns.

(Name of Bidder with Address) _____, represented by _____ (Authorized Signatory), which expression shall unless repugnant to the subject or context includes its administrator, successor and assigns

Hereinafter referred to as "Parties" in the collective sense and each of which is referred to as " _____ (Name of Pipe Manufacturer)" & " _____ (Name of Bidder)" in the individual sense.

WHEREAS BMC (hereinafter referred to as Employer) has invited tender (hereinafter referred to as the ("project")) for the following work:

Name of Project: _____

WHEREAS if the said project is awarded to " _____"(Name of Bidder) to execute the said project and it would also need _____ pipes and we the " _____"(Name of Bidder) hereby enter into this MoU with " _____(Name of Pipe Manufacturer)_____" for timely execution of _____ pipe line work and supply of pipes as per "Form 23 - Assured pipe Supply Declaration" attached herewith and as per the tender conditions and further we mutually agree to execute the said project jointly and both the parties would be jointly and severally responsible for execution of the said projects as per the Bidding Documents.

IN WITNESS WHEREOF all the parties mentioned herein above have signed this MOU on the day, month and year first above mentioned.

No change shall be made in this agreement without prior consent of Employer and other party. However, If the Employer direct the parties to make changes in MOU agreement so as to fulfil the tender condition / requirement, the parties shall discuss with the employer and shall mutually agree for such changes as may be required to be made in the agreement.

In the interest of timely completion of the project, after discussion and getting assurance from manufacture of _____ pipe, the following schedule for _____ pipe supply is proposed in order to meet the milestones and desired target of the projects.

Total number of days for supply of pipe shall be _____ days from the date of work order. We hereby declare that the supply of pipes for the Project will be ensured by us (within _____ days) as per the above-mentioned schedule. We are aware that, in case the above schedule is not met with by us, we shall be liable for paying the Liquidated damages as prescribed in the tender documents for non-fulfilment of assured supply of pipes.

For, (Name of Bidder)

For, (Name of Pipe Manufacturer)

Authorised Signatory

Authorised Signatory

Encl.: Form 23 - Assured Pipe Supply Declaration

CONTRACT NO.

**Bhavnagar Municipal Corporation
BHAVNAGAR**



(A WHOLLY OWNED BHAVNAGAR MUNICIPAL CORPORATION UNDERTAKING)

ESTIMATED COST

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

ESTIMATED COST: RS. 14,70,03,332.00/-

VOLUME – II: GENERAL CONDITION OF CONTRACT

Employer

EXECUTIVE ENGINEER

(Drainage Dept.)

BHAVNAGAR Municipal Corporation

Sir Mangal Sinhji Road, Near Kalanala,

Bhavnagar,

Bhavnagar,-364001.

Contact Number: 0278 2424801-10

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I N D E X

GENERAL CONDITIONS OF CONTRACT		
Clause 1	Security deposit	
Clause 2	Liquidated damages for delay	
Clause 3	Default by contractor	
Clause 4	Action when the progress of any particular portion of the work is unsatisfactory	
Clause 5	Non exercise of powers under clause 3 not a waive	
Clause 5-A	Powers to seize tools, plants, machineries, materials and stores of the contractor on invocation of clause 3	
Clause 6	Extension of Time limit	
Clause 7	Final Measurements and final bill on completion of work	
Clause 8	Intermediate and final payments	
Clause 9	Payment at reduced rates	
Clause 10	Bills to be submitted monthly	
Clause 11	Bills and rates payable	
Clause 12	Materials to be supplied by the Department	
Clause12-A	Consumption and return of materials supplied by the Department	
Clause 12-B	Safe custody of materials supplied by the Department	
Clause 13	Drawings, designs, instruction of the Engineer- in- Charge and specifications, order of	
Clause 14	Excess over Tender Quantities, Extra Items and Variations	
Clause 15	No. Claim to any payment or compensation for alterations or for restrictions of work	
Clause 16	Claims under the contract	
Clause 17	Remedies for inferior or bad work, materials of workmanship and maintenance clause	
Clause 17-A	Defect liability clause	
Clause 18	Work to be open for inspection- Contractor's responsible agent to be present.	
Clause 19	Notice to be given before work is covered up	
Clause 20	Damage to contract work- in- progress and damages to surrounding properties.	
Clause 20-A	Damages due to acts of God and unprecedented floods	
Clause 21	Contactoer to supply plant, ladders, scaffolding etc, and is liable for damage arising from non-provision of lights, fencing etc	
Clause 21-A	Regulations for scaffolds, working platforms, gangways and stairways	
Clause 21-B	Regulations for hoisting appliance	

Clause 22	Measures for prevention of fire	
Clause 23	Liabilities to contractors for any damages done in or outside work	
Clause 24	Risk & Cost Clause	
Clause 25	Recovery from Contractors	
Clause 26	Work not to be sublet; consequences for unauthorised subletting, bringing and becoming insolvent	
Clause 27	Sums payable by way of compensation to be considered as reasonable compensation without reference to actual loss.	
Clause 28	Changes in the constitution of firm to be notified	
Clause 29	Works to be under directions of Superintending Engineer	
Clause 30	Settlement of Disputes and Arbitration	
Clause 31	Deleted	
Clause 32	Lump sums in estimates.	
Clause 33	Action where no specifications	
Clause 34	Definition of work	
Clause 35	Non refund of quarry fees & Royalties	
Clause 36	Compensation under the Workmen's Compensation Act	
Clause 36-A	Liability of the contractor in case of accidents	
Clause 36-B	Arrangements for personal safety requirements and first aid	
Clause 37	Quantities in the tender to be considered approximate and they are subject to variations	
Clause 38	Employment of famine or other labour	
Clause 39	Claim for compensation for delay in starting the work	
Clause 40	Claim for compensation for delay in the execution of work	
Clause 41	Entering upon or commencing any portion of work	
Clause 42	Minimum age of persons employed	
Clause 43	Method of payment	
Clause 43-A	Set off Clause....	
Clause 44	Check Measurements	
Clause 45	Termination by Engineer in Charge	
Clause 46	Payment upon Termination	
Clause 47	Rates exclusive of applicable Goods and Service Tax (GST) and inclusive of all other taxes	
Clause 47-A	Income Tax	
Clause 48	Employment through Employment Exchange and local labour	
Clause 49	Fair wages	
Clause 50	Deleted	
Clause 51	List of Machinery	

Clause 52	Deleted...	
Clause 53	Local labour on normal rates	
Clause 54	Land on Hire and rental charges	
Clause 55	Vaccination to labourers	
Clause 56	Camp facilities to workers	
Clause 57	Gum boots, hand gloves, masks etc, to labourers	
Clause 58	No distinction between harijans and other workers	
Clause 59	Price Variation Clause	
Clause 60	Fencing and Lighting	
Clause 61	Liabilities for accidents to persons	
Clause 62	Access to site and work on site	
Clause 63	Reports regarding labour	
Clause 64	Treasure trove	
Clause 65	Indemnity	
Clause 66	Insurance of labourers	
Clause 67	Setting out	
Clause 68	Cement Register	
Clause 69	Materials and works Test Register	
Clause 70	Progress Schedule	
Clause 71	Secured Advance. (Deleted)	
Clause 72	Advance payment (Deleted)	
Clause 73	Advance against machineries (Deleted)	
Clause 74	Mobilization Advance	
Clause 75	Licence for contact labour	
Clause 76	Recovery of Testing Charges and handing over empty cement bags	
Clause 77	Recover of Sales Tax	
Clause 78	Building and other construction works welfare cess (Labour cess)	
Clause 79	Notice Board	

GENERAL CONDITIONS OF CONTRACT

(CLAUSE-1) Security Deposit:

Within ten days from the date of issue of the letter accepting his Tender, the successful Bidder shall furnish the required Security Deposit for performance and attend the office of the Engineer In-Charge for execution of the Contract documents. If he fails to furnish the Security Deposit for performance or to execute the Contract for the work offered to him, his EMD shall be forfeited, and the Bidder may be disqualified from tendering for further works.

The successful bidder shall have to pay initial performance security deposit in the form of an unequivocal bank guarantee equivalent to 5% of Capital Cost and 5% of Operation and Maintenance Cost separately issued by any nationalized bank or as per list mentioned in latest GR of Finance Department.

Special Condition For Submission of EMD, SD,FD:

Note: Henceforth Bank Guarantee, Earnest Money Deposit, Security Deposit, Fixed Deposit, Demand draft of State Bank of India will not be accepted.

Further amount equivalent to 5% of the Capital Cost shall be deducted from the running bill as retention money during construction period and 5% of the Operation and Maintenance Cost shall be deducted from the running bill as retention money during Operation and Maintenance period.

The Contractor will be permitted to give an unequivocal composite bank guarantee from any nationalized bank or as per list mentioned in latest GR of Finance Department of GOG (Government of Gujarat), to cover the performance security and the retention money.

Without limitation to the provisions of the preceding paragraph, whenever the Employer's representative determines an addition to the Contract Price as a result of a change in cost and/or legislation or as a result of variation amounting to more than 25 percent of the portion of the Contract Price payable in a specific currency, the Contractor, at the Employer's representative's written request, shall promptly increase the value of the performance security in that currency by an equal percentage.

The performance security for the works shall be valid beyond 30 days from the date of completion and successful commissioning and performance security for the Operation and Maintenance works shall be valid 30 days beyond the date of completion of the Operation and Maintenance period.

5% performance security and 5% retention money recovered from each running bills till successful completion of the work (Total 10% of contract value) shall be released as mentioned below:

- (i) Performance Bank Guarantee equivalent to 50% of total security deposit shall be released after 30 days from the date of successful commissioning subject to the receipt of 10% amount of the O&M contract value as O&M security deposit from contractor.
- (ii) Remaining 50% of total security deposit shall be released after 30 days from the date of successful completion of the defect liability period i.e., 3(Three)year from the date of successful completion.
- (iii) The successful bidder shall deposit Performance security of 10% of the O&M contract value in the form of an unequivocal bank guarantee. The performance security will remain valid beyond 60days from the date of completion of O&M period.
- (iv) On successful completion of O&M and settlement of all dues recoverable from contractor Security Deposit for O&M period shall be released within 30 days from the date of successful completion of O&M works.

Stage	Release of Security Deposit
After 30 days from the date of successful commissioning (Subject to the receipt of 10% amount of the O&M contract)	50% of Security Deposit as Performance Security in the tender prescribed format (calculated on Capita Cost)
After 30 days from the date of successful completion of the defect liability period.	Remaining 50% of Security Deposit (calculated on Capita Cost)
On successful completion of O&M (Subject to settlement of all dues recoverable from contractor)	Security Deposit for O&M period (calculated on O&M Cost)

Prior to making any claim under the performance security, the Employer shall, in every case, notify the Contractor stating the nature of the default for which the claim is to be made.

(CLAUSE-2) Liquidated damages for delay:

2.1 Overall Physical Progress of work:

- a) The schedule of completion of the work shall be as under: -

Time	Percentage of work (Physical)	MODE OF DEDUCTION AT EACH MILESTONE
25%	15%	DEPOSIT
35%	25%	DEPOSIT
50%	40%	DEPOSIT
60%	50%	DEPOSIT
75%	75%	DEPOSIT
100%	100%	MODE OF DEDUCTION AT EACH MILESTONE

- b) However, if the contractor fails to meet any of the milestone both in time (e.g., 25 % for first milestone) and corresponding Physical progress (e.g. 15 % for first milestone)

as mentioned above, amount to be retained at the rate of 0.1 percentage of that milestone value per day till said designated part (s) is completed. In case, if the contractor executes and meets the subsequent milestone criteria, then the earlier retained amount shall be released. However, such retention / release for the slippage of subsequent / other milestones shall be applicable in the similar manner.

- c) However, if the contractor meets any of the next milestones of physical completion of work within the corresponding time limit as per the table above, the amount kept as deposit as per Para (b) above, shall be returned to the contractor after completing that milestone.
- d) If the contractor does not complete the entire work under the scope on the date of Completion, (i.e., 100% of the physical progress at the end of 100% of the time of completion), Liquidated damages at the rate of 0.1% of contract value per day of delay shall be recovered from the contractor. In such case, the amount retained as deposit shall be converted into liquidated damages.
- e) In case the time limit for completing the work is extended under any circumstances by BMC the milestone for completing the works will get changed according to the table as specified in Clause (a) above. in case, the work is not completed within the extended time limit and no further time extension to be granted, the liquidated damages shall be payable as 0.1% of the total contract value per day subjected to the maximum amount of 10% of the Estimated amount put to tender or total contract value whichever is higher.

2.2 Pipeline Crossing Works:

- a) The contractor must complete the pipeline crossing works requiring permissions of following authorities, within stipulated time limit as mention below. The contractor is required to plan and frame his project execution schedule accordingly.

NO.	AUTHORITY	TIME LIMIT IN MONTHS
a.	Railway	6 months from the date of receiving the work permit or 2 months from the date of receiving caution order from Railway or 6 months from the date of issue of LOI, whichever is later (While calculating the total time limit for completion of the structures of Railway, the relevant rules of the railway authority should also be taken into account.)
b.	National Highway	6 months from the date of receiving the permission from Concerned Authority or from the date of issue of LOI, whichever is later
c.	State Highway	6 months from the date of receiving the permission from Concerned Authority or from the date of issue of LOI, whichever is later

NO.	AUTHORITY	TIME LIMIT IN MONTHS
d.	Major Canal Crossing	6 months from the date of receiving the permission from Concerned Authority or from the date of issue of LOI, whichever is later
e.	Minor Canal Crossing	3 months from the date of receiving the permission from Concerned Authority or from the date of issue of LOI, whichever is later
f.	Gas / Oil / Petroleum Pipeline	6 months from the date of receiving the permission from Concerned Authority or from the date of issue of LOI, whichever is later
g.	Forest	6 months from the date of receiving the permission from Concerned Authority.

- b) If contractor fails to execute the works as in (a) above within stipulated time limit as mention above, he shall attract compensation at 0.1% cost of respective work per day of delay, calculated on the basis of BOQ, and it will have cumulative effect till the actual date of completion of the delayed work. The compensation recovered under this clause will be of permanent nature and will remain non-refundable under any circumstances.

2.3 Supply of Pipes:

- a) The contractor shall pay specific attention to timely supply of pipes under the project. The contractor is bound to supply pipes as per the specification laid within the time period stipulated in work plan approved by EIC. For ensuring the same, the contractor has to upfront declare at the time of bidding, their method of procurement of pipes i.e. (i) Through cash (if yes, this has to be reflected in their cash flow / fund flow plan to be submitted by contractor within one month from the date of signing of contract agreement) (ii) Through credit (iii) Through Letter of Credit (LOC); etc. In case of LOC, the contractor will enter into/ open LOC with the approved vendor within one month from the date of approval of QAP of pipes matching with delivery schedule. The maximum ceiling for number of times for opening of LOC is four, however the date of opening of last LOC with approved vendor for supply of pipes will be 4 months prior to stipulated end date for supply of pipes as per approved work plan.

- 2.4 The aggregate maximum of liquidated damages Payable under clause No 2 shall not Exceed 0.1% of contract value per day and shall be subject to the maximum amount of 10 % of the estimated amount put to tender or contract value whichever is higher.

- 2.5 The reasons requiring recovery of liquidate damages of ten percent of the contract value for performance shall be sufficient cause for termination of contract and for forfeiture of security deposit including amount of performance bond/security and registration of the contractor shall also be kept in abeyance for three years from the date as fixed in all cases.

(CLAUSE-3) Default by Contractor:

If the Contractor shall neglect or fail to proceed with the work with due diligence or if he violates any of the provisions of the Contract, the Engineer-in-Charge shall give the Contractor a notice, identifying deficiencies in performance and demanding corrective action, such notice shall clearly state that it is given under the provision of this clause. After service of such notice, the contractor shall not remove any plant; equipment and material from the site. The Government shall have a lien on all such plant; equipment and material from the date of such notice till the, said deficiencies have been corrected as mentioned in the said notice.

If the contractor fails to take satisfactory corrective action within ten days after receipt of such notice, the Engineer In-charge on behalf of Governor of Gujarat shall terminate the contract in whole. In case, the entire contract is terminated, the amount of security deposit and performance bond if any together with the value of the work done but not paid for, shall stand forfeited to the Government. The plants, equipment and materials, held under this clause shall then be at the disposal of the Government to recover the amount equivalent to the liquidated damages and registration of the contractor shall be kept in abeyance for three years from the date as fixed in all such cases.

The Engineer In-charge, if necessary, shall direct that a part of the whole of such plant, equipment and material be removed from the site within a stipulated period, if the Contractor fails to do so, the Engineer- in-charge shall cause them or any part of them to be sold holding the net proceeds of such sale to the credit of the Contractor. After settlement of accounts, the lien by the Government of the contractor's remaining plant equipment and balances of materials shall be released.

Termination of the contract in whole shall be an adequate authority for the Engineer In-charge to demand discharge of the obligations from the guarantors of the security for the obligations from the guarantors of the security for the performance.

(CLAUSE-4) Actions when the progress of any particular portion of the work is unsatisfactory.

If the progress of any particular portion of the work under Contract is unsatisfactory, the Engineer-in-charge shall, notwithstanding that the general progress of the work is satisfactory, in accordance with Clause-2 be entitled to take necessary action under Clause-3, after giving the Contractor ten days' notice in writing and the contractor shall have no claim whatsoever for any compensation for any loss caused to him due to such action.

(CLAUSE-5) non-exercise of power under Clause-3 not a waiver.

In any case in which any of powers conferred upon the Engineer-in-charge by Clause 3 hereof shall have become exercisable and the same shall not have been exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable at any future date.

(CLAUSE-5A) Powers to seize tools, plants, machineries, materials and stores of the contractor on invocation of clause 3

In the event of the Engineer- in charge taking action under clause 3, he may, if so desire, take possession of all or any tools, plants, machineries, materials and store in or upon the work or the site thereof or belonging to the contractor of procured by him and intended to be used for upon the work of the site thereof or belonging to the contractor or procured by him and intended to be used for the execution of the work or any part thereof, by paying or allowing for the same in account at the contract rate or in case of contract rates not being applicable at such reasonable rates, as may be comparable to current market rates where ascertainable of similar articles and comparable condition, to be certified by the Engineer-in-charge. In the alternative the alternative the Engineer-in-charge may by notice in writing to the contractor or his clerk of the works foreman or other authorized agent require him to remove such tools, plants, machineries, materials or store form the premises within a time to be specified in such notice and in the event of the contractor failing to comply with any such requisition, the Engineer- in- charge may remove them at the contractor's expense or shall remove them by auction or private sale at the risk and cost of the contractor in all respects, and the certificate of the Engineer-in -charge as to the expenses of any such removal and the amount of the proceeds and expenses of any such removal shall be final and conclusive against the contractor.

(CLAUSE-6): Extension of time limit: -

If the contractor shall desire an extension of the time for completion of the work on the ground of his having been unavoidably hindered in its execution or any other ground he shall apply in writing to the Engineer -in- charge before the expiration of the period stipulated in the tender or before the expiration of 30 days from the date on which he was hindered whichever is earlier and the Engineer-in-charge may, if in his opinion, believe that there are reasonable grounds for granting an extension, grant such extension, as he thinks necessary or proper. The decision of the competent authority in this matter shall be final.

(CLAUSE-7): Final measurement and final bill on completion of work:

As soon as the work is completed, the contractor shall give a notice of such completion to the Engineer-in- charge and on receipt of such notice the Engineer-in-charge shall inspect the work and if he is satisfied that the work is completed in all respects then Engineer In-charge shall take final measurements: -

No certificate of completion shall be issued not shall the work be considered to be complete till the contractor shall have removed from the premises, on which the work has been executed, all scaffoldings, sheds and surplus materials, except such, as are required for rectification of defects; rubbish and all huts and sanitary arrangements required for his workmen on the site in connection with the execution of the work, as shall have been erected by the contractor for the workmen and cleared all dirt from all parts of building(s) in, upon or around which the work has been executed or of which he may have possession for the purpose of the execution thereof and cleared floors, gutters and drains, cased doors and sashes, oiled locks and fastening labelled keys clearly and handed them over to the Engineer- in- charge or his representative and made the whole premises fit for immediate occupation or use to the satisfaction of the Engineer-in-charge. if the contractor shall fail to

comply with any of the requirements of these conditions as aforesaid, on or before the date of completion of the works, the Engineer-in-charge may, at the expense of the contractor, fulfil such requirements and dispose of the scaffolding, or surplus materials and rubbish etc. as he thinks fit and the contractor shall have no claim in respect of any such scaffolding or surplus materials except for any sum actually released by the sale thereof less the Cost of fulfilling the requirements and any other amount that may be due from the contractor. If the expenses of fulfilling such requirements are more than the amount realised such disposal as aforesaid the contractor shall forthwith, on demand, pay such excess. The Engineer-in-charge shall also have the rights to adjust the amount of excess against any amounts that may be payable to the contractor.

(CLAUSE-8): Intermediate and final payments:

No payments shall be made for any work, estimated to cost less than rupees one thousand till after the whole of the said work shall have been completed and a certificate of completion given. But in the case of works estimated to cost more than rupees one thousand, the contractor shall on submitting a monthly bill therefore, be entitled to receive payment proportionate to the part of the work then approved and passed by the Engineer-in-charge, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the contractor. All such intermediate payments shall be regarded as payments by way of advance against the final payments only and not as payments for work actually done and completed and shall not preclude the Engineer-in-charge from requiring bad, unsound, imperfect or unskilled work to be removed and taken away and reconstructed, or re-erected, nor shall any such payment be considered as an admission of the due performance of the contractor or any part thereof in any respect or the accruing of any claims, nor shall it conclude, determine, or affect in any way the power of the Engineer-in-charge as to the final settlement and adjustment of the account or otherwise or in any other way vary or effect the contract. The final bill shall be submitted by the contractor within one month of the completion of the work, otherwise the Engineer-in-charge's certificate of the measurements and of the total amount payable for the work shall be final and binding on all parties.

(CLAUSE-9): Payment at reduced rates:

The rates for items of works shall be valid only when the items concerned are accepted as having been completed fully in accordance with the sanctioned specifications. In cases where the items of work are accepted as not so completed, the Engineer In-charge can make payments at reduced rates.

(CLAUSE-10): Bill to be submitted monthly

A bill shall be submitted by the contractor each month on or before the date fixed by the engineer-in-charge for all works executed in the previous month and engineer-in-charge shall take or cause to be taken the requisite measurement for the purpose of having the same verified and the claim, so far as it is admissible, shall be adjusted, if possible, within ten days from the presentation of the bill. If the contractor does not submit the bill within the time fixed as aforesaid, the Engineer-in-charge may depute a subordinate to measure up

the said work in the presence of the contractor or his duly authorized agent whose countersignature to the measurement list shall be sufficient warrant and the Engineer-in-charge may prepare a bill form such list which shall be binding on the contractor in all respects.

(CLAUSE-11): Bills and rates payable:

The contractor shall submit all the bills on the printed forms at the office of the Engineer-in-charge. The charges to be made in the bills shall always be entered at the rates specified in the agreement or at the partly reduced rates subject to the approval by the Engineer-in-charge in the case of items not completed/executed as per agreements or in the case of any extra work ordered in pursuance of these conditions and not mentioned or provided for the tender, at the rate here in after provided for such work.

(CLAUSE-12): Materials to be supplied by the department.

If the specification of the work provides for the use of any special description of materials to be supplied from the Department Store or if it is required that the contractor shall use certain stores to be provided by the Engineer-in-charge (Such materials and stores and the prices to be charged therefore as here in after mentioned being so far as practicable for the convenience of the contractor but not so as in any way to control the meaning or effect of this contract specified in the schedule or memorandum hereto annexed) the contractor shall be supplied with materials and stores as may be required from time to time to be used by him for the purpose of the contract only, and the value of the full quantity of materials and stores so supplied shall be set off or deducted from any sum then deposited, or the proceeds of sale thereof, if the deposit is held in govt. securities, the same or a sufficient portion thereof shall, in that case be sold for the purpose. All materials supplied to the contractor shall remain the absolute property of Govt. and shall on account be removed from the site of the work and shall at all time, be open to inspection by the Engineer-in-charge. Any such materials, unused and in perfectly good condition at the time of completion or termination of the contract, shall be returned to the Departmental store if the Engineer-in-charge so requires by a notice in Writing given under his hand, but the contractor shall not be entitled to return any such materials except with the consent in writing of the Engineer-in-charge and he shall have no claim for compensation on account of any such material except with the consent in writing of the Engineer-in-charge and he shall have no claim for compensation on account of any such material supplied to him as aforesaid but remaining unused by him or for any wastage in or damage thereto.

For materials provided in Schedule-A and consumed in excess quantities, the rates provided in Schedule A shall be increased/ decreased corresponding to the increased/ decreases in the new rate payable for excess quantity as compared to date of issue of such quantity of materials.

(CLAUSE-12A): Consumption and return of materials supplied by the department.

The contractor shall be entitled to use the material supplied by the Department only to the extent of quantities of such materials required for execution of the work as per theoretical calculation. The Engineer-in-charge- may however, on being satisfied that a large quantity of such materials is required for the execution of the work permit the contractor to use such large quantity of the materials. Such permission shall be given in writing.

The contractor is bound to return in good condition such materials issued in excess of the requirements so worked out or in excess of the quantities so permitted to be used by the Engineer-in-charge. If the contractor fails to return such extra materials within a period of 15days from the date of the demand in writing of such materials being made by the Engineer- in charge, he shall be charged for the excess materials at double the issue rate for materials specified in Schedule A of contract Agreement.

(CLAUSE-12B): -Safe custody of materials supplied by the department

All stores and materials supplied by the department shall be in safe custody. The store shall be accessible to the Engineer-in-charge or his agent at all times, no materials shall be allowed to remove from the site of the work and any material required for the execution of the work shall be taken out form the store only in the presence of a duly authorized agent of the Engineer-in-charge.

(CLAUSE-13): Drawings, designs, instructions of the engineer-in-charge and specifications, order of precedence in case of discrepancies

- (1) The contactor shall execute the whole and every part of the work in the most substantial and workmen-like manner and both as regards materials and in other respects in strict accordance with specifications.

The contractor shall also conform exactly, full and faithfully to the design, drawings and instructions in writing for the work signed by the Engineer-in-charge. The design and the drawings shall be lodged in the office of the site engineer-in-charge to which the contractor shall be entitled to have access or the purpose of inspection at such office during office hours.

Where the instructions referred to above are not contained in separate letters addressed to the contractor the same shall be recorded in the work order book, which shall be maintained and kept on the site of the work. The contractor shall be required to sign such entries in the work -order book in token of having noted the instruction. However, if the contractor fails to sign the work- order book for any reason whatsoever, the entry of the instructions in the work order book shall be deemed to be the due notice to him of the said instructors. The work-order book shall be open for inspections to the contractor on the site or the work during office hours.

- (2) The contractor will be entitled to receive one copy of the accepted tender along with the work order free of cost.
- (3) The several documents forming the contract are essential parts of the contract and requirements' occurring in one is binding as through occurring in all. They are

intended to be mutually explanatory and complimentary and to describe and provide for a complete work.

In the event of any discrepancy in the several documents forming the contract or in any one document, the following order of precedence should apply:

- (a) Dimension and quantities: (i) Drawings (ii) Schedule-B of the Tender form (iii) specifications.

On drawings, figures dimensions, unless obviously incorrect, will be followed in preference to scaled dimensions.

- (b) Description: (i) Schedule-B of the Tender form: (ii) Drawings (iii) specifications.

In the case of defective description or ambiguity, the Engineer-in-charge is entitled to issue further instructions directing in what manner the work is to be carried out. The contractor cannot take any advantage of any apparent error or omission in drawings or specification and the Engineer-in-charge shall be entitled to makes corrections and interpretations as necessary to fulfil the plans and specifications.

(CLAUSE-14) Excess over Tender Quantities, Extra Items and Variations

The Engineer-in-charge shall have power to make any alterations in or addition to the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work and the contractor shall be bound to carry out the wok in accordance with any instructions in this connection which may be given to him in writing signed by the Engineer-in-charge and such alternation shall not invalidate the contract and any additional work which the contractor may be directed to do in the manner above specified as part of work shall be carried out by the contractor on the same conditions in all respects on which he agreed to do the main work and at the same rate as are specified in the tender for the main work.

- (14.1) Except that when the quantity of any item exceeds the quantity as in the tender by more than 10 % the contractor will be paid for the quantity in excess of 10 % at the rate entered in the S.O.R. of the year during which the excess in quantity is first executed or tender rate whichever is less.

- (14.2) If the additional or altered work includes any class or work for work of which no rate is specified in this contract, then such class of work shall be carried out.

- (i) At the rate derived from the item within the contract which is comparable to the one involving additional or altered class of work where there is more than one comparable item, the item of the contract which is nearest in comparison with regard to class or classes of the work involved, shall be selected and the decision of board shall be final and binding to the contractor.

- (ii) If the rate cannot be derived in accordance with (i) above, such class of works shall be carried out at the rate entered in the Schedule for the year in which the tender was received, increased or decreased by the percentage by which the tender amount is more or less as compared to the amount arrived at the rates in the in "Schedule of Rates" of the Division in the year in which the tender was received. If the Schedule of rates does not contain all the items,

the percentage increase or decrease of the tender shall be calculated considering such items which were included in the "Schedule of Rates" of the Division for the year and for materials consumed on such item the rate to be charged would be the basic rate taken into account for fixing the rate in S.O.R. referred to above, instead of the rate stipulated in Schedule 'A'.

(iii) If it is not possible to arrive at the rate from (i) and (ii) above, such class or work shall be carried out at the rate decided by the competent authorities on the basis of detailed rate analysis after hearing the contractor before a Committee of two superintending Engineers stationed at the same place or the nearest place.

(14.3) If the additional or altered work, for which no rate is entered in the "Schedule of Rates" is ordered to be carried out before the rate is agreed upon, then the contractor shall within seven days of the date of receipt by him of the order to carry out the work inform the Engineer-in-charge of the rate, which it is his intention to charge for such class of work and if the Engineer in charge does not agree to this rates, he shall be intimated in writing be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner as he may consider it advisable, provided always that if the contractor shall commence work or incur any expenditure in regard thereof before the rates shall have been determined as lastly herein before mentioned, then in such cases he shall only be entitled to be paid in respect of the work carried out of expenditure incurred by him prior to the date of the determination of the rate as aforesaid according to such rate or rates as shall be fixed by the Engineer In-charge in the event of the dispute, the decision of the Superintending Engineer of the Circle shall be final.

Where, however the work is to be executed according to the designs, drawings and specifications recommended by the contractor and accepted by the competent authority, the alternation above referred to shall be within the scope of such designs, drawings and specifications appended to the tenders.

The time limit for the completion of the work shall be extended in the proportion that the increase in the cost occasioned by alternations bears to the cost of the original contract work and the certificate of the engineer-in-charge as to such proportion shall be final and conclusive.

(CLAUSE-15) No. Claim to any payment or compensation for alterations or for restrictions of work

If at any time after the execution of the contract documents the Engineer-in-charge shall for any reason whatsoever, require the whole or part of the work, as specified in the tender, be stopped for any period or shall not require the whole or part of the work to be carried out at work, as specified in the tender, be stopped for any period of shall not require the whole or part of the work to be carried out at all or to be carried out by the contractor he shall give notice in writing, stating the fact to the Contractor who shall thereupon suspend or stop the work totally or partially, as the case may be. In any such case, except as provided hereunder, the Contractor shall have no claim to any payment or compensation whatsoever

except as provided hereunder on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not so derive in consequence of the full amount of the work not having been out, or on account of any loss that he may be put to on account of materials purchased or agreed to be purchased or unemployment of labour required by him, He shall not have also any claim for compensation by reason of any alterations having been made in the original specifications, drawings, designs and instructions which may involve any curtailment of the work as originally contemplated.

The Contractor shall not be entitled for loss of any expected profit of such work.

(CLAUSE 16 :) Claims under the contract

Time limit for unforeseen claims: The contractor shall not be entitled to any compensation from Government on any account unless where allowed by the conditions of his this contact.

(CLAUSE-17) Remedies for inferior or bad work, materials of workmanship and maintenance clause:

If, at any time before the expiry of Defects Liability period as detailed in Clause 17-A. It shall appear to the Engineer-in-charge or his sub-ordinate in charge of the work that/any work has been executed unsound, imperfect or unskilled workmanship or with materials or inferior quality or that any materials or articles provided by him for the execution of the work are unsound, or of a quality inferior to that contracted for or are otherwise not in accordance with the contract, it shall be lawful for the Engineer-in-Charge to intimate this fact in writing to the contractor and then notwithstanding the fact that the work, materials or articles complained of may have been passed, certified and paid or the contractor shall be bound forthwith to rectify, or remove and reconstruct the work so specified in whole or in part as the case may require, or if so required, shall remove the materials or articles so specified in whole or in part and provide other proper and suitable materials or articles at his own charge and cost, and in the event of his failing to do so within a period to be specified by the Engineer-in-charge in the written in the written intimation aforesaid, the contractor shall be liable to pay compensation at the rate or percent on the amount of the estimate of the rectification for every day not exceeding ten days during which the failure so continues, and in the event of any such failure as aforesaid continuing beyond ten days, the Engineer-in-charge may rectify or remove, and re-execute the work or remove and replace the materials complained of as the case may be at the risk and expense in all respects of the contractor. Should the Engineer -in-charge consider that any such inferior work or materials as described above may be accepted or made use of, it shall be within his discretion to accept the same at such reduced rates as he may fix therefore.

However, the contractor shall be responsible for normal maintenance of the work till the final bill for the work is prepared by the Departmental Officer.

(CLAUSE-17A) Defect liability clause:

The contractor shall be responsible to make good and remedy at his own expense any defect in works (Items) carried out by the contractor including surface worn out which may develop or may be noticed or may be noticed before the period mentioned hereunder from the certified date of completion. The Engineer-in-charge shall give the contractor a notice in Writing about the defects and the contractor shall make good the same within 15 days of

receipt of the notice. In the case of failure on the contractor, the Engineer- in charge may rectify or remove or re-execute the work at the risk & cost of the contractor. The Engineer-in-charge shall be entitled to appropriate the whole or any part of the amount of security deposit towards the expenses, if any, incurred by him in rectification, removal or re-execution. **The Detect Liability Period shall be 3 (Three) year from the certified date of completion of work.**

(CLAUSE-18) Work to be open to inspections- Contractor or responsible agent to be present:

All works under or in course of execution or executed in pursuance of the contract shall, at all times be open to the inspection and supervision of the Engineer-in-Charge and his subordinates and the Contractor shall, at all times during the usual working hours, and all other times for which reasonable notice of the intimation of the Engineer -in-charge or his subordinate to visit the works shall have been given to the contractor, either himself be present to receive orders and instruction or have a responsible agent duly accredited in writing present for the present for the purpose. Orders given to the contractor's duly authorized agent shall be considered to have the same force and effect as if they had been given to the contractor himself.

Employment of a qualified site Engineer by the Contract. As per tender document clause 3.0 of qualifying criteria

(CLAUSE-19) Notice to be given before work is covered up:

The contractor shall give not less than five days' notice in writing to the Engineer-in-charge or his subordinate in charge of the work before covering up or otherwise placing beyond the reach of measurement any work in order that the same may be measured and if any work shall be covered up or placed beyond the reach of measurement without such notice having been given or consent obtained. The same shall be uncovered at the contractor's expense and in default thereof, no payment or allowance shall be made for such work or for the materials which the same was executed.

(CLAUSE-20) Damage to contract work-in-progress and damages to surrounding properties.

If the contractor or workmen, or servants shall break, deface, injure or destroy any part of the building or the work in question in/on which they may be working or any building, road, fence, enclosure or grass- land or cultivated ground contiguous to the premises on which the work or any part thereof is being executed or if any damage shall be done to the work from any cause whatever before damage occurred /caused due to normal flood or rain or if any imperfections become apparent in it within three months from the grant of a certificate of completion, final or otherwise by the Engineer-in-charge, the contractor shall make good the same at own expenses or in default, the Engineer-in-charge may cause the same to be made good by other contractor, and deduct the expenses (of which the certificate of the Engineer-in-charge shall be final) from any sums that may thereafter become due to the contractor or from his security deposit or the proceeds of sale thereof or a sufficient portion thereof of a sufficient portion thereof,

(CLAUSE-20-A) Damages due to acts of God and unprecedented floods.

Neither party shall be liable. to the other for any loss of damage occasioned by or arising out of acts of God, such as unprecedented flood, Volcanic eruption, earthquake of other convulsion of nature and other acts such as but not restricted to general strike, invasion, the acts of foreign countries, hostilities, or war like operations before or after declaration or war, rebellion, military or Usurped power which prevent performance of the contract and which could not have been foreseen or avoided by a prudent person.

Note: "Unprecedented flood" means the flood crossing the High Flood Level of the past 10 year(s) which is on the available record.

(Modified Vide R.& B.D.G.R. No. TNC- TNC-1096-IB-143-(16)-C dated 11-1-99)

(CLAUSE-21) Contractor to supply plant, ladders, scaffolding etc. and is liable for damage arising from non- provision of lights, fencing etc-:

The contractor shall supply at his own cost all material (except such special materials if any, as may, in accordance with the contract to be supplied form the Public Works Department Store), plant, tools, appliances, implements, ladders, cordage, tackle, scaffolding, and any temporary works which may be required for the proper execution of the work whether in the original, altered or substituted form and whether included in the specifications. or other documents forming part of the contract or referred to in these conditions of not and which may be necessary for the purpose of satisfying or complying with requirements of the Engineer-in-charge as to any matter or to which under these conditions he is entitled to be satisfied or which he is entitled to require together with carriage therefore to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of settings out works and counting, weighing and assisting in the measurement of examination at any time and form time to time, of the work or the materials, failing this, the same may be provided by the Engineer - in-charge at the expense of the Contractor and the expenses may be deducted from any money due to the Contractor under the contractor or form his security deposit, or proceed of sale thereof or of a sufficient portion thereof. The contractor shall provide all necessary fencing and lights required to protect the public form accident and shall also be bound to bear expenses of defences of every suit, action or other legal proceeding at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person, or which may, with consent of the Contractor, be paid in compromising any claim by any such person.

(CLAUSE-21A) Regulations for scaffolds, working platforms, gangways and stairways

The Contractor shall provide suitable scaffolds and working platforms. Gangways and stairways, and shall comply with the following regulations in connection therewith,

- (a) Suitable scaffolds shall be provided for workmen for all works that cannot be safely done form a ladder or by other means.
- (b) A scaffold shall not be constructed, taken down or substantially altered except-

- (i) Under the supervision of a competent and responsible person.
- (ii) Appointed by contractor and by competent workers possessing adequate experience in this kind of work.
- (c) All scaffolds and appliances connected therewith and all ladders shall-
 - (i) be of sound material
 - (ii) be of adequate strength having regard to the loads and strains to which they will be subjected, and,
 - (iii) be maintained proper condition.
- (d) Scaffolds shall be so constructed that on part thereof can be displaced in consequence of normal use.
- (e) Scaffolds shall not be overloaded and so far, as practicable the load shall be evenly distributed.
- (f) Before installing the lifting gear on scaffolds, special precaution shall be taken to ensure the strength and stability of the scaffolds.
- (g) Scaffolds shall be periodically inspected by a competent person.
- (h) Before allowing a scaffold to be used by his workmen, the Contractor shall, whether the scaffold has been erected by his workmen or not, take steps to ensure that it complies fully with the regulation herein specified.
 - (i) Working platforms, gangways shall-
 - (i) be so constructed that no part thereof can sag unduly or unequally.
 - (ii) be so constructed and maintained having regard to the prevailing conditions as to reduce as far as practicable risks of persons tripping or slipping and-
 - (iii) be kept free from any unnecessary obstruction.
 - (i) In the case of working platforms, gangways working places and stairways at a height exceeding 2.00 metre (to be specified)
 - (i) Every working platform and every gangway shall be closely boarded unless other adequate measures are taken to ensure safety.
 - (ii) Every working platform, gangway, working place and stairway shall be suitably fenced.
- (k) Every opening in the floor of a building or in a working platform shall, except for the time and to the extent required to allow the access of person or the transport or shifting of materials be provided with suitable means to prevent the fall of persons or material.
- (l) When persons are employed on a roof where there is danger of falling from a height exceeding 3.00 (to be specified) meters suitable precaution shall be taken to prevent the fall of persons or material.
- (m) Suitable precautions shall be taken to prevent persons being struck by articles which might fall from scaffold or other working places.

- (n) Safe means of access shall be provided to all working platform and other working places.

(CLAUSE-21B) Regulations for hoisting appliance

The contractor shall comply with the following regulations as regards the hoisting appliances to be used by him-

- (a) Hoisting Machines and tackle including their attachments, anchorages and supports shall-
- (i) be of good mechanical construction sound material and adequate strength and free from patent defect, and
 - (ii) be kept in good repair and in working order.
- (b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of suitable quality and adequate strength and free from patent defect.
- (c) Hoisting machines and tackles shall be examined and adequately tested after erection on the site and before use and be re-examined in position at intervals to be prescribed by Engineer-in-charge.
- (d) Every chain, ring, hook, shackle, swivel and pulley block used in hoisting or lowering materials or as a means of suspension shall be periodically examined.
- (e) Every crane driver or hoisting- appliance operator shall be properly qualified.
- (f) No. person who is below age of 15 years shall be in control of any hoisting machine, including any scaffolds, nor shall give signals to the operator.
- (g) In the case of every hoisting machine and of every chain, ring hook, shackle, swivel and pulley block used in hoisting or lowering or as a means of suspension the safe working load shall be ascertained by adequate means.
- (h) Every hoisting machine and all gears referred to in preceding regulation shall be plainly marked with the safe working load.
- (i) In the case of hoisting machine having a variable safe working load, each safe working load and conditions under which it is applicable shall be clearly indicated.
- (j) No part of any hoisting machine or gear referred to in regulation 'g' above shall be loaded beyond the safe working load except for the purpose of testing.
- (k) Motors, gears, transmissions, electric wiring and other dangerous parts of hoisting appliances shall be provided with sufficient safeguards.
- (l) Hoisting applications shall be provided with such means as will reduce to a minimum the risk of the accidental descent of the load.
- (m) Adequate precautions shall be taken to reduce to minimum the risk of any part of a suspended load becoming accidentally displaced.

(CLAUSE-22) Measures for prevention of fire:

The contractor shall not set fire to any standing jungle, trees, bush wood or grass without a written permit from the engineer-in-charge.

When such permit is given, and also in all cases when destroying cut or dug up tress, bush wood, grass etc, by fire, the contractor shall take necessary measures to prevent such fire spreading to or otherwise damaging surrounding property. When such permit is given, and also in all cases when destroying cut or dug up tress, bush wood, grass etc by fire, the contractor shall take necessary measures to prevent such fire spreading to or other-wise damaging surrounding property.

(CLAUSE-23) Liability of contractors for damages done in or outside work area:

Compensation for all damage done intentionally or unintentionally by Contractor's labourers whether in or beyond limits of Government property including any damages caused by the spreading of fire mentioned in the clause 22, shall be estimated by the Engineer-in - charge, or such other Officer as he may appoint and the estimates of the Engineer-in-charge, subject to the decision of the Superintending Engineer, on appeal, shall and the contractor shall be bound to pay the amount of the assessed compensation on demand, failing which the same will be recovered from the Contractor as damages in the manner prescribed in clause 1 or deducted by the Engineer-in-charge from any sums that may be due or become due from Government to the contractor under this contract or otherwise.

The Contractor shall bear the expenses of defending any action or other legal proceeding that may be brought by any person for injury sustained by him owing to neglect of precautions to prevent the spread of the fire and he shall also pay the damages and cost that may be awarded by the court in consequence.

(CLAUSE 24) Risk & Cost

The Engineer-in-charge or the Competent Authority defined under rules may, without prejudice to his rights against the Contractor, in respect of any delay or inferior workmanship or otherwise, or any claims for damages in respect of any breaches of the contract and without prejudice to any rights or remedies under any of the provisions of this Contract or otherwise, and whether the date for completion has or has not elapsed, by notice in writing, absolutely determine the Contract in any of the following cases:

- (i) If the Contractor having been given by the Engineer-in-charge, a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in any inefficient or otherwise improper or un-workman like manner shall omit to comply with the requirements of such notice for a period of seven days, thereafter, or if the Contractor shall delay or suspend the execution of the work so that either in the judgment of the Engineer-in-charge (which shall be final and binding) he will be unable to secure completion of the work by the date for completion or he has already failed to complete the work by that date,
- (ii) If the Contractor, being a company, shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver or a manager, on behalf of a creditor, shall be appointed or if circumstances shall arise, which entitle the court or creditor to appoint a receiver or a manager or which entitle the court to make a winding up order,
- (iii) If the contractor commits breach of any of the terms and conditions of this Contract,

- (iv) If the contractor commits any acts mentioned in, clause 26 thereof. When the Contractor has made himself liable for action under any of the cases aforesaid, the Engineer-in charge on behalf of the Governor of Gujarat shall have powers: -
- a) To determine or rescind the contract, as aforesaid (of which determination or rescission notice in writing to the Contractor under the hand of the Engineer-in-charge shall be conclusive evidence), upon such determination or rescission, the earnest money, full security deposit of the contract shall be liable to be forfeited and shall be absolutely at the disposal of Government.
- b) To employ labour paid by the Department and to supply materials to carry out the work or any part of the work, debiting the Contractor with the cost of the labour and the price of the materials (of the amount of which cost and price certified by the Engineer-in-charge shall be final and conclusive against the contractor) and crediting him with the value of the work done in all respects in the same manner and at the same rates, as if it had been carried out by the Contractor under the terms of this Contract. The certificate of the Engineer-in-charge, as to the value of the work done, shall be final and conclusive evidence against the Contractor provided always that action under the sub-clause shall only be taken after giving notice in writing to the Contractor. Provided also that; if the expenses incurred by the Department are less than the amount payable to the Contractor at his agreement rates, the difference shall not be paid to the Contractor.
- c) After giving notice to the contractor to measure up the work of the contractor and to take such part thereof, as shall be unexecuted out of his hands, and to give it to another contractor to complete, in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor, if the whole work had been executed by him (of the amount of which excess, the certificate in writing of the Engineer-in-charge shall be final and conclusive) shall be borne and paid by the original Contractor and may be deducted from any money due to him by Government under this contract or on any other account whatsoever, or from his Earnest Money, Security Deposit, Enlistment Security or the proceeds of sales thereof, or a sufficient part thereof, as the case may be. In the event of any one or more of the above courses being adopted by the Engineer-in-charge, the Contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of contract. And, in case action is taken under any of provisions aforesaid, the Contractor shall not be entitled to recover or be paid, any sum for any work thereof or actually performed under this contract unless and until the Engineer-in-charge has certified, in writing, the performance of such work and the value payable in respect thereof, and he shall only be entitled to be paid the value so certified. No interest shall be payable to the Contractor on any payment due or awarded by any authority.

(CLAUSE 25) Recovery from Contractors

Whenever any claim against the Contractor for the payment arises under the contract, the Department may be entitled to recover such sum by:

- a) Appropriating, in part or whole of the Performance Guarantee and/or Security Deposit and / or any sums payable under the contract to the contractor.
- b) If the amount recovered in accordance with (a) above is not sufficient, the balance sum may be recovered from any payment due to the contractor under any other contract of the department, including the securities which become due for release.

The department shall, further have an additional right to effect recoveries as arrears of land revenue under the Gujarat Land Revenue Code.

(CLAUSE 26) Work not to be sublet; consequences for unauthorised subletting, bribing and becoming insolvent.

The Contractor shall not sublet the entire work under the contract or any part thereof under any circumstances, except the specialised work which is permitted as described in following clauses.

The contractor shall be permitted to sublet the specialised work of Railway Crossings, by the Box Pushing technique. The contractor to which the subletting is proposed to be done, shall be an experienced contractor, who has successfully carried out similar crossing works in the Western Railway region. The contractor shall propose the name of specialised agency to the Engineer In Charge, along with the details of work completed by the specialised agency, proposed time schedule, equipment to be deployed for the proposed crossing works, arrangement for seeking approval from Railway authorities etc, to the Engineer In Charge for his approval to the agency.

The actual work on site shall start only on approval from the Engineer In Charge. The extent of the work allocated to the specialised agency shall be only for the Box structure to be pushed under the railway track. All the approaches, pipe laying and other auxiliary works related to the crossing shall be responsibility of the Contractor.

The contractor shall be responsible for the safety of work and labour and other laws for the sublet work to be carried out by the specialised agency. All the safety, insurance and legal requirement of this contract shall be applicable mutatis mutandis to the work sublet to the specialised agency.

The payments to such approved specialised agency shall be directly made by the Contractor. However, Competent Authority will have a right to recover from any amount due to the Contractor, any amount payable by the contractor to the engaged specialised agency. A tripartite agreement shall be signed between the Contractor, Specialised Agency and Competent Authority to that effect.

Contract may be rescinded and security deposit forfeited for subletting the work without approval or for bribing a public officer or if contractor becomes insolvent.

(CLAUSE-27) Sums payable by way of compensation to be considered as reasonable compensation without reference to actual loss:

All sums payable by a contractor by way of compensation under any of these conditions shall be considered as a reasonable compensation to be applied to the use of Government without reference to the actual loss or damage sustained and whether any damage has or had not been sustained.

(CLAUSE-28) Change in the constitution of firm to be notified:

In the case of a tender by partners, any change in the constitution of a firm shall be forthwith notified by the Contractor to Engineer-in-charge for his information.

(CLAUSE-29) Works to be under directions of Executive Engineer:

All works to be executed under the contract shall be executed under the direction and subject to the approval in all respects of Engineer-in-charge of the Division for the time being, who shall be entitled to direct at what point or points and in what manner they are to be commenced and from time to time carried on.

(CLAUSE-30) Settlement of Disputes & Arbitration:

A) SETTLEMENTS OF DISPUTES:

- i) If any dispute of any kind whatsoever may arise between the Employer and the Contractor in connection with or arising out of the Contract, including without prejudice to the generality of the foregoing any question regarding its existence validity or termination, or the execution of the works whether during the progress of the work or before or after the termination, abandonment or breach of the contract, the either parties shall have to raise/ refer their disputes/ differences / claims in writing to the other party, within a period of 30 days on occurrence of such events, to resolve any such dispute or difference.
- ii) The contractor shall have to refer their disputes to the concerned Engineer-in-charge. After receipt of the dispute from the contractor under this clause, the Engineer-in-charge of works shall have to submit their report to the Competent Authority within a period of 90 (Ninety) days. The Competent Authority shall offer an opportunity to the contractor to be heard and to furnish evidence in support of their disputes within 30 (Thirty) days after the receipt of the disputes duly compiled by Engineer-in-charge. After hearing the contractor regarding their disputes along with their documentary support and the concern Engineer-in-charge in charge of the work, the Competent Authority shall give decision within a period of 120 (One Hundred Twenty) days or the contractor is dissatisfied with the decision within 120 (One Hundred Twenty) days after the contractor has been heard. If The Competent Authority does not give decision within 120 (One Hundred Twenty) days or the contractor is dissatisfied with the decision of the Competent Authority, the contractor shall within 30 (thirty) days after receiving the instruction or decision, appeal to the Competent Authority. After hearing both the parties the Competent Authority will give reasonable decision within 180 (One Hundred Eighty) days from the date of receipt of appeal by the contractor. The decision of the Competent Authority shall be final and binding on both the parties. If the Competent Authority does not give decision within 180 (One Hundred Eighty) days after the date of

appeal by the contractor, the contractor will have right to refer the dispute to arbitration tribunal as per provision of clause "Arbitration".

B) ARBITRATION:

- i) Subject to Clause (A) mentioned above and in the event of any dispute or difference arising out of or in any way relating to all concerning these contracts or the construction or effect of these contracts shall on the initiative of either party to the contract be referred to "The Arbitration Tribunal Constituted Under the Provision Of Gujarat Public Work Contract Dispute Arbitration Tribunal Act, 1992".
- ii) The arbitration shall be conducted in accordance with the provisions of the "Gujarat Public Work Contract Dispute Arbitration Tribunal Act, 1992" or statutory modifications there on. The Arbitration shall be held at such place and time as the Tribunal may determine.
- iii) The decision of the tribunal shall be final and binding upon both the parties. The expenses of the arbitration shall be paid as may be determined by the Tribunal.
- iv) Performance of the contractor under the contract shall if reasonably be possible, continue during the arbitration proceedings and payments due to the contractors by the owner shall not be withheld, unless they are the subject matter of the arbitration proceedings.
- v) The dispute is deemed to have arisen on the date, on which Competent Authority shall not give his decision as mentioned above in Clause (A) or in the case of intimation of any decision, the contractor intimates in writing that he has finally refused to accept the offer made by the authority.
- vi) Where any dispute arises between the parties to the work contract either party shall irrespective of whether such works contract provides for any arbitration or not, refer, within one year from the date that Competent Authority has not given the decision as per Clause (A) such dispute in writing to the Tribunal for arbitration in such form and accompanied by such documents or other evidence any by such fees, as may be prescribed.
- vii) Legal jurisdiction: All question relating to this Tender shall be governed by the law of India and shall be subject to jurisdiction of court at Gandhinagar, Gujarat.

(CLAUSE-31) Deleted.

(CLAUSE-32) Lump sum in estimates:

When the estimate on which a tender is made includes lump sum in respect of part of the contractor shall be entitled to payment in respect of the items of works involved of the part of the work in question at the same rates as are payable under this contract for such items, or if the part of the work in question is not in the opinion of the Engineer-in-charge capable of measurement, the Engineer-in-charge may, as his discretion, pay the lump sum amount entered in the estimate in the estimate and the certificate in writing or the Engineer-in-

charge shall be final and conclusive against the contractor with regard to any sum or sums payable to him, under the provisions of this clause.

(CLAUSE-33) Action where no specifications:

In the case of work for which there is no such specification, such work shall be carried out in accordance with the Divisional Specification and in the event of there being no Divisional Specifications, then, in such case the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-charge.

(CLAUSE-34) Definition of work:

The expression 'work' or 'works' where used in these conditions shall, unless there be something in the subject or context repugnant to such construction be construed to mean the work, of the works, contracted to be executed under or in virtue of the contract, whether temporary or permanent and whether original, altered, substituted or additional.

(CLAUSE-35) Non refund of quarry fees & Royalties:

The contractor shall pay the royalty to the competent authority/ local body as per rules. The contractor shall furnish quarterly the statement showing quarterly or quarried materials, from whom purchased (with full address of the seller) and copies of bills for purchase to the District Officer of the Mining and Geology Department or authority competent to levy royalty in the area of work. Contractor shall also furnish such additional information as regards royalty payment to the Royalty authority. The royalty charges paid shall be borne by the Contractor and shall not be reimbursed by the Engineer-in-charge (Authority: R & BD Circular No. TNC-2286-UO-39(19)-C, dtd,23/10/1989)

(CLAUSE-36) Compensation under the workmen's compensation Act:

The contractor shall be responsible for and shall pay compensation to his workman payable under the Workmen's Compensation Act. 1923 (VII of 1923) hereinafter called the said Act) for injuries caused to the workmen. If such compensation is paid by Government as principal under sub- section 12(1) of the said Act on behalf of the Contractor it shall be recoverable by Government from the contractor under sub-section 12(2) of the said section. Such compensation shall be recovered in the manner laid down in clause-1 above.

(CLAUSE-36A) Liability of the contractor in case of accidents

The contractor shall be responsible for and shall pay the expenses of providing medical aid to any workmen who may suffer a bodily injury as a result of an accident. If such expenses are incurred by Government, the same shall be recoverable from the contractor for with and be deducted, without prejudice to any other remedy of Government from amount due or that may become due to the contractor.

(CLAUSE-36B) Arrangements for personal safety requirements and first aid

The contractor shall provide all necessary personal safety equipment and first aid apparatus available for the use of the person employed on the site and shall maintain the same in suitable condition for immediate use at any time and shall comply with the following regulations in connection therewith.

- (a) The workers shall be required to use the equipment so provide be the Contractor and Contractor shall take adequate steps to ensure proper use of the equipment by those concerned.
- (b) When work is carried on in approximately to any place where there is a risk of drowning all necessary equipment shall be provided and kept for use and all necessary steps shall be taken for the prompt rescue of any person, in danger.
- (c) Adequate provision shall be made for prompt first aid treatment of all injuries to be sustained during the course of the work.

(CLAUSE-37) Quantities in the tender to be considered approximate and they are subject to variations.

The quantities shown in the tender are approximate and no claim shall be entertained for quantities of work executed being less than those entered in the tender. In the case of increase in the quantities by more than 10% the new rate will be paid to the contractor for the quantities in excess of 10% as per schedule of rates of GWSSB/ R&B. The rates for the increased quantities as aforesaid will be fixed in the manner specified in Clause-14.

(CLAUSE-38) Employment of famine or other labour:

The contractor shall employ any famine, convict or other labour of particular kind or class, if ordered in writing to do so by the Engineer-in-charge.

(CLAUSE -39) Claim for compensation for delay in starting the work

No compensation shall be allowed for any delay caused in the starting of the work on account of delay in making available the full site of land at a time.

(CLAUSE-40) Claim for compensation for delay in the execution of work

No claim for compensation shall be allowed for any delay in execution of the work on account of water standing in borrows pits or compartment. The rates are inclusive of hard or cracked soil, excavation in mud, sub soil water or water standing in borrow-pits and no claim for an extra rate shall be entertained unless otherwise expressly specified.

(CLAUSE -41) Entering upon or commencing any portion or work:

The contractor shall not enter upon or commence any portion or work except with the written authority and instruction of the Engineer-in-charge or of his subordinate in charge of the work. Failing such authority, the contractor shall be no claim to ask measurement of or payment for work.

(CLAUSE-42) Minimum age of person employed:

- (i) No contractor shall employ any person who is under the age of 18 years.

(CLAUSE -43) Method of Payment: Payment shall be made by cheques or RTGS directly into account of the contractor

(CLAUSE -43-A) Set off Clause

Any sum of money due and payable to the contractor (including the security deposit returnable to the contractor) executing and Government work or work of any District Panchayat wholly financed as grant-in-aid under this contract shall be appropriated by any District Panchayat/ Government and shall be set off against any claim of the Government/ District Panchayat of Gujarat State by the District Panchayat of Gujarat State/ Government for the payment of a sum of money arising out or under any other contract made by the contractor with the Government/ District Panchayat of Gujarat State for the work wholly financed as grant-in-aid by Government of Gujarat State. When no such amount for purpose of the recovery from the contractor against any claim of the Government / District Panchayat of Gujarat State is available, such a recovery shall be made from the contractor as arrears of land revenue.

(CLAUSE -44) Check Measurements

- 44.1. The department reserves to itself the right to prescribe a scale of check measurement of work in general or specific scale for specific works or by other special orders.
- 44.2. Checking of measurement by superior officer shall supersede measurements by subordinate officer(s), and the former will become the basis of the payment.
- 44.3. Any over/excess payments detected, as a result of such check measurement or otherwise at any stage up to the date of completion of the defect liability period specified in this contract, shall be recoverable from the Contractor, as per clause 24 above.

(CLAUSE -45) Termination by Engineer in Charge

If the Contractor fails to carry out any obligation under the Contract, the Engineer in Charge may by notice require the Contractor to make good the failure and to remedy it within a specified reasonable time.

- 45.1. The Engineer in Charge shall be entitled to terminate the Contract if the Contractor:
 - a. abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract,
 - b. the Contractor is declared as bankrupt or goes into liquidation other than for approved reconstruction or amalgamation;
 - c. without reasonable excuse fails to comply with the notice to correct a particular defect within a reasonable period of time as specified in Clause-3, Clause 20, Clause 21 and Clause 23.
 - d. the Contractor does not maintain a valid instrument of financial security as prescribed;
 - e. the Contractor has delayed the completion of the Works by such duration for which the maximum amount of liquidated damages is recoverable;
 - f. If the Contractor fails to deploy machinery and equipment or personnel or set up a field laboratory as specified in the contract document.

g. If the contractor, in the judgment of the Engineer in charge has engaged in corrupt or fraudulent practices in competing for or in executing the contract as specified in clause 26.

h. Any other fundamental breaches as specified in the Contract.

45.2. In any of these events or circumstances, the Engineer in Charge may, upon giving 14 days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site. However, in the case of sub-paragraph (c) or (g), the Engineer in Charge may terminate the Contract immediately.

45.3. Notwithstanding the above, the Engineer-in-Charge may terminate the Contract for convenience by giving notice to the Contractor.

(CLAUSE -46) Payment upon Termination

If the contract is terminated under clause 45.2, the Engineer shall issue a certificate for value of the work done less liquidated damages, if any, less recoverable advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed as indicated in the Contract. The amount so arrived at shall be determined by the Engineer-in-Charge and shall be final and binding on both the parties.

46.1. Payment on termination under clause 45.3 above -

If the Contract is terminated under clause 44.3 above, the Engineer shall issue a certificate for the value of the work done, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract and less taxes due to be deducted at source as per applicable law.

46.2. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be recovered as per clause 25 above.

(CLAUSE-47) Rates are exclusive of GST but inclusive of all other taxes

The rates to be quoted by the contractor must be exclusive of GST but inclusive of all other taxes and applicable Cess, levies on such taxes. GST shall be paid extra on the admissible payment as per the approved tender rates and condition of price variation; GST shall be paid as per prevailing rates at the time of payment

(CLAUSE-47A) Income tax: -

Deduction will be made at source on the contractor's bill towards Income tax by the employers as per prevailing rules of the Income tax authority.

(CLAUSE -48) Employment through Employment Exchange and local labour

The contractor should as far as possible, obtain his requirement of labourers skilled and unskilled, from the nearest Employment Exchange so as to utilize the local employment potential. If there are no local Employment Exchange or such Exchanges are not able to

provide the required labour locally, suitable labourers should be utilized to the maximum extent possible.

(CLAUSE -49) Fair Wages:

If a Contractor fails to pay within '7' (Seven) days to the labourer(s)/ worker(s) the minimum wages prescribed by the Government under the Minimum Wages Act-1948 as in force from time to time, the Engineer-in-charge shall be at liberty to deduct the amount payable to the labourers/ workers from his (Contractor's) bills or deposit(s) payable by the contractor after making due inquiries and establishing the claim(s) of the labourer(s)/ worker(s).

The contractor shall not be entitled to any payment of compensation on account of any loss that the contractor may have to incur on amount of the action as aforesaid. Before the action as aforesaid, is enforced, a notice in writing to the contractor shall be issued by the Engineer-in-charge to pay the wages as per

Minimum Wages Act in force at the relevant time. If contractor does not act as afore said within seven days, then the action contemplated as above shall be taken against him.

(CLAUSE -50) Deleted

(CLAUSE -51) List of Machinery:

The contractors shall also give a list of machineries in his possession and which they propose to use in the work.

(CLAUSE -52) Deleted

(CLAUSE -53) Local labour on normal rates:

The contractor shall have to engage local labour and person seeking employment where available on current minimum wage rate of Gujarat Government and revision if any.

(CLAUSE -54) Land on Hire and rental charges

Rent will be recovered from the contractor for the land (if available) given to them for stacking materials as well as for construction of temporary hutments etc.

Land Measuring Charges

As per latest prevailing Government rates applicable from time to time.

(CLAUSE -55) Vaccination to labourers

The contractor shall employ only such labour who shall produce a valid certificate of having been vaccinated against small pox within a period of last three years.

(CLAUSE -56) Camp Facilities to Workers.

1. Huts:

The contractor shall build sufficient number of huts on a suitable of land for the use of the labourers according to the following specifications:

- (1) Huts of bamboos and grass may be constructed.

- (2) A good site shall be selected. High ground removed from jungle but well provided with trees shall be chosen wherever it is available. The neighbourhood of rank jungle, grass or weeds should particularly be avoided. Camps should not be established close to large cuttings of earth-work.
- (3) The lines of huts shall have open spaces of at least 10 m. between rows. When a good natural site cannot be procured, particular attention should be given to the Water supply works.
- (4) There should be no over-crowding. Floor spaces at the rate of 2.8 Sq. m. per head shall be provided. Care should be taken to see that the huts are kept clean and in good order.
- (5) The contractor must find out his own land. If he wants Government land, he should apply for it and pay assessment for it.

2. Drinking Water:

The contractor shall as far as possible, provide an adequate supply of chlorinated pure potable drinking water for the use of labourers.

3. The contractor shall construct semi-permanent latrines for the use of labourers on the following scale, namely:

- (a) Where female is employed, there shall be at least one latrine for every 25 females.
- (b) Where males are employed, there shall be at least one latrine for every 25 males.

Provided that where the number of males or female exceed 100, it shall be sufficient if there is one latrine for every 25 males or females, as the case may be upto the first 100 and one for every 50 thereafter.

4. Privacy in latrines: Every latrine shall be under cover and so partitioned off as to secure privacy and shall have a proper door and fastenings.

5. Notice to be displayed outside latrines and urinals:

- (1) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal a notice in the language understood by the majority of the workers for Men Only or For Women Only: as the case may be.
- (2) The notice shall also bear the figures of a man or of a woman, as the case may be.

6. Urinals: There shall be at least one urinal for male/ female workers upto 50 employed at a time. Provided that where the number of male or female workmen, as the case may be, exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females up to first 500 and one for every 100 males or females or part thereof.

7. Latrines and Urinals to be accessible:

- (1) The latrines and urinals shall be conveniently situated and accessible to workers at all times at the establishment.
- (2)(i) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
- (2)(ii) Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the Public Health Authorities.

8. Water for latrines and urinals:

Water shall be provided by means of pipes or tanks or their wise, so also be conveniently accessible in or near the latrines and urinals.

9. Bathing and washing places:

- (1) The contractor shall construct sufficient number of bathing places; every unit of 20 persons being provided with a separate bathing place.
- (2) Washing places should also be provided for the purpose of washing clothes. Every unit of 30 persons shall have at least one washing place.
- (3) Such bathing and washing places should be suitably screened and separate places provided for male and female workers.
- (4) Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

10. Medical Facilities:

The contractor shall engage a medical officer with a travelling dispensary for a camp having 500 or more persons if there is no Government or other private dispensary situated within 6 km from the camp.

11. Conservancy and cleanliness:

The contractor shall provide the necessary staff for effecting the satisfactory conservancy and cleanliness of the camp to the satisfaction of the Engineer-in-charge. At least one sweeper per 200 persons should be engaged. Conservancy staff should dump refuse in compost pit, away from the labour camp.

12. Health Provisions:

The District Health Officer of the District or the Deputy Director of Health services shall be consulted before opening a labour camp and his instructions on matters such as water supply, sanitary convenience, the camp-site accommodation and food supply shall be followed by the contractor.

13. Precaution against epidemic:

- (a) The authorities in charge of the colonies should get the labourers inoculated against cholera and plague and vaccinated against smallpox at the time of recruitment, if they are not inoculated or vaccinated within 6 months or 3 years respectively prior to the date of recruitment.
- (b) When, in any labour camp there is an epidemic disease or is threatened with such an outbreak, the authorized in charge of the labour camps should ensure

that all the inmates of the labour colonies are inoculated or vaccinated as the case may be depending on the diseases, within 72 hours after the outbreak.

- (c) The authorities in charge of the labour colony should arrange to communicate by wire regarding the outbreak of the epidemic disease on the very day of the outbreak, to the Mamlatdar of the Taluka, the District Health officer or to the Deputy Director of the above officers in the prescribed form regarding the progress of the epidemic disease.
- (d) When the authorities in charge of the labour colony suspect or have reason to believe that any inmate of the labour colony is suffering from the infectious or contagious disease, they shall forthwith arrange for the segregation of such persons to isolated huts to be specifically provided for the purpose and also for their treatment.
- (e) As regional malaria epidemic outbreaks are likely to occur in such project areas, the authorities in charge of the labour colonies should report promptly the occurrence of unusual incidence of cases of malaria and also inform the District Health Officers of the District Deputy Director of Public Health (Malaria) and the Director of Public Health and also arrange to institute all necessary anti-malarial measures as may be advised by the officials of the Public Health Department.
- (f) The authorities in charge of the colonies should also arrange to carry out any other measures that may be recommended by the officials of the Public Health Department necessary to prevent or control the spread of disease.

14. Rest Rooms

- (1) In every place where in contract labour is required to halt at night in connection with the contract works and in which employment of contract labour is likely to continue for three months or more, the contractor shall provide and maintain rest rooms or other suitable alternative accommodation within fifteen days of the employment of contract labour.
- (2) If the amenity referred to in sub-rule is not provided by the contractor within the period prescribed the employer shall provide the same within a period of fifteen days of the expiry of the period laid down in the sub-rule (1).
- (3) Separate rooms shall be provided for women employees.
- (4) Effective and suitable provision shall be made in every room for securing and maintaining adequate ventilation for the circulation of fresh air and there shall also be provided and maintained sufficient and suitable natural or artificial lighting.
- (5) The rest room or other suitable alternative accommodation shall be of such dimensions as to provide at least a floor area of 1 sq. mt. for each person making use of rest rooms.

- (6) The rest rooms or other suitable alternative accommodation shall be so constructed as to afford adequate protection against heat, wind, rain and shall have smooth, hard and impervious surface.
- (7) The rest rooms or other suitable alternative accommodation shall be a convenient distance from the establishment and shall have adequate supply of wholesome drinking water.

15. Canteen Facilities:

- (1) In every establishment of contract work and wherein work regarding the employment of contract labour is likely to continue for six months and wherein contract labour numbering one hundred or more are ordinarily employed, the adequate canteen facilities shall be provided by the contractor for the use of such contract labour within sixty days of the commencement of the employment of contract labour.
- (2) If the contractor fails to provide the canteen facilities within the time laid down the same shall be provided by the principal employer within sixty days of the time allowed to the contractor.
- (3) The Canteen shall be maintained by the contractor or principal employees as the case may be in an efficient manner.

16. Accommodation in canteen:

- (1) The canteen shall consist of at least dining hall, kitchen, storeroom, pantry and washing place separately for workers and for utensils.
 - (2)(i) The canteen shall be sufficient lighted at all times where any person has access to it.
 - (ii) The floor shall be made of smooth and impervious materials and inside walls shall be lime-washed or colour-washed at least once in each year, provided that the inside walls of the kitchen shall be lime-washed every four months/
 - (3)(i) The premises of the canteen shall be maintained on clean and sanitary condition.
 - (ii) Waste water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as cause nuisance.
- (ii) Suitable arrangements shall be made for the collection and disposal of garbage.

17. Accommodation in dining hall:

- (1) The dining hall shall accommodate at a time, at least 30% of the contract labour working at a time.
- (2) The floor area of the dining hall excluding the area occupied per dinner to be accommodated shall as prescribed in sub-rule (1).
- (3) (i) A portion of the dining hall and service counter shall be partitioned and reserved for women workers, in proportion to their numbers (ii) Washing places for women shall be separate and screened to secure privacy.
- (4) Sufficient table, stools, chairs or benches shall be available of the number of dinners to be accommodated as prescribed in sub-rule-1.

18. Equipment in canteen:

- (1)(i) There shall be provided and maintained sufficient utensils, crockery, cutlery, furniture and any other equipment necessary for the efficient running of the canteen.
- (ii) The furniture utensils and other equipment shall be maintained in a clean and hygienic conditions.
- (2)(i) Suitable clean clothes for the employees serving in the canteen shall also be provided and maintained.
- (ii) A service counter, if provided, shall have a top of smooth and impervious materials.
- (i) Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipment.

19. Food stuff to be served:

The food stuff and other items to be served in the canteen shall be in conformity with the normal food habits of the contract labour.

20. Prices to be displayed:

The charges of food stuffs, beverages and any other item served in the canteen shall be based on 'no profit, no loss' and shall be conspicuously displayed in the canteen.

21. Canteen to be run on 'No profit no loss' basis:

In deriving the prices of food stuffs and other articles served in the canteen, the following items shall not be taken into consideration as expenditure namely.

- (a) The rent for the land and building.
- (b) The depreciation and maintenance charges for the building and equipment provided for in the canteen.
- (c) The cost of purchase, repairs, and replacement of equipment including furniture, crockery, cutlery and utensils.
- (d) The water charges and other charges incurred for lighting and ventilation.
- (e) The interest on the amount spent on the provisions and maintenance of furniture and equipment provided for in the canteen.

The local officers should check up whether, facilities as offered and which are admissible under the existing rules and orders are made available to the workers and enforce upon the contractors the necessary of adhering the instructions for promotion of welfare of the workers according to the terms of the contract.

22. Books of accounts and registers of the canteen:

The books of accounts and registers and other documents used in connection with the running of the canteen shall be produced on demand to an inspector.

23. Audit of the Account of the Canteen:

The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors; provided that the Labour Commissioner may approve of any other person to audit the accounts, if he is satisfied that it is not feasible to appoint a registered accountant and auditor in view of the size or the location of the canteen.

(CLAUSE -57) Gum boots, hand gloves, masks etc, to labourers

Contractor shall have to arrange for the supply of gumboot, Hand gloves, and mask etc. invariably the labourers / workers engaged by the contractor on asphalt work.

(CLAUSE -58) No distinction between harijans and other workers

The contractor shall not show any distinction between Harijan and other class of labourers/ workers employed in carry out the Government work.

(CLAUSE-59) Price Variation Clause:

~~A) PRICE VARIATION FOR DUCTILE IRON PIPES:- (Not Applicable)~~

~~The price variation shall be based on the latest Monthly wholesale price index declared by office of Economic Advisor to GOI, Ministry of Commerce & Industries. Price Index is available on website: <http://eaindustry.nic.in> /Wholesale price index of Pig Iron shall be considered as “Base Index”~~

~~Price variation in the rates of DI pipe shall be calculated on account of variation in monthly wholesale price index (WPI) of Pig Iron with base index. In event of any variation, prices will be calculated as per formula given below:~~

$$P = R_1 + 0.65 [\{ (I_1 - I_0) / I_0 \} \times R_0]$$

Where:

P	=	Effective New Price Considering Variation in Rs. / Mtr.																														
R₀	=	Value of R ₀ for DI K-7 pipe are as below: <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Size (In mm)</th> <th>Rupees/ Mtr.</th> </tr> </thead> <tbody> <tr><td>1</td><td>500</td><td>6505</td></tr> <tr><td>2</td><td>450</td><td>5418</td></tr> <tr><td>3</td><td>400</td><td>4583</td></tr> <tr><td>4</td><td>350</td><td>3858</td></tr> <tr><td>5</td><td>300</td><td>3110</td></tr> <tr><td>6</td><td>250</td><td>2466</td></tr> <tr><td>7</td><td>200</td><td>1880</td></tr> <tr><td>8</td><td>150</td><td>1477</td></tr> <tr><td>9</td><td>100</td><td>1003</td></tr> </tbody> </table>	Sl. No.	Size (In mm)	Rupees/ Mtr.	1	500	6505	2	450	5418	3	400	4583	4	350	3858	5	300	3110	6	250	2466	7	200	1880	8	150	1477	9	100	1003
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I₁	=	Current Monthly Wholesale Price Index of Pig Iron as per price variation effect on the date which is offered for pipe inspection																														
I₀	=	Monthly Wholesale Price Index of PIG Iron given as Base Index as on last date of online bid submission (i.e. last date of online submission as per the n-procure website log), as published by office of Economic Advisor, on website http://waindustry.nic.in .																														
R₁	=	Approved rate of Consolidated Item of Contractor																														

(Note: # to be changed in accordance to Prevailing SOR while approving DTPs)

Condition for variation in prices of DUCTILE IRON PIPES

1. No ceiling for escalation for difference in the cost of DI Pipe will be applicable.
2. This clause shall be operative from the date of Signing of Agreement and up to the expiry of original time limit of Tender.
3. The contractor shall have to give undertaking at the time of claiming their bills for price variation as under:

"We hereby certify that the Pig Iron of the DI Pipes for which the bill preferred is not purchased through any Government or Semi Government undertaking at the concession rate".

4. ~~Price Variation (payable/Recoverable) on Extra and Excess Items shall be allowed upto increase of 10% (due to Excess+Extra) of overall total length of respective type of pipelines (PVC or DI or MS or HDPE) mentioned in BOQ of the tender.~~
5. ~~If the time limit is extended without penalty, then in such case price variation (positive/negative) on the pipes shall be applicable restricted to the Bil of Quantities mentioned in tenders plus Excess and Extra Subject to Clause 4 above. For that part of the extended time for completion, wherein delay is attributable to contractor for the quantities procured during such time period, no positive price variation (Extra payable to contractor) shall be admissible but negative price variation (Recovery against quoted price) shall be admissible. For this purpose, days on which penalty is imposed shall be counted backwards from the actual date of completion.~~
6. ~~Price Variation shall be calculated by concern Division office and shall be verified by paying Authority prior to making payment.~~
7. ~~This formula shall be used only for DI Pipeline for calculating Price Variation.~~
8. ~~This clause will be applied to the work irrespective of the cost of the work.~~
9. ~~The final amount of variation payable / recoverable shall be calculated only on basis of final publication of WPI on Website: <http://eaindustry.nic.in>~~
10. ~~In case of any discrepancy/dispute regarding application of price variation clause, decision of Concerned Chief Engineer shall be final and binding to the Contractor.~~

Guidelines:

- a. ~~The base index of pig iron as the value of I_0 shall be taken as on last date of online bid submission (i.e., last date of online submission as per the n-procure website log)~~
- b. ~~The value of R_0 shall be taken as per Prevailing GWSSB SOR which has been referred for preparing the estimated cost (in DTPs).~~
- c. ~~The various sizes of DI pipe which has been referred for preparing the estimated cost (in DTPs) (as per their grade) shall be mentioned in the table of R_0 .~~

~~B) PRICE VARIATION FOR UPVC PIPES:~~

~~as per attached Circular Of GWSSB dated 16/03/2023~~

~~C) PRICE VARIATION FOR HDPE PIPES:~~

~~as per attached Circular Of GWSSB dated 16/03/2023~~

(CLAUSE -60) Fencing and lighting:

- (a) The contractor shall, unless otherwise specified, be responsible for the proper fencing, lighting grading and taking of the necessary safety measures for all works comprised in the contract and for the proper provision of temporary road, ay, foot-

way, guards, fences, caution notice etc. as far as the same may be rendered necessary by reasons of the work for the accommodation of workmen, foot passengers or other traffic and of owners and occupiers of adjacent property and the public and shall remain responsible for any accidents that may occur on account of his failure to take proper & timely precautions.

- (b) All the arrangements made for fencing and lighting shall be maintained by the contractor through the currency of the contract till the physical taking over of the work by department.

(CLAUSE -61) Liability of Accidents to Persons:

Responsibilities and liabilities of the contractor under workmen's compensation act are give in clause-37 in addition following shall also apply: (a) On the occurrence of an accident, which result in death of workmen employed by the contractor or which is so serious as is likely to result in death of any such workmen, the contractor, shall within 24 hours of happening of such accident(s) intimate, in writing to the Engineer-in-charge the fact of such accident(s). The contractor shall indemnify Government against all loss or damage sustained by the Government resulting directly or indirectly from his failure to give intimation in the manner aforesaid including the penalties or fines, if any, payable by the Government as a consequence of Government's failure to give notice under the workmen's compensation act or otherwise to conform to the provisions of the said act in regard to such accident(s) (b) in the case of an accident, in respect of which compensation may become payable under workmen's compensation Act, whether by the contractor or by the Government as principal Employer, it shall be lawful for the Engineer-in-charge to retain out of money due and payable to the contractor, such sum or sum of money as may, in the opinion of the Engineer-in-charge, be sufficient to meet such a liability. The opinion of the Engineer-in-charge shall be final in regard to all matters arising under this clause.

(CLAUSE -62) Access to site and work on site:

The Engineer may, if he considers fit from the time, enter upon any land(s) which may be in possession of the contractor his contract for the purpose of executing any work not included in this contract and may execute such works not included in this contract by agents or by other contractors, at his opinion and the contractor shall, in accordance with the requirements of the Engineer-in-charge, afford all reasonable facilities for execution of the work including occupation of lands by structure or otherwise for any other contractor employed by the Government and his workmen or for the workmen of the Government who may be employed in the execution on or near the site of the work not included in the contract or of any contract in connection with or ancillary to the work and in default, the contractor shall be liable to the Government for any delay or expense incurred by reason of such default. Provided always that if damage arising, make a statement of the same of the Engineer-in-charge who shall from time to time, assess the value in his judgment of such

damage and the Government shall from time to time pay to the contractor the amount (if any) accepted as justified by the Engineer-in-charge.

(CLAUSE -63) Reports Regarding Labour:

The contractor shall submit the following reports to the Engineer-in-charge:

- (i) A daily report in the suitable format of the strength of labour, both skilled and unskilled employed by him on the work(s). The contractor shall increase or decrease the strength both skilled and unskilled. If directed by the Engineer-in-charge. The submission of such reports shall not, however, relieve the contractor of his responsibilities and duties regarding progress or any other obligation under the contract.
- (ii) A classified weekly return in the suitable form of the number of person employed on the works during the preceding week.
- (iii) A weekly return in the suitable form showing the health of the contractor's camp, the number of person's ill of in capacities and the nature of their illness.
- (iv) A report of any accident, which may have occurred, to be sent within 24 hours of the occurrence.
- (v) Such other report as may be prescribed.

(CLAUSE -64) Treasure Trove:

In the event of discovery by the contractor or his employees, during the progress of work of any gold, silver, oil or other minerals of any description and precious stones, treasures, coins, antiquates, relic, fossils or other articles or value of interest whether geological, archaeological or any other such treasure & other things shall be deemed to be the absolute property of the Government and the contractor shall duly preserve the same to the satisfaction of the Engineer-in-charge from time to time, and relive the same to such persons as the Engineer-in-charge may appoint.

The contract shall take all reasonable precautions to prevent his workmen or any other person from removing or damaging any such articles or things, immediately after the discovery thereof the before removal acquaint the Engineer-in-charge with such discovery and carry out his orders for the disposal of the same.

(CLAUSE -65) Indemnity:

The contractor shall indemnify the Government against all actions, suits, claims and demands through or made against the department in respect of work of this contractor against any loss damage to Department in consequence of any action or suit being brought against the contractor for anything done or omitted to be done in execution of the work of this contract.

(CLAUSE -66) Insurance of Labourers:

The contractor shall be responsible to arrange for insurance of all labourers, skilled and unskilled workers, supervisors etc. employed by him as per labour regulation of the state.

(CLAUSE -67) Setting out:

The contractor shall be responsible for the true and proper setting out of the works and the correctness of positions, levels, dimensions and alignments of all parts of the work and for the provisions of all necessary instruments, appliance and labour in connection therewith. If, at any time, during the progress of the work, any errors, appear or arise in the position, levels, dimensions or alignments or any part of the work, the contractor, on being required to rectify such errors by the Engineer-in-charge shall at his own expense do so to the satisfaction of the Engineer-in-charge. If however, such error is based on incorrect data supplied in writing by the Engineer-in-charge, the expenses of rectifying the same shall be borne by the Department. The checking of and setting out of any line or level by the Engineer-in-charge or his representative shall not in any way, relieve the contractor of his responsibilities for the correctness of the error. The contractor shall carefully protect and observe all bench-marks, site-nails, page and other things used in setting out of the work(s).

(CLAUSE -68) Cement Register:

A register in the prescribed form showing day-to-day receipt, consumption and balance of cement on site of work will be maintained by the Department, which shall invariably be signed daily by the contractor or his authorized representative in token of its correctness.

(CLAUSE -69) Materials and Works Test Register:

A register in the prescribed form showing day to day receipt, consumption and balance of cement on site of work by the Department, which shall invariably be signed by the Contractor of his authorized representative in taken of its correctness.

(CLAUSE -70) Progress Schedule:

- (a) The contractor shall furnish within one month (unless extended by the Engineer-in-charge) of the order to start the work, the progress schedule in quadruplicate indicating the date of starting, the monthly expected to be achieved and the anticipated completion date of each major item of work to be done by him, also indicating dates of procurement and setting up the materials, plants and machinery. the schedule should include a statement of proposed general and detailed arrangements for carrying out works, and of item, order and manner in which it is proposed general and detailed arrangements for carrying out works, and of item, order and manner in which it is proposed general and derailed arrangements for carrying out works, and of item, order and manner in which it is proposed that these shall be executed. The schedule should be framed keeping requirement of the clause-2 of tender form in view and be such as in practice to the achievement towards completion of the work in the time limit and of the particular items on the dates specified in the contract and shall have to approval of the Engineer-in-charge. Further, the dates for the progress, as in this schedule shall be adhered to.
- (a) In case it is found necessary, at any stage to alter the schedule the contractor shall submit in good, time a revise schedule incorporating necessary modification proposed and get the same approved from the Engineer-in-charge. No revised schedule shall be operative without such acceptance in writing. The Engineer-in-charge is further

empowered to ask for more detailed schedule or schedules, any week by week for any item or items and the contractor shall supply the same as and when asked for.

- (b) The Engineer-in-charge shall have at all times the right without in any way vitiating this contract forming grounds for any claim, to alter the order of the work of any part thereof and the contractor shall after receiving such direction, proceed in the order directed. The contractor shall also revise the progress, schedules accordingly and submit four copies of the revised schedule to the Engineer-in-charge within seven days of the said Engineer's direction to alter the order of works.
- (c) The contractor shall furnish sufficient plant, equipment and labour and shall work such hours and shifts as may be necessary to maintain the progress of the work as per approved progress-schedule. The working and shift hours shall comply with all the Government regulations in force and shall be such, as may be approved by the Engineer-in-charge and the same not be varied without the prior approval of Engineer-in-charge.
- (d) The contractor shall from time to time, as may be required by the Engineer-in-charge, furnish the Engineer-in-charge with a statement in writing of the arrangements he proposes to adopt for the execution of this contract and the Engineer-in-charge may, if he considers necessary at any time advise alternation in the same, which the contractor shall adopt on notice thereof.
- (e) The progress schedule(s) shall be in the form of progress chart, forms, statements, and/ or reports as may be approved by the Engineer-in-charge.
The contractor shall submit four copies showing the progress of the work in the form of a chart etc., at periodically intervals as may be specified by Engineer-in-charge.
- (f) The Approval of the progress schedules by the Engineer-in-charge shall not relieve the contractor of schedule require by the Engineer-in-charge shall not entitle the contractor to any extra payment.

(CLAUSE -71)	Secured Advance	:	Deleted
(CLAUSE -72)	Advance Payment	:	Deleted
(CLAUSE -73)	Advance against Machineries	:	Deleted
(CLAUSE -74)	Mobilization Advance	:	Deleted
(CLAUSE -75)	License for contract labour		

Before, starting the work, the contractor will have to obtain the license from the District Assistant Labour Commissioner under the Contract Labour (Regulation and Abolition) Act, 1970 and contract Labour (regulation and Abolition) Gujarat Rules 1972 after paying necessary fees and deposit on the basis of the number of labourers to be employed on the work and will have to supply two true copies of the said licence to the Deputy Executive Engineer before the work is started.

(CLAUSE -76): Recovery of Testing Charges and handing over empty cement bags

All testing charges such as steel, cement, cubes, destructive tests of pipe weld joints etc shall be paid by the contractor. All inspection charges payable to the third-party inspection agency shall be paid by BMC.

The contractor shall have to carry out testing of material at his own cost. Testing of material including the mix design shall be carried out at laboratories of GERI, Engineering Colleges, Polytechnics, Engineers India Ltd., DGTD and other NABL and R & B approved laboratories_or Water Resources Department or Industries Department approved laboratory. However, 10% of total testing of all material shall be carried out at any of GERI laboratory. The test results of these Laboratories will be binding to the Contractor about suitability of use of materials.

However, in respect of works involving use of mass concrete, the contractor will set up the site testing Laboratory and will provide testing instruments etc. as under:

Laboratory

The contractor will construct permanent structure of minimum 25 square meter area duly connected with water and electric supply to house site testing Laboratory including a curing pond as per requirement.

Instruments:

The contractor will provide and install the instruments as I.S. Standard to carry out the test prescribed therein.

1. Hydraulic Compression Testing Machine, hand operated 100 tonnes capacity. Conform to the requirements of IS: 516-1959, IS :14858-2000 calibrated to an accuracy of $\pm 1\%$ indicated load within range.
2. Test sieve set IS: 460-1972, 30 cm dia frame of size 40mm, 20mm, 12.5mm and 10 mm and 20 cm dia frame of size 4.75mm, 3.35 mm, 2.36mm, 1.18mm, 600-micron, 300-micron, 150-micron, 90 micron and 75 micron.
3. Slump apparatus conforming to IS: 7320.
4. Cube moulds 150x150x150 mm size conforming to IS: 516-1959, IS : 10086-1982
5. Thickness and length gauge as per IS: 2386 (Part-I)- 1963.
6. Electronic Balances of 5 Kg, 50 kg capacity.
7. Le-chatelier apparatus as per IS : 4031.
8. Vicat apparatus as per IS : 4031

Frequency of tests will be as indicated in I.S. standards and as referred in R. & B. D. G.R. No. SSR-1099-IB/91(9)-c, dated 26-7-1999 or latest circular of R & B / GWSSB

(Clause: 77): Recover of Sales Tax

One percent of estimated cost put to tender for this work after deducting the cost of materials as per Schedule 'A' valued at basic rate in the sanctioned estimate shall be deducted from the running account bills of the contractor for testing the quality of materials and workmanship, no additional testing charges in addition to the above shall be recovered from the contractor (Applicable to R & B Works only) (G.R.No. R & B TNC-1085-4-C, Dated 20-12-91)

(Clause: 78): Building and other construction works welfare cess (Labour cess)

As per Building and other construction works welfare cess act and the provision under Rule No.5 of the rules of 1998 of Gujarat State, the 1% cess shall be recovered from the running account bill of the contractor.

(Clause 79):

“કોન્ટ્રાક્ટરના માર્ગદર્શન માટેની સુચના૧૯ મુજબ ઇજારદારશ્રી નિયત સ્થળે બોર્ડ લગાવીને ફોટોગ્રાફ સહિતનો અહેવાલ આ કામ સંબંધિત ઇજનેરશ્રી ની જાણ હેઠળ વર્કઓર્ડર ઇસ્યુ કર્યાની તારીખથી એક મહિનામાં કરશે .જો તેમ કરવામાં વિલંબ થાય તો વિલંબિત સમયમાં ચુકવવાના રનીંગ બીલ માંથી ટેન્ડરની રકમના ૦.૨૫ %થી ૧% જેટલી રકમ રોકવામાં આવશે. (મા.મ.વિ.ના તા. ૨૬-૪-૭૮ ના પરિપત્ર તથા તા.૨૭-૧૧-૯૦,૧૮-૧૧-૯૧,૨૨-૭-૯૮તથાતા:૫-૩-૨૦૧૧ના ઠરાવ ક્રમાંક ઇએલસી-૧૦૮૦-૨૪-સ,આધારીત)

SPECIAL CONDITIONS OF CONTRACT

(A) ROYALTIES

The Contractor shall be liable to pay the royalty of the quarried materials /minerals used in the construction of works at the rates specified in the Narmada Water Resources, Water Supply & Kalpsar Dept. Resolution No. GEN-2010-595-(6) - M.I cell (k-1) Dtd.29/4/11 (Gujarati version, copy enclosed) and shall be recovered from the running bills of the work from time to time and remaining amount if any shall be recovered from the final bill before releasing the security deposit of the work.

The contractor shall furnish the statement showing the quantity of quarried materials / minerals from whom purchased (with full address of the seller) and copies of the bills for purchase to the Executive Engineer of the in charge of the work. The contractor shall also furnish such additional information as regards royalty payments to the competent authority.

(B) GENERAL DESIGN OBLIGATIONS:

The contractor shall be deemed to have scrutinized, the employer's requirements (including design criteria and calculations, if any). The contractor shall be responsible for the design of the works and for the accuracy of such employer's requirements (including design criteria and calculation). The employer shall not be responsible for any error, inaccuracy or omission of any kind in the employer's requirements as originally included in the contract and shall not be deemed to have given any representation of accuracy or completeness of the any data or information. Any data or information received by the contractor, from the employer or otherwise, shall not relieve the contractor from his responsibility for the design and execution of the works.

Technical Standards and Regulations: The design, the contractor's documents, the execution and the completed works shall comply with the Country's technical standards wherever available or with international standards, building construction and environmental Laws, Laws applicable to the product being produced from the works and other standards specified in the employer's requirements applicable to the works or defined by the applicable Laws.

(C) Additional security to be withheld for unbalance rates:

Payments for the items where contractor has quoted rate higher than 10% over estimated rates in the item:

If the contractor has quoted unbalanced rates for items i.e., more than 10 (ten) percent of the overall percentage of accepted tender. The payment of such items in the running bills will be made at estimated rate of that item plus or minus overall variation percentage of the accepted tender plus five percent of the estimated rate of that item, the balance amount as per accepted tender rate will be withheld from running bills and will be released as per R&B Department Circular no PARCH/102008/(61)C dated 03-05-2013. No interest will be payable for such

withheld amount (R&B Department Circular no. PARCH/102008/ (61) dated 27-11-2008).

(D) Implementation of Gujarat State Purchase Policy - 2016:

All the Equipment/Instrument/Pipes etc. should be manufactured in India, as per "MAKE IN INDIA" policy of Government of India and Gujarat state Purchase Policy-2016 Resolution No. SPO/102015/691093/Ch dated 03-06-2016 (issued by Government of Gujarat, Industries and Mines department). (Gujarati version, Copy enclosed as Annexure-6)

(E) Total Value of Change in scope of work shall not exceed Twenty-Five Percent (25%) of approved Contract amount. The increase beyond this limit may need administrative approval by tendering authority.

(F) Safety requirements: Contractor should follow IS Safety Manuals, Codes and Labour Regulations for safe working at site.

(G) Construction of the Work:

The Contractor shall construct the works as specified, and in conformity with the Specifications and Standards set forth in the contract. The Contractor shall be responsible for the correct positioning of all parts of work, and shall rectify any error in the positions, levels, dimensions, or alignment of work. and the Contractor agrees and undertakes that the construction shall be completed on or before the scheduled Completion Date, including any extension thereof.

The total price of the works shall be initially the price as indicated in the offer acceptance letter unless the same is modified or changed by Gujarat Urban Development Company in view of any modification or change brought about after final approval of drawing, and actual execution of the work. It is clearly understood that the payment will be based on actual work done quantities

(H) Construction Programme:

The contractor shall submit a detailed programme in MS projects software within 15 days after receiving the letter of acceptance. Whenever necessary, contractor shall also submit a revised programme indicating how he plans to catch up with the slippages. Each programme shall include the order in which he intends to carry out the work including the anticipated timing of procurement, deployment of resources and quantities involved. The programme will be projected as Bar Chart / CPM - Network presentation. Contractor shall promptly give notice of probable future events or circumstance which may adversely affect the work. The programme should include deployment of financial resources commensurate with the work planned each month. If at any time actual progress is too slow to achieve target programme and/or progress has fallen behind the current programme then the engineer may instruct the contractor to submit revised programme with plan to mitigate time.

The Contractor shall establish a quality control mechanism to ensure compliance with the provisions of this Agreement (the "Quality Assurance Plan" or "QAP").

QUALITY ASSURANCE, MONITORING AND SUPERVISION-

(I) **Quality of Materials and workmanship:**

The Contractor shall ensure that the Construction, Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Good Industry Practice.

Quality control system

The Contractor shall establish a quality control mechanism to ensure compliance with the provisions of this Agreement (the "Quality Assurance Plan" or "QAP").

The Contractor shall, within 30 (thirty) days of the commencement Date, submit to the EIC its Quality Assurance Plan which shall include the following:

- a) organization, duties and responsibilities, procedures, inspections, and documentation.
- b) quality control mechanism including sampling and testing of Materials, test frequencies, standards, acceptance Criteria, testing facilities, reporting, recording and interpretation of test results, approvals, check list for site activities, and proforma for testing and calibration in accordance with Good Industry Practice; and
- c) Internal quality audit system.

The BMC shall convey its comments to the Contractor, if any, required, and the Contractor shall incorporate those in the QAP to the extent required for conforming with the provisions in the contract.

The Contractor shall procure all documents, apparatus and instruments, fuel, consumables, water, electricity, labour, Materials, samples, and qualified personnel as are necessary for examining and testing the Project Assets and workmanship in accordance with the Quality Assurance Plan.

The cost of testing of Construction, Materials and workmanship shall be borne by the Contractor

(J) **Methodology:**

The Contractor shall, at least 15 (fifteen) days prior to the commencement of the construction, submit to the BMC for review the methodology proposed to be adopted for executing work, giving details of equipment to be deployed, traffic management and measures for ensuring safety. The BMC shall review and convey its comments to the Contractor, if any.

(K) **Inspection and technical audit by the BMC:**

The BMC or any representative authorized by the BMC in this behalf may inspect and review the progress and quality of the construction of Work and issue appropriate directions to the BMC and the Contractor for taking remedial action in the event work are not in accordance with the provisions of this Agreement.

(L) **Road cutting & Restoration**

The Contractor shall take a timely action in accordance to the Approved Implementation Plan for obtaining the necessary permissions for road cutting from GMC/BMC/PWD / CPWD. A comprehensive list of locations with respective time schedules shall be provided to BMC who intern shall assist the Contractor in obtaining the permissions. The Operator shall adhere to the standards, specifications and all requirements in compliance to the prevailing Dig and Restore Protocols prescribed by BMC/PWD / CPWD from time to time. On completion of work on pipelines, the Operator shall ensure standard refilling of the trench and

inform BMC for timely restoration of the road for minimizing inconvenience to the users and residents.

While Road Restoration Following guidelines should be followed:

1. The contractor shall have to restore the road up as per BMC norms including refilling trench in layers, watering, rolling and compacting to within 10days after trenching is completed in a particular street/reach.
2. Contractor shall erect informatory board at his own cost showing type of work, inconvenience expected and timeline for various construction activities going to take place in a particular street or a particular reach of road as per direction of Employer's Representative in charge.
3. The contractor shall have to do the sequencing of activities as per direction of Employer's Representative in charge to synchronize sewer work and water pipe line work to minimize the road excavation and restoration in the street which will have both pipe lines.
4. The Contractor should ensure that House service connections and hydrostatic testing shall be conducted before the road is restored and opened to the traffic. Employer will not pay for any rework in this regard. Penalty of ₹10,000.00 will be applicable for each day of delay in restoration to normal condition over the permitted time.

(M) Shifting of obstructing utilities

The Contractor shall, in accordance with Applicable Laws cause shifting of utility (including electric lines, water pipes and telephone cables) to an approved location or alignment. Contractor shall not be paid separately for the same. The Contractor shall ascertain, determine and verify the locations of all utility services and co-ordinate with utility agencies for the diversion of affected services and the laying of new services. The Contractor shall support and protect services that need not be diverted or pending diversion and remove all abandoned services. Contractor shall be responsible for relocation, reconstruction, reconfiguration of driveways, site accesses, temporary and permanent drains, pipe conduits and necessary connections for public lighting and traffic lighting, earth works, environmental safeguards, necessary safety measures and protection works etc

The Contractor's responsibility for the execution of works includes the submissions to relevant government authorities / technical departments for obtaining all necessary clearances /approvals.

The Contractor shall co-ordinate and interfaces his works with that of all other contractors, subcontractors, utility service agencies, statutory authorities, etc. and achieve the completion of the Works to the satisfaction of the Engineer-in-charge.

Shifting of Existing Utilities:

Contractor is required to liaison with concerned department for identifying exact location of the existing utility services. Any damages by the contractor to the existing utilities while carrying out work shall be repaired/reinstated by contractor at his own cost.

Deposits / Supervision charges levied by Govt. dept. & paid by the contractor for the purpose of shifting of utilities shall be reimbursable after due assessment, verification and scrutiny except for street light poles, set of signal poles, road signs/sign boards & consumer connection for water connections (Domestic/commercial).

The Bidder shall coordinate with utility service Providers for proper Shifting/ Relocating of the Utilities. The work shall be carried as per approval of Utility service Provider.

All the Charges required for Shifting / relocating of Utilities shall be included in the Quoted Rate and the Contractor shall not be paid extra for the same.

Electric & street Light Poles - Contractor is required to remove electric & street light poles including uprooting underground part with due co-ordination with concerned utility owners.

Electric cables - Contractor is required to remove electric cables with due co-ordination with concerned utility owners.

Transformer stations - Contractor is required to remove transformer station poles if asked for including uprooting underground part.

Water supply lines - Water supply lines if encountered during construction of utility Conduits & storm water drains cross work etc shall be removed only after new water supply line is operational.

Sewer lines - Sewer lines if encountered during construction of utility conduits and storm water drains cross work etc shall be removed only after new alternative sewer line is operational.

- (N) The guideline issued by CPWD through OM No. DG/MAN/382 dated 06.02.2019 for approval of TMT bars will be applicable in this contract
- (O) Emulsion and Bitumen should be procured from government refinery and should be indigenous product. No imported product is allowed in this contract.

SR .No	Type for Utility including but not limited to	Maximum Size of Utility (Without additional shifting charges)	Remark
1.	Concrete/Brick Storm Water Drain	Any size	Will be in the scope of the Contractor as specified above
2.	Water Supply – House Service Consumer Connection (Domestic & Commercial)	Any size	Damage caused to the existing House Service connections and water supply services shall be restored within 24 Hours with no additional cost to the Employer.
3.	Power Supply – House Service Consumer Connection (Domestic & Commercial)	Any size	Damage caused to the existing underground Household Power Supply connections and Power supply services shall be restored within 24 Hours with no additional cost to the Employer.
4.	Electrical Street Light Poles	Any size	Will be in the scope of the Contractor as specified above
5.	Electric cables	Any size	Will be in the scope of the Contractor as specified above
6.	Transformer stations	Any size	Will be in the scope of the Contractor as specified above
7.	Existing Water Supply Service Pipes	Any size	<p>Dismantling/Refurbishment of existing Water Supply service pipeline of any size is in the scope of the contractor with no additional cost implication to the Employer</p> <p>Damage caused to the existing Water Supply Service pipes and consumer connections shall be rectified within 24 Hours with no additional cost to the Employer.</p> <p>Payment shall be made after discarding existing services in only exceptional case for which the prior permission is granted by the Employer.</p>

SR .No	Type for Utility including but not limited to	Maximum Size of Utility (Without additional shifting charges)	Remark
8.	Sewer Lines	Any size	Will be in the scope of the Contractor as specified above
9.	Cable ducts/ Lines (Internet and Telecommunication)	Any size	Will be in the scope of the Contractor as specified above
10.	Street Furniture, Solar Poles, and other street infrastructure	Any Size	Shifting/ Dismantling/ Demolition and reconstruction of existing infrastructure will be paid extra.
11.	Fire and Gas Pipelines	Any size	Will be in the scope of the Contractor as specified above
12.	Traffic Signal poles, Road Signage Boards & Poles	Any Size	Will be in the scope of the Contractor as specified above
13.	The cost incurred for rectification of damages caused to the existing service lines of any category will be recovered from RA bill of the Contractor if not rectified within 24 Hours from the date of issuance of notice by the Employer.		
14.	Shifting of Utilities shall be done in coordination with concerned utility owners.		
15.	The charges for shifting will be paid after due assessment, verification, and scrutiny by the EIC. It shall be measured as additional work after approval of quantities.		
16.	Delay caused due to improper coordination of the Contractor with the concerned utility owner in shifting of respective Utility shall not be the reason for request to time extension and Contractor is liable to penalty for such delay.		

Note: In addition to the contract conditions as mentioned above, the following circulars/letters issued by Gujarat government are also to be followed:

- a. AB/C May 1.2/2010-11, File No. 25/3095/2011-3959, Dated: 16.06.2011 issued by GWSSB "Jal Seva Bhavan" Sctor-10-A, Gandhinagar, Gujarat.
- b. Gen. 2010-595 (6) MIL (K-1), Dated: 29.04.2011, issued by NWRWS & Kalpsar Division, Gujarat.
- c. No: Material: cell/L/C/General/34, Dated: 21.01.2010 issued by GWSSB "Jal Seva Bhavan" Sctor-10-A, Gandhinagar, Gujarat.
- d. **Annexure 1**-Integrity pact to be signed by the contractor.
- e. **Annexure 2**-Insurance of work to be taken during execution of the contract if awarded.
- f. **Annexure 3**- Corrigendum GR. No FD/MSM/e-file/4/2023/0057/DMO Date:21.04.2023 (Enclosed) mentioning the list of banks from which the SD/EMD shall be accepted.
- g. **Annexure 4**- R&B Department Circular no. PARCH/102008/ (61) dated 27-11-2008 and R&B Department Circular no. PARCH/102008/ (61) dated 03-05-2013.
- h. **Annexure 5** - Circular no. vigilance cell/inspection note/188 dated 19/3/2012 of Member Secretary, GWSSB, Gandhinagar (copy of circular in Gujarati version is attached)
- i. **Annexure 6**- Gujarat state Purchase Policy-2016 Resolution No. SPO/102015/691093/Ch dated 03-06-2016
- j. **Annexure 7**- Board office, Gandhinagar circular No. AB/CM1-2/covid-19/F.No.98/2020/167 dt: 21/06/2021
- k. **Annexure 8**- Board office, Gandhinagar circular No. Tech Cell/makan & Bandhkam Shramyogi/2021/571 dated 17/03/2021 of chief engineer, GWSSB, Gandhinagar (copy of circular in Gujarati version is attached)
- l. **Annexure 9**- Board office, Gandhinagar circular No. Tech Cell/GST/Circular/ 351 dated 18/04/2022 of chief engineer, GWSSB, Gandhinagar

Annexure 1

Integrity pact to be signed by the contractor.

INTEGRITY PACT

OUR COMITMENT

We commit ourselves to trust, transparency and setting ethical standards in implementation of various works for ultimate long-term benefits for society. We also reiterate our commitment to development to mutual respect and best practices for setting very high-quality standards in works and attitude.

OUR CONDUCT

We abide to accomplish our work with

- Integrity and trust
- Ethics and courtesy
- Transparency and quality.

BMC Commitment	Party's Commitment
<ul style="list-style-type: none"> • To maintain high ethical standards • To ensure transparency in transactions • To ensure to abide by the terms of agreement of contract and to consider the views of parties objectively. • To try to ensure timely payments for work done. • To ensure that no improper demand is made by employees or by anyone on their behalf. • To provide maximum possible help to all contractors/ vendors/suppliers and any other party working with us so that the contracted assignment is completed in time. 	<ul style="list-style-type: none"> • Not to bring pressure/recommendation from outside to influence decision. • To abide by general discipline to be maintained in our dealings. • To be prompt and reasonable in fulfilling the terms of agreement of contract and legal obligations. • To ensure high standards are set for quality of work or supplies at lowest possible cost. • Not to use any pressure, threat, intimidation or inducement of any kind of any of the employees. • To be true and honest in furnishing specification and information and make all efforts for completing the contracted assignment well in time.
BMC	Signature of Contractor
<i>Building Ethical Partnership and Working Together</i>	

Annexure-2

Insurance

The contractor shall without limiting his or the employer obligations and responsibilities insure:

- a) The works, together with materials and plants for incorporation therein, to the full replacement cost (Term "Cost" in this context shall include profit)
- b) The contractor equipments and other things brought onto the site by the contractor, for a sum sufficient to provide for their replacement at site.
- c) The insurance detailed above shall be in the joint names of the contractor and the employer at the contractor's cost and shall cover the employer and the contractor against all loss or damage from whatsoever cause arising from the start of date of work to the completion of operation and maintenance period as per the scope of work.
- d) Contractor All Risk Policy (CAR) should be submitted by the Contractor clearly defining the terms and conditions of the risk covered under the policy and to be submitted within 30 days after the issuance of work order. The CAR policy should remain valid for the entire period of contract including Operation and Maintenance period.

Any amount not insured or not recovered from the insurer shall be borne by the Employer or the contractor in accordance with their responsibilities under Clause-1.

The contractor shall except if and so far as the contractor provides otherwise, indemnify the Employer against all losses and claims in respect of,

- a) Death or injury to any person, or
- b) Loss of or damage to any property (other than the works) which may arise out of in consequent of the Operation and maintenance of the facility and the remedying of any defects therein, and against all claims proceedings, costs, charges, and expenses whatsoever in respect thereof or in relation thereto.

The "Expectations" referred to are:

- a) The permanent use or occupation of land by the works, or any part thereof,
- b) The right of then Employer to execute the works , or any part thereof on, under in or through any land
- c) Damage to property which is the unavoidable result of the execution and completion of the works or remedying of any defects therein, in accordance with the contract and
- d) Death of or injury to persons or loss of or damage to the property resulting from any act or neglect the Employer ,his agent, servant or other contractor not being employed by the Contractor or in respect of any claims proceedings, damages, cost, charges and expenses in respect thereof or in relation , where the injury or damages was contributed to by the contractor, his servant or agents, such part of said injury or damages as may be just and equitable having regards to the extent of responsibility of the Employer, his servants or agents or other contractor for injury or damage

The Employer shall indemnify the contractor against all claims, proceeding, damages, cost, charge and expenses.

The contractor shall without limiting his or the employer's obligations and responsibilities issue, joint name of the contractor and responsibilities, insure in the joint name of the contractor and the employer, against liabilities for death or injury to any person or loss of damages to any properties (Other than the facility) arising out of the operation and maintenance of the project other than the exceptions defined.

The insurance policy should include a cross liability clauses such that the insurance shall apply to the contractor and to the employer as separate insurer.

The employer shall not liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the contractor or any

Subcontractor, other than death or injury resulting from any act or default of the employer, his agent or servants. the contractor shall indemnify and keep indemnified the employer against all such damages and compensations, other than those for which the employer is liable as aforesaid, and against all claims ,proceeding, damages, costs, charges, and expenses what so ever in respect there of or in relation thereto.

The contractor shall insure against such liability and shall continue such insurance during the whole of the tie that any persons are employed by him or the facility provided that in respect of any person, employed by any subcontractor, the contractors obligation to insure as aforesaid under this sub clauses shall be satisfied if the subcontractor shall have insured against the liability in respect of such person in such manner that the employer is indemnified under the policy, but the contractor shall require such sub-contractor to produce to the employer, when required such policy of insurance and receipt for the payment of the current premium.

In the event that the contractor or the employer fails to comply with the condition imposed by the insurance policy affected pursuant to the contract, each will indemnify the other against all loses and claims arising from such failure according to the contract conditions.

In view of circular no. vigilance cell/inspection note/188 dated 19/3/2012 of Member Secretary, GWSSB, Gandhinagar (copy of circular in Gujarati version is attached at **Annexure-5**)

1. Agency shall have to take insurance policy and intimate to GWIL along with the evidence within time limit. In case of noncompliance entire responsibility shall be rest with the agency and required amount shall be recovered from any due amount of the agency.
2. BMC can recover penalty amount from the agency for not taking the insurance. Though the penalty amount is recovered, responsibilities of the agency for taking insurance shall be continued and will not be escaped from this responsibility.

સજયમાં બાંધકામ માટે વપરાતા ગૌણ
ખનિજોની રોયલ્ટીની વસુલાત અંતિમ
વપરાશકાર પાસેથી કરવા બાબત

ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ

"જલસેવા ભવન" શ્રે.૧૦-એ ગાંધીનગર.

પરિપત્ર નં. એવી/સીમે-૧-૨/૨૦૧૦-૧૧/ફા.નં.૨૫/૩૦૯૫/સને ૨૦૧૧ ૩૬૫૮
તા. ૧૬/૬/૨૦૧૧

વંચાણે લીધા :- (૧) ગુજરાત પા.પુ. અને ગ.વ્ય.બોર્ડ ગાંધીનગરનો પરિપત્ર નં.

P.H.W.Dn. MOJASA
Inward No. ૨૬૬૬
Date: ૨૦/૬/૧૧
E.E.:
D.No.:
H.C.:
Marking

એવી/ સીમે-૧-૨/૨૦૧૦-૧૧/ફા.નં.૨૫/૩૦૯૫/સને ૨૦૧૧
તા. ૧૨-૫-૨૦૧૧

(૨) ગુજરાત સરકારના નર્મદા, જળસંપત્તિ, પા.પુ. અને કલ્પસર
વિભાગ, સચિવાલય, ગાંધીનગરના ઠરાવ ક્રમાંક જીઇએન-
૨૦૧૦-૫૯૫-(૬)એમઆઇસેલ (ક-૧) તા. ૨૯-૪-૨૦૧૧

ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ ગાંધીનગરના સંદર્ભ-૧
હેઠળના પરિપત્રથી બાંધકામ માટે વપરાતા ગૌણ ખનિજોની રોયલ્ટી બાબતે
કાર્યવાહી કરવા સુચનાઓ પરિપત્રિત કરવામાં આવેલ છે.

ત્યારબાદ ગુજરાત સરકારના નર્મદા, જળસંપત્તિ, પા.પુ. અને કલ્પસર
વિભાગ, સચિવાલય, ગાંધીનગરના સંદર્ભ-૨ હેઠળના ઠરાવથી (નકલ સામેલ છે)
બાંધકામમાં વપરાતા ગૌણ ખનિજોની રોયલ્ટીની વસુલાત અંતિમ વપરાશકાર
પાસેથી કરવા બાબતે કાર્યપધ્ધતિ ઠરાવવામાં આવેલ છે જે મુજબ બોર્ડ ફ્સ્ટકની
ક્ષેત્રિય કચેરીઓમાં અમલ કરવા નક્કી થયેલ છે. નીચે મુજબની કાર્યપધ્ધતિનો
અમલ કરવાનો રહે છે.

(૧) કાલમાં બાંધકામમાં વપરાતા નીચેના ખનિજો માટે આ કામે પધ્ધતિનો
અમલ કરવાનો રહેશે.

- સાદી રેતી/માટી/કંકર/ગ્રેવલ
- બ્લોક ટ્રેપ (કપચી, ગ્રીટ, મેટલ, રબલ, વિગેરે)
- બિલ્ડીંગ સ્ટોન/લાઇમ સ્ટોન/સેન્ડ સ્ટોન/કવાર્ટઝાઇટ

As per Municipal Plan

- સોફ્ટ મુરમ/હાર્ડ મુરમ
- ઇટ માટી/ઇટ

(૨) રોયલ્ટીની વસુલાત માટેની કાર્યપદ્ધતિ

સરકારી બાંધકામાં વપરાતા ગૌણ ખનિજોની રોયલ્ટી વખતો વખત ચુકવાતા રનીંગ બીલમાંથી કપાત કરવાની રહેશે અને આખરી બીલમાંથી બાકી રહેતી તમામ રોયલ્ટીની રકમની વસુલાત જે તે ઠેકેદારની સીકવોરીટી ડીપોઝીટ છુટી કરતા પહેલાં જે તે સંલગ્ન વિભાગે વસુલવાની રહેશે સરકારશ્રીને બાંધકામમાં વપરાયેલ ખનિજોની પુરેપુરી રોયલ્ટી મળી રહે તે માટે પરિશિષ્ટ-૧ માં જણાવેલ દર અનુસાર મુજબ કપાત કરવાની રહેશે.

ઉપરોક્ત વસુલાત કરેલ રોયલ્ટીની રકમ નીચેના સદરે સમય મર્યાદામાં સબમિટ વિભાગે જમા કરાવવાની રહેશે.

૦૮૫૩-નોન ફેરસ માઇનીંગ એન્ડ મેટલર્જીકલ ઇન્ડસ્ટ્રીઝ

૧૦૨- મીનરલ કન્વેશન ડી, રેન્ટ એન્ડ રોયલ્ટી

૦૧ - રીસીપ્ટ અન્ડર ગુજરાત માઇનોર મીનરલ રૂલ્સ-૧૯૬૬

- (૩) બાંધકામમાં વપરાતા ગૌણ ખનિજોના પ્રવર્તમાન રોયલ્ટી દર પરિશિષ્ટ-૧ માં દર્શાવેલ છે.
- (૪) રાજ્ય સરકાર દ્વારા ગૌણ ખનિજોના રોયલ્ટી દરોની જ્યારે જ્યારે ફેરવિચારણા થશે ત્યારે તે મજબૂત દરે રોયલ્ટી વસુલ/કપાત કરવાની રહેશે.
- (૫) સરકારી, અર્ધસરકારી કામોમાં વપરાયેલ ગૌણ ખનિજોની કપાત કરેલ રોયલ્ટીની વિગત પરિશિષ્ટ-૨ માં દર માસે ૧૦ તારીખ સુધીમાં જે તે સબમિટ કચેરીએ ભૂસ્તર વિજ્ઞાન અને ખનિજ ખાતાની સંલગ્ન જીલ્લા કચેરીને મોકલી આપવાની રહેશે.
- (૬) આ કાર્યપદ્ધતિની તા. ૧-૪-૨૦૧૧ પછીના ડ્રાફ્ટ ટેન્ડર પેપર્સમાં જોગવાઈ કરવાની રહેશે અને તે પહેલાંના કામોને લાગુ પડશે નહીં અને આવા કામોમાં હાલની એડવાન્સ પ્રથા મુજબ નિયમોનુસાર ખનિજો મેળવી ઉપયોગ કરવાનો રહેશે.

ઉક્ત પરિપત્રનો અમલ બોર્ડ હસ્તકની સર્વે ક્ષેત્રિય કચેરીઓ દ્વારા અચૂક કરવાનો રહેશે.

બિડાણ : ઉપર મુજબ

કેમ
(ડી.જયપાલસિંહ)
સભ્ય સચિવ

પ્રતિ,

- મુખ્ય ઇજનેરશ્રી ઝોન-૧/૨/૩/૪, વડોદરા/અમદાવાદ/રાજકોટ/ભુજ
- મુખ્ય ઇજનેરશ્રી મટીરીયલ સેલ/યાંત્રિક
- પ્રોજેક્ટ ડાયરેક્ટરશ્રી એડીબી/અબેન સેલ ગાંધીનગર.
- નિયામકશ્રી ગુજરાત જલસેવા તાલીમ સંસ્થા ગાંધીનગર
- અધિક્ષક ઇજનેરશ્રી (સર્વે)
- કાર્યપાલકશ્રી (સર્વે)
- સીનીયર મેનેજરશ્રી (નાણાં-હિસાબ) સર્વે
- નાયબ મેનેજરશ્રી (નાણાં-હિસાબ) સર્વે
- સીસ્ટમ મેનેજરશ્રી, પ્રોગ્રામર સેલ, વડી કચેરી, ગાંધીનગર.

નકલ રવાના

- માન. અધ્યક્ષશ્રીના કાર્યકારી, સચિવશ્રી, બોર્ડ કચેરી, ગાંધીનગર.
- સભ્ય સચિવશ્રી, અંગત મદદનીશશ્રી, બોર્ડ કચેરી, ગાંધીનગર.
- નાણાં નિયંત્રકશ્રી, બોર્ડ કચેરી, ગાંધીનગર.
- મુખ્ય વહીવટી અધિકારીશ્રી, બોર્ડ કચેરી, ગાંધીનગર.

જનકા નં. ૨૧૦૧/૧૮૩૦ ૧૨-૧૧ ૧૧-૨૦૧૩

આજના તારીખે મુજબ નાણાં મહાવિભાગ રાજકોટ
જાહેર આગોશ્તી ટેન્ડર નેપ (વિભાગ-વોડોદરા/ભુજ)
પ્રતિબંધિત નાણાં સર્વે સેલ દ્વારા ૨૧/૧૧/૧૩.

કેમ
કાર્યપાલક ઇજનેર
જા.આ.બાંધકામ વિભાગ
ગુ.પા.પુ. અને મ.વ્ય. બોર્ડ
વોડોદરા.



1. 1/11
2. 1/11

ખનિજોની રોયલ્ટીની વસુલાત અંતિમ
વપરાશકાર પાસેથી કરવા બાબત"

ગુજરાત સરકાર,
નર્મદા, જળસંપત્તિ, પાણી પુરવઠા અને કલ્પસર વિભાગ,
કરાવ ક્રમાંક-જીઈએન-૨૦૧૦-૫૯૫-૬)-એમઆઈસેલ (ક-૧),
સચિવાલય, ગાંધીનગર.

તા. ૧૪/૨૦૧૧.

29 APR 2011

વંચાણે લીધા:-

Shri
U.S.S.
M. S. S.

- (૧) ઉદ્યોગ અને ખાણ વિભાગ, સચિવાલય, ગાંધીનગર પરિપત્ર ન. એનસીઆર-૧૦૯૦-૩૦૮૩-ક
તા.૧૨-૧-૧૯૯૪.
- (૨) ઉદ્યોગ અને ખાણ વિભાગ, સચિવાલય, ગાંધીનગર પરિપત્ર ન. એનસીઆર-૧૦૯૦-૩૦૮૩-ક
તા.૯-૫-૧૯૯૪.

કરાવ:-

U.S.S.

U.S.S.

U.S.S.

રાજ્ય સરકારે સપ્ટેમ્બર-૨૦૦૩ માં જાહેર કરેલ ખનિજ નીતિ અનુસાર ખનિજ જથ્થાની
રોયલ્ટી પુરપુરી મળી રહે તે માટે રસ્તા અને મકાન, સિયાઈ, પંચાયત, નિગમો વિગેરેના
હેક્ટેદારોના કામોના બિલોમાંથી સીધી કપાત કરવાની પ્રથા અમલમાં મૂકવાની જાહેરાત કરાવેલ
છે. રાજ્ય સરકારશ્રીના પરિપત્ર તા.૯-૫-૧૯૯૪ મુજબ હેક્ટેદારોએ વપરાશ કરેલ ખનિજ જથ્થા
મુજબના રોયલ્ટીના આધાર/પુરાવાની ચકાસણી કરી સંલગ્ન ભૂસ્તર વિજ્ઞાન અને ખનિજ
ખાતાની જિલ્લા કચેરીઓ દ્વારા "નો ડયુ" પ્રમાણપત્ર આપવાની પ્રથા અમલમાં છે. હેક્ટેદારો દ્વારા
નો ડયુ સર્ટીફિકેટ રજુ થયા બાદજ સિક્યોરીટી ડીપોઝીટ છૂટી કરવામાં આવે છે. ઉપરોક્ત
પદ્ધતિમાં વિલંબ થતો નિવારવા હાલમાં પરિપત્ર તા.૧૮-૮-૨૦૦૯થી ઝડપી ચકાસણી કરી
તાત્કાલિક આવું પ્રમાણપત્ર આપવાની જોગવાઈઓ કરેલ છે.

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હાલની પદ્ધતિ પારદર્શક અને સરળ બનાવવા અને બાંધકામમાં વપરાતા ગૌણ
ખનિજની રોયલ્ટી પૂરેપૂરી મળી રહે તે માટે તા.૧-૭-૨૦૧૦ ના રોજ માન. મુખ્ય મંત્રીશ્રીના
અધ્યક્ષસ્થાને મળેલ બેઠકમાં થયેલ સૂચન મુજબ સજયમાં મળી આવતાં ગૌણ ખનિજોની રોયલ્ટી
લીઝ ધારક પાસેથી ન લેતાં અંતિમ વપરાશકાર (End user) પાસેથી લેવામાં આવે તો

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બાંધકામના ઠેકેદારો વિગેરેને કામમાં સરળતા રહેશે. સરકારી બાંધકામોમાં રોયલ્ટી, વખતો વખત ચુકવાતા બિલોમાંથી કપાત કરી (At source) વસુલાત કરવાનું નક્કી કરવામાં આવેલ હતું. જે ધ્યાને લઈ સરકાર દ્વારા પુખ્ત વિચારણાને અંતે નીચે મુજબની કાર્યપદ્ધતિનો અમલ કરવા ઠરાવવામાં આવે છે.

૧. ફાલમાં બાંધકામમાં વપરાતા નીચેના ખનિજો માટે આ કાર્યપદ્ધતિનો અમલ કરવાનો રહેશે.

- સાદી રેતી/ માટી/ કંકર/ ગ્રેવલ
- બ્લેકટ્રેપ (કપચી, ગ્રીટ, મેટલ, રબલ, વિગેરે)
- બિલ્ડીંગ સ્ટોન/ લાઈમસ્ટોન/ સેન્ડસ્ટોન/ક્વાર્ટઝાઈટ
- સોફ્ટ મુરમ/ હાર્ડ મુરમ
- ઈંટ માટી/ ઈંટ

૨. રોયલ્ટી વસુલાત માટેની કાર્યપદ્ધતિ:-

સરકારી બાંધકામમાં વપરાતા ગૌણ ખનિજોની રોયલ્ટી વખતો વખત ચુકવાતા રનીંગ બીલમાંથી કપાત કરવાની રહેશે અને આખરી બીલમાંથી બાકી રહેતી તમામ રોયલ્ટીની રકમની વસુલાત જે તે ઠેકેદારની સીક્યોરીટી ડિપોઝીટ છુટી કરતાં પહેલાં જે તે સંલગ્ન વિભાગે વસુલવાની રહેશે. સરકારીને બાંધકામમાં વપરાયેલ ખનિજોની પુરેપુરી રોયલ્ટી મળી રહે તે માટે પરિશિષ્ટ-૧માં જણાવેલ દર અનુસાર મુજબ કપાત કરવાની રહેશે. ઉપરોક્ત વસુલાત કરેલ રોયલ્ટીની રકમ નીચેના સદરે સમય મર્યાદામાં સબંધિત વિભાગે જમા કરાવવાની રહેશે.

૦૮૫૩ - નોન ફેરસ માઈનીંગ એન્ડ મેટલર્જીકલ ઈન્ડસ્ટ્રીઝ

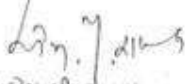
૧૦૨ - મીનરલ કન્સેશન ફી, રેન્ટ એન્ડ રોયલ્ટી

૦૧ - રીસીપ્ટ અન્ડર ગુજરાત માઈનોર મીનરલ રૂલ્સ-૧૯૬૬

૩. બાંધકામમાં વપરાતા ગૌણ ખનિજોના પ્રવર્તમાન રોયલ્ટી દર પરિશિષ્ટ-૧ માં દર્શાવેલ છે.
૪. રાજ્ય સરકાર દ્વારા ગૌણ ખનિજોના રોયલ્ટી દરોની જયારે જયારે ફેરવિચારણા થશે ત્યારે તે મુજબના દરે રોયલ્ટી વસુલ/ કપાત કરવાની રહેશે.
૫. સરકારી, અર્ધસરકારી કામોમાં વપરાયેલ ગૌણ ખનિજોની કપાત કરેલ રોયલ્ટીની વિગત પરિશિષ્ટ-૨ માં દર માસે ૧૦ તારીખ સુધીમાં જે તે સબંધિત કચેરીએ ભુસ્તર વિજ્ઞાન અને ખનિજ ખાતાની સંલગ્ન જીલ્લા કચેરીને મોકલી આપવાની રહેશે.

સા.પ.સં.પા.પુ. અને ક.વિ. સચિવાલય, ગાંધીનગર.
રહેશે અને તે પહેલાના કામોને લાગુ પડશે નહીં અને આવા કામોમાં કાલની એડવાન્સ
રોયલ્ટી પ્રથા મુજબ નિયમોનુસાર ખર્ચો મેળવી ઉપયોગ કરવાનો રહેશે.

ગુજરાત રાજ્ય સરકારના રાજ્યપાલશ્રીના હુકમશ્રી અને તેમના નામે.


(એમ. પી. પટેલ)

ખાસ ફરજ પરના અધિકારી (સિ.ઓ.)

નર્મદા, જળસંપત્તિ, પાણી પુરવઠા અને કલ્પસર વિભાગ,
ગાંધીનગર.

પ્રતિ,

- માન. મંત્રીશ્રી (જસ.)ના અંગત સચિવશ્રી, ન.જ.સં.પા. પુ. અને ક.વિ. સચિવાલય, ગાંધીનગર.
- માન. રાજ્યકક્ષા મંત્રીશ્રી(જસ.)ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર.
- માન. સંસદીય સચિવશ્રી(જસ.) ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- સચિવશ્રી (જસ.) ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર.
- ખાસ સચિવશ્રી (જસ.) ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- સર્વે મુખ્ય ઈજનેરશ્રી અને અધિક સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- વહીવટી સંચાલકશ્રી, જળસંપત્તિ વિકાસ નિગમ લી. ગાંધીનગર.
- મુખ્ય ઈજનેર અને નિયામકશ્રી, જળ અને જમીન વ્યવસ્થાપન સંસ્થા, આણંદ.
- મુખ્ય ઈજનેર અને નિયામકશ્રી, ગુજરાત ઈજનેરી સંશોધન સંસ્થા, વડોદરા.
- સર્વે તાંત્રિક અધિકારી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- સર્વે અધિક્ષક ઈજનેરશ્રીઓ, ન.જ.સં.પા.પુ.અને ક.વિ.વિભાગ.
- સર્વે શાખાઓ ન.જ.સં.પા.પુ.અને ક.વિ.વિભાગ, સચિવાલય, ગાંધીનગર.
- સિલેક્ટ ફાઇલ

परिशिष्ट - १

बिंधकाममा वपराता गौ प्रनीशेला शेयल्टीना दर-(ता.१५-१-२०१० नी असरथी)

अ.नं.	प्रनिशुं नाम	शेयल्टी दर प्रति मे. टन
१	जौल प्रनिशु लाहंमस्टोन (अ) ड्रेस ब्लोक (ब) रबल (क) मेटल	३०
२	ब्लेक ट्रेप (अ) रबल (ब) कपची (क) मेटल (द) जीट	२५
३	सेन्ड स्टोन (अ) ड्रेस ब्लोक (ब) रबल (क) मेटल	३०
४	क्वार्टाईज	२०
५	सामान्य रेली	१२
६	कंकर	१२
७	सामान्य माटी	१२
८	सोफ्ट मुरम	१२
९	सर्ड मुरम	२०
१०	ग्रेवल	१५
११	बिल्डींग स्टोन (अ) सफुल्ल बिल्डींग स्टोन (ब) प्रांगछा सेन्ड स्टोन(बिल्डींग स्टोन तरीके उपयोग) (क) रायोल्लाईट (बिंधकाम माटे उपयोगी)	३०
१२	अन्य बिंधकामना प्रनिशु	३०

સરકારી/ અર્ધસરકારી બાંધકામમાં વપરાયેલ ગૌણ પ્રવિજોની દર માસે રોયલ્ટીની વિગત દર્શાવતું પત્રક-

૧. કચેરીનું નામ:.....

૨. માસ/ વર્ષ.....

અ.નં.	કોન્ટ્રાક્ટરનું નામ અને સરનામું	કામનું નામ	વર્ક ઓર્ડર નંબર તારીખ અને કામની વિગત	વપરાયેલ પ્રવિજ જથ્થાની રોયલ્ટી/ પ્રવિજ કિંમતની વિગત						નોંધ
				પ્રવિજનું નામ	જથ્થો મે. ટન	રોયલ્ટી નો દર	રોયલ્ટી/ પ્રવિજ કિંમતની રકમ રૂ. માં	ચલાણ નંબર	તારીખ	
૧	૨	૩	૪	૫	૬	૭	૮	૯	૧૦	૧૧

કુલ રૂ.....

ઓડિટ અધિકારીની સહી અને હેતો

નંબર

તારીખ

સંબંધિત અધિકારીની સહી/ હેતો

પ્રતિ,

મદદનીશ ભુસ્તરશાસ્ત્રીશ્રી/ ભુસ્તરશાસ્ત્રીશ્રી,

ભુસ્તર વિભાગ અને પ્રવિજ ખાતુ,

જીલ્લા કચેરી.....ની જાણ તથા સંબંધિત ચલાણની નકલ સામેલ છે.



ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ,

"જલ ભવન", સેક્ટર - ૧૦-એ,
એરફોર્સ સ્ટેશનની સામે, ગાંધીનગર - ૩૮૨૦૧૦.
ફોન : (૦૭૯) ૨૩૨ ૫૧૦૯૨
ફેક્સ : (૦૭૯) ૨૩૨ ૫૧૦૯૪ / ૨૩૨ ૨૫૯૭૯

૭૧
૭/૧૫

જા. નં. મટી. સેલ/સી/જનરલ/૩૪

તા. ૨૨/૦૧/૨૦૧૦

પ્રતિ,
મુખ્ય ઈજનેર શ્રી / પ્રોજેક્ટ ડાયરેક્ટર શ્રી,
ઝોન - ૧/૨/૩/૪/પાંચત્રિક / અર્બન સેલ
વડોદરા/અમદાવાદ/રાજકોટ/કચ્છ-ભુજ/ગાંધીનગર.

P.H.W.Dn. MODASA	
Drawn No.	૪૭૩
Date	૨૨/૧/૧૦
E.F.	(H)
B.A.	
M.T.	
Signature	SK

વિષય :- ભારત સરકારશ્રીના સેન્ટ્રલ એક્સાઈઝના નોટીફિકેશન નં. : ૨૬/૨૦૦૯,
તા. ૪-૧૨-૨૦૦૯ ની જોગવાઈઓને અનુલક્ષીને મળવાપાત્ર એક્સાઈઝ
એક્ઝમ્પ્શનનો લાભ લેવા બાબત.

- સંદર્ભ :- (૧) ભારત સરકારશ્રીના સેન્ટ્રલ એક્સાઈઝના નોટીફિકેશન નં. ૬/૨૦૦૬ તા. ૧-૩-૨૦૦૬
(૨) ભારત સરકારશ્રીના સેન્ટ્રલ એક્સાઈઝના નોટીફિકેશન નં. ૬/૨૦૦૭ તા. ૧-૩-૨૦૦૭
(૩) બોર્ડ કચેરીના મટી. સેલ(સિ.) ના પત્ર જા. નં. મટી. સેલ/સિ/આરસી/૨૧૯
તા. ૨૬-૩-૨૦૦૭
(૪) ભારત સરકારશ્રીના સેન્ટ્રલ એક્સાઈઝના નોટીફિકેશન નં. ૧૬/૨૦૦૯ તા. ૭-૭-૨૦૦૯

ઉપરોક્ત વિષયના અનુસંધાને ભારત સરકારશ્રી ના સેન્ટ્રલ એક્સાઈઝ ડીપાર્ટમેન્ટ દ્વારા
તાજેતરમાં બહાર માડવામાં આવેલ નોટીફિકેશન નં. ૨૬/૨૦૦૯, તા. ૪-૧૨-૦૯ ની નકલ
આ સાથે સામેલ છે.

આ નોટીફિકેશનમાં પીવાના પાણીની યોજનાના અમલીકરણ માટે ઉપયોગમાં લેવામાં
આવતી કઈ પાઈપોને એક્સાઈઝ એક્ઝમ્પ્શનનો લાભ મળવાપાત્ર થાય તે અંગેની જોગવાઈઓ
સ્વયંસ્પષ્ટ છે. જે મુજબ પ્રવર્તમાન જોગવાઈઓને અનુલક્ષીને પીવાના પાણીની યોજનાઓમાં
ઉપયોગમાં લેવામાં આવતી નીચે મુજબની પાઈપોને એક્સાઈઝ એક્ઝમ્પ્શનનો લાભ
મળવાપાત્ર થાય છે.

- (i) " Pipes needed for delivery of water from its source to
the plant (including the clear tender water reservoir if
any, there of), & from there to the first storage point."

(ii) " Pipes of outer diameter exceeding 10 centimeter, when such pipes are integral part of the water supply project. "

આ જોગવાઈઓનો આપના સ્તરેથી અભ્યાસ કરવા અને તે જોગવાઈઓ મુજબ જે પાઈપોને એક્સાઈઝ એક્ઝમ્પ્શન મળવાપાત્ર થતુ હોય તે પાઈપો માટે એક્સાઈઝ એક્ઝમ્પ્શનના પ્રમાણપત્રો તાકીદે જે તે સપ્લાયરને ઈસ્યુ કરવાની સંબંધિતોને સુચના આપવા વિનંતી છે.

આ બાબત બોર્ડના રેઈટ કોન્ટ્રેક્ટ હેઠળના તેમજ ટર્ન-કી પ્રકારના કામો માટે ઉપયોગમાં લેવાનાર પાઈપો માટે તા. ૪-૧૨-૦૯ પહેલા કે પછી મુકાયેલ તમામ સપ્લાય ઓર્ડર કે જેના પાઈપો ડીસ્પેચ થયેલ ન હોય તેને લાગુ પાડવાની રહેશે. જેથી સંબંધિત ઉત્પાદક પેઢીઓ / સપ્લાયરોને તે અંગેની તાકીદે જાણ કરવા અને તદઅનુસાર એક્સાઈઝ એક્ઝમ્પ્શનના પ્રમાણપત્રો તેઓને ઉલટ ટપાલે મોકલી આપવા વિનંતી છે. જેથી નોટીફિકેશનની જોગવાઈઓ મુજબ એક્સાઈઝ એક્ઝમ્પ્શનનો લૂભ બોર્ડને મળી શકે.

આ બાબતને ટોચ અગ્રતા આપવા વિનંતી છે.

D.E.E.P.R.S.D.	
PR.ODA	
Insword No.	૪૦૩
Date	૦૬/૧૦
D.E.E.	જી
S.D.C.	૪
Marking	SK

સભ્ય સચિવ,

ગુ.પા.પુ. અને ગ.વ્ય. બોર્ડ,
ગાંધીનગર.

બિડાણ : સેન્ટ્રલ એક્સાઈઝના નોટીફિકેશન નં. ૨૬/૨૦૦૯, તા. ૪-૧૨-૦૯ ની નકલ.

નકલ રવાના પ્રતિ :

- અધિક્ષક ઈજનેરશ્રી, જાહેર આરોગ્ય વર્તુળ / યાંત્રિક વર્તુળ (સર્વે)
- કાર્યપાલક ઈજનેરશ્રી, જાહેર આરોગ્ય બાંધકામ વિભાગ / યાંત્રિક વિભાગ (સર્વે)

બિડાણ : ઉપર મુજબ.

બા.નં. ૨૫૩૧/૨૪ / ૨૦૧૦ તા. ૨૭/૧/૨૦૧૦

જા.પા.પુ. સિ. જા. સ.વ. વી. બા.પા. રૂ. પેરા રિભાના નિરીક્ષક /
સિવિલિ / બા.પ. ઠાકમના લાભી આ પ્રતિબદ્ધ વિભાગને
આ સંબંધિત તમામ માહિતી આપવા બાબતે.

બિડાણ : સેન્ટ્રલ એક્સાઈઝ નોટીફિકેશન
નં. ૨૬/૨૦૦૯ તા. ૪/૧૨/૦૯ ની નકલ
- અત્રિત.

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CC
7/13

TO BE PUBLISHED IN THE GAZETTE OF INDIA, EXTRAORDINARY, PART II, SECTION 3, SUB-SECTION (i)

GOVERNMENT OF INDIA
MINISTRY OF FINANCE
(DEPARTMENT OF REVENUE)

New Delhi, the 4th December, 2009

Notification No. 26/2009-Central Excise

G.S.R. (E) - In exercise of the powers conferred by sub-section (1) of section 5A of the Central Excise Act, 1944 (1 of 1944), the Central Government, on being satisfied that it is necessary in the public interest so to do, hereby makes the following further amendment in the notification of the Government of India, in the Ministry of Finance (Department of Revenue), No. 6/2006-Central Excise, dated the 1st March, 2006 which was published in the Gazette of India, Extraordinary, vide number-G.S.R.96(E), dated the 1st March, 2006, namely:-

In the said notification, in the Table, against S. No. 7, in column (3), in item (3), for the figure and letters "20 cm", the figure and letters "10 cm" shall be substituted.

[F.No.354/34/2008-TRU]

(Prashant Kumar)
Under Secretary to the Government of India

Note: The principal notification was published in the Gazette of India, Extraordinary, vide number G.S.R.96(E), dated the 1st March, 2006, and was last amended by notification No. 16/2009-Central Excise, dated the 7th July, 2009 and published vide number G.S.R. 474(E), dated the 7th July, 2009.

ક્રમાંક: શ્ર.આ.૬/૧/કોન્ટ્ર/ભથ્થા/ ૨૦૧૮/૩૩૦૫
શ્રમ આયુક્તની કચેરી, ગુજરાત રાજ્ય,
ઉદ્યોગ ભવન, બ્લોક નં. ૧૧, ૧૨ અને ૧૪,
બીજો માળ, સેક્ટર-૧૧, ગાંધીનગર.
તારીખ:-૩૧/૩/૨૦૧૮

પરિપત્ર

કોન્ટ્રાક્ટ મજૂર (નિયમન અને નાબુદી) અધિનિયમ, ૧૯૭૦ હેઠળ ખાસ ભથ્થુ બહાર પાડવા બાબત.

આથી સર્વે સરકારી શ્રમ અધિકારીશ્રીઓને જણાવવામાં આવે છે કે, કોન્ટ્રાક્ટ મજૂર (નિયમન અને નાબુદી) અધિનિયમ, ૧૯૭૦ અને ગુજરાત નિયમો, ૧૯૭૨ હેઠળ કોન્ટ્રાક્ટરોને આપવામાં આવતા લાયસન્સની શરત નં(૪)માં સ્પષ્ટ જણાવ્યા મુજબ લઘુતમ વેતન અધિનિયમ, ૧૯૪૮ હેઠળ જે અનુસુચિત વ્યવસાયો માટે સરકારશ્રીએ લઘુતમ વેતન નક્કી કરેલ છે. તેવા વ્યવસાયોમાં કામે રાખતા કોન્ટ્રાક્ટરોએ તેમના શ્રમયોગીઓને જે તે અનુસૂચિમાં સરકારે નક્કી કરેલ લઘુતમ વેતન દરે પગાર તથા વખતો વખત જાહેર થતું જીવનનિર્વાહ ભથ્થું ચૂકવવાનું રહે છે પરંતુ જે વ્યવસાયોનો લઘુતમ વેતન હેઠળની અનુસૂચિમાં સમાવેશ થતો ન હોય તેવા વ્યવસાયોમાં સંકળાયેલ કોન્ટ્રાક્ટ શ્રમયોગીઓને આ પરિપત્રથી નક્કી થયા મુજબનું વેતન ચૂકવવાનું રહેશે.

લઘુતમ વેતન અધિનિયમ, ૧૯૪૮ હેઠળ જાહેર થયેલ અનુસુચિત વ્યવસાય સિવાયના વ્યવસાયમાં કોન્ટ્રાક્ટ મજૂર (નિયમન અને નાબુદી) અધિનિયમ, ૧૯૭૦ અને ગુજરાત નિયમો, ૧૯૭૨ના નિયમ-૨૩ અન્વયે આપવામાં આવતા લાયસન્સની શરત નં(૬) થી મળેલ સત્તાની રૂએ, શ્રમ આયુક્તશ્રી, ગુજરાત રાજ્ય, ગાંધીનગરે શ્રમયોગીઓને ચૂકવવાની થતી મજૂરીના દર નીચે મુજબ નક્કી કરેલ છે. જે તા.૧-૩-૨૦૧૫થી અમલમાં આવેલ છે.

અ.નં	શ્રમયોગીઓનો વર્ગ	દૈનિક લઘુતમ વેતન દર	
		ઝોન-૧	ઝોન-૨
૧	કુશળ	૨૯૩	૨૮૪
૨	અર્ધકુશળ	૨૮૪	૨૭૬
૩	બીનકુશળ	૨૭૬	૨૬૮

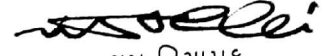
આ જાહેરનામાના હેતુ માટે સ્પષ્ટીકરણ

(ક) ઝોન-૧ ગુજરાત રાજ્યમાં, ગુજરાત પ્રોવિશિયલ મ્યુનિસિપલ કોર્પોરેશન અધિનિયમ, ૧૯૪૯ હેઠળ રચાયા પ્રમાણેના મ્યુનિસિપલ કોર્પોરેશનની હદોની અંદરના વિસ્તારોનો અને ગુજરાત નગરપાલિકા અધિનિયમ, ૧૯૬૩ હેઠળ રચાયા પ્રમાણેની નગરપાલિકા હદોની અંદરના વિસ્તારોમાં અને સંબંધિત શહેરી વિકાસ સત્તામંડળોની હકુમતની અંદર આવતા વિસ્તારોના સમાવેશ થશે.

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(ખ) ઝોન-૨ માં, ઝોન-૧ માં સમાવિષ્ટ હોય તે વિસ્તારો સિવાયના ગુજરાત રાજ્યના તમામ વિસ્તારોનો સમાવેશ થશે.

ઉક્ત નક્કી કરવામાં આવેલ વેતનદરો ઉપરાંત કોન્ટ્રાક્ટરોએ કોન્ટ્રાક્ટ શ્રમયોગીઓને જીવન-નિર્વાહ ખર્ચ આંક સાથે સંકળાયેલ ખાસ ભથ્થું આપવાનું રહે છે. આથી નિયત કરેલ મૂળ વેતનના દરો ઉપરાંત જીવન નિર્વાહના આંક ઉપર આધારિત આપવાનું ખાસ ભથ્થું તા.૧-૦૪-૨૦૧૮ થી તા.૩૦-૦૯-૨૦૧૮ સુધીના ૬(છ) માસના સમય માટે દૈનિક રૂ. ૩૬.૨૦ પૈસા (અંકે રૂપિયા છત્રીસ અને વીસ પૈસા પૂરા) લેખે લાયસન્સની શરત નં.૬ હેઠળ મળેલ સત્તાની રૂએ નક્કી કરવામાં આવે છે. જે ઠરાવેલ વેતનના દરની રકમ ઉપરાંત કોન્ટ્રાક્ટરોએ કોન્ટ્રાક્ટ શ્રમયોગીઓને ચૂકવવાના રહેશે. આ હુકમનો સંબંધિત કોન્ટ્રાક્ટરો અમલ કરે તે જોવા આથી જણાવવામાં આવે છે.



શ્રમ નિયામક

ગુજરાત રાજ્ય, ગાંધીનગર.

નકલ રવાના:

- (૧) અધિક શ્રમ આયુક્તશ્રી, ગુજરાત રાજ્ય, ગાંધીનગર.
- (૨) નાયબ શ્રમ આયુક્તશ્રી,
- (૩) સર્વે મદદનીશ શ્રમ આયુક્તશ્રી,
- (૪) સર્વે સરકારી શ્રમ અધિકારીશ્રી,
- (૫) કચેરીની સર્વે શાખાઓ, ૧, ૨, ૩, ૪, ૫, ૬, ૭, ૮, ૯, ૧૦, ૧૧, ૧૨, ખાસ સેલ અને આઇ.ટી. સેલ
- (૬) શાખાની સીલેક્ટ ફાઇલ/પરિપત્ર ફાઇલ

ક્રમાંક:શ્ર.આ.૬/૧/ ૨૦૧૮ / ૪૪૩૫ ૫૩૨
શ્રમ આયુક્તની કચેરી, ગુજરાત રાજ્ય,
ઉદ્યોગ ભવન, બ્લોક નં. ૧૧, ૧૨ અને ૧૪,
બીજો માળ, સેક્ટર-૧૧, ગાંધીનગર.

તા.૩૧-૦૩-૨૦૧૮

પ્રતિ,

- (૧) નાયબ શ્રમ આયુક્તશ્રી, અમદાવાદ, વડોદરા, સુરત, રાજકોટ
- (૨) મદદનીશ શ્રમ આયુક્તશ્રી (તમામ)
- (૩) સરકારી શ્રમ અધિકારીશ્રી (તમામ)


શ્રમ આયુક્ત,
ગુજરાત રાજ્ય, ગાંધીનગર


લઘુતમ વેતન અધિનિયમ,૧૯૪૮ હેઠળના ખાસ ભથ્થાની જાહેરાત.

લઘુતમ વેતન અધિનિયમ,૧૯૪૮ હેઠળ સરકારશ્રીએ જે તે વ્યવસાય માટે નિયત કરેલ મૂળ પગારના દર ઉપરાંત જીવન નિર્વાહ આંક ઉપર આધારીત આપવાના ખાસ ભથ્થાના દૈનિક દર હવે તા.૧-૦૪-૨૦૧૮ થી તા. ૩૦-૦૯-૨૦૧૮ સુધીના સમય માટે નીચે મુજબ રહેશે.

ક્રમ	અનુસુચિત રોજગારી/વ્યવસાય	ખાસ ભથ્થાના દૈનિક દર (રૂ. પૈસા)
૧	૨	૩
૧	શીપ બ્રેકીંગ તથા સ્વીપીંગ અને કલ્પીનીંગકામની રોજગારી(વ્યવસાય)	રૂ.૪૧.૫૦ પૈસા
૨	ઇંટ ઉત્પાદન, જરી ઉદ્યોગ, (અખાડેદાર સિવાય), રેડીમેડ ગારમેન્ટ અને દરજીકામનો વ્યવસાય,રેડીમેડ ગારમેન્ટમાં પીસ રેટથી કામ કરતા શ્રમયોગીઓ માટે, મીઠા ઉદ્યોગ અને તમાકુ અને બીડી બનાવવાના કામ અંગેની રોજગારી(વ્યવસાય)	રૂ.૧૨૩.૭૦ પૈસા
૩	અનુ. નં ૧,૨ અને અગરબત્તી બનાવવાની રોજગારી સિવાયની દરેક રોજગારી (વ્યવસાય)	રૂ.૩૬.૨૦ પૈસા

અનુ નં ૧, ૨ અને ૩ ની સામે દર્શાવેલ વ્યવસાયમાં ઉપરોક્ત સમય દરમિયાનના ખાસ ભથ્થાના દૈનિક દર જાહેર કરવામાં આવે છે


નાયબ શ્રમ આયુક્ત
અને લઘુતમ વેતન અધિનિયમ,૧૯૪૮
અન્વયેના સક્ષમ અધિકારી, ગાંધીનગર


રવાના કરવા પ્રમાણિત કર્યું.
મદદનીશ શ્રમ આયુક્ત
ગાંધીનગર

Special Allowance. birencontractor

ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ

(ગુજરાત સરકારનું સાહસ)

"જવસવા ભવન", ૬૧ સી. ૧, અરકાસ સ્ટેશન સામે, સેક્ટર-૧૦-એ, માંધીનગર.

ફોન : (૦૭૯) ૨૩૨૫૧૦૮૬

ફોન નં. : ૯૧-૦૭૯-૨૩૨૫૧૦૮૬, ૨૩૨૨૨૪૧૭

E-mail : msgwssb@gmail.com

Website : www.gwssb.gujarat.gov.in

એમ. ધોળકિયા, આઈ.એ.એસ.
સભ્ય સચિવ

ક્રમાંક: એમએસ/પીએ/ ૨૩ /૨૦૧૮

તા. ૨૬.૧૨.૨૦૧૮

પ્રતિ,

મુખ્ય ઈજનેરશ્રી

ઝોન-૧/૨/૩/૪/૫

વડોદરા/અમદાવાદ/રાજકોટ/ભુજ/જૂનાગઢ

પ્રોજેક્ટ ડાયરેક્ટર(અર્બન સેલ)

માંધીનગર

વિષય : ખોદાણની કામગીરીમાં હાર્ડ રોકની આઈટમ બાબતે અગત્યની સુચનાઓ

અત્રેની કચેરીમાં રજૂ થતી વિવિધ ટેન્ડર મંજુરીઓ તેમજ એકસેસ- સેવીંગ તથા એકસ્ટ્રા આઈટમની દરખાસ્તની ચકાસણી કરતાં માલૂમ પડેલ છે કે, ટેન્ડર અંતર્ગત થયેલ / થનાર હાર્ડ રોક ખોદાણની આઈટમ BOQ માં હોવા બાબતે તથા ખોદાણમાં જો હાર્ડ રોકનો જથ્થો એકસેસ ક્વોન્ટિટી અથવા એકસ્ટ્રા આઈટમ તરીકે ગણતરીમાં લેવાનો થાય તેવા કિસ્સામાં દરખાસ્તમાં સરકારશ્રીના ધારાધોરણો અનુસાર નીચે મુજબની વિગતો રજૂ કરવાની રહેશે.

- (૧) સર્વે દરમ્યાન/યોજનાકીય કામગીરી દરમ્યાન પાઈપલાઈન એલાઈનમેન્ટની આજુબાજુના વિસ્તારમાં આવેલ હયાત કૂવા/બોરના સ્ટ્રેટાની વિગતો
- (૨) એલાઈનમેન્ટ પર ટ્રાયલપીટ/ટ્રાયલબોર કરી મળેલ સ્ટ્રેટાની વિગતો
- (૩) હાર્ડ રોક બાબતે પ્રથમ ભૂસ્તરશાસ્ત્રીનો અહેવાલ મેળવી રજૂ કરવાનો રહેશે.
- (૪) હાર્ડ રોક બાબતે સરકાર માન્ય લેબોરેટરી કે " ગેરી" માં પેટ્રોગ્રાફિક ટેસ્ટના (Petrographic Test for Mineralogy of the Rock) પરિણામો આધારે હાર્ડ રોકનો પ્રકાર તથા પથ્થરની વિવિધ એન્જીનીયરીંગ પ્રોપર્ટી અંગે કરાયેલ પરિક્ષણો જેવા કે- કોમ્પ્રેસીવ સ્ટ્રેન્થ, ક્ષર્ણિગ સ્ટ્રેન્થ, વોટર એબશોર્પશન, ડ્યુરેબીલીટી, વેધરીંગ ટેસ્ટના પરિણામો સામેલ રાખવાના રહેશે.
- (૫) હાર્ડ રોકના ખોદાણમાંથી નીકળેલ જથ્થાનું સાઈઝ તેમજ એન્જીનીયરીંગ પ્રોપર્ટી આધારિત ઉપયોગી અને બિનઉપયોગી જથ્થામાં વર્ગીકરણ (Classification) કરાવવાનું રહેશે અને તે અંગેનો નિયત રેકર્ડ નિભાવવાનો રહેશે.
- (૬) ઉપયોગી જથ્થા માટે સાઈટ ઉપર તેનો અલગથી સ્ટેક (Stack) કરી યોજનાકીય કામમાં મેશનરી-રબ્બલ, સોલીંગ, કોંક્રીટ-એગ્રીગેટ, રોડ મેટલ તરીકે ઉપયોગ થઈ શકે તે મુજબ ઈસ્યુ કરી તેનો રેકર્ડ નિભાવવાનો રહેશે. આ અંગેની નિયમાનુસાર વસૂલાત કરવાની રહેશે.

- (૭) બીનઉપયોગી તેમજ ઉપયોગી પૈકી ફાજલ થયેલ હાર્ડ રોક જથ્થાની હરાજી કરી નિકાલ કરવાનો રહેશે.
- (૮) જો હરાજી કરવામાં ન આવે તો ઉપયોગી જથ્થાની કિંમત જેટલી રકમની કપાત એજન્સીને ચૂકવવાના થતાં નાણાંમાંથી કરવાની રહેશે.
- (૯) હાર્ડ રોક ખોદાણ માટે ઉપયોગમાં લેવાયેલ બ્લાસ્ટીંગ મટીરીયલની નિયમોનુસાર મંજૂરી/સાયવણી કરવાની રહેશે. ઉપયોગમાં લેવાયેલ જથ્થાની વિગતોનો રેકર્ડ નિભાવવાનો રહેશે.
- (૧૦) જો ઉક્ત તમામ મુદ્દાની પૂર્તતા સાધનિક રેકર્ડ /પરિણામોની નકલ સહ કરવામાં આવેલ ન હોય તો હાર્ડ રોકની આઈટમને સોફ્ટ રોક તરીકે ગણી તે મુજબના દરે ચૂકવણું કરવાનું રહેશે. આ માટે એજન્સી પાસેથી જરૂરી સંમતિ મેળવી લેવાની રહેશે જેથી ભવિષ્યમાં કોઈ કાનૂની બાબતો ઉપસ્થિત ન થાય.

ઉક્ત મુદ્દાઓની પૂર્તતા કર્યા બાદ જ દરખાસ્ત બોર્ડ કચેરીમાં મંજૂરી અર્થે રજૂ કરવાની રહેશે.

M. S. Patel
(તુષાર ધોળકિયા)

નકલ સવિનય રવાના પ્રતિ:

- (૧) માનનીય અધ્યક્ષશ્રી, ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ, ગાંધીનગર
- (૨) વહીવટી સંચાલકશ્રી, ગુજરાત વોટર ઈન્ફ્રાસ્ટ્રક્ચર લીમિટેડ, ગાંધીનગર
- (૩) મુખ્ય કારોબારી અધિકારીશ્રી, વાસ્મો, ગાંધીનગર

નકલ રવાના પ્રતિ:

- (૧) મુખ્ય ઈજનેરશ્રી (ટેકનીકલ સેલ) ને જાણ તથા રજૂ થતી દરખાસ્તોમાં ઉપરોક્ત મુદ્દાઓની ચકાસણી થવા સારું.
- (૨) મુખ્ય ઈજનેરશ્રી (યાંત્રિક) બોર્ડ કચેરી, ગાંધીનગરને જાણ તથા જરૂરી કાર્યવાહી સારું થવા સારું.
- (૩) નાણાં નિયંત્રકશ્રી, બોર્ડ કચેરી, ગાંધીનગરને જાણ તથા ઉપરોક્ત મુદ્દાઓની ચકાસણી થવા સારું.
- (૪) માસ્ટર કાઉન્સિલ

ટેન્ડરમાં ભરેલ અસામાન્ય ઉંચા ભાવોના સંદર્ભે કામ પર પડતા ખર્ચ પર નિયંત્રણ રાખવા તથા કામની નાણાંકીય પ્રગતિ ભૌતિક પ્રગતિ સાથે સુમેળમાં રહે તે માટે જરૂરી જોગવાઈ કરવા બાબત.

ગુજરાત સરકાર
માર્ગ અને મકાન વિભાગ
પરિપત્ર ક્ર. પરચ/૧૦૨૦૦૮/(૬૧)/સ
તા.૨૭-૧૧-૨૦૦૮.

પરિપત્ર :

ટેન્ડરમાં અસામાન્ય ઉંચા કે નીચા ભાવો ડિજિટાઇઝેશન દ્વારા ઘણી વાર ભરાતા હોવાનું સરકારશ્રીના ધ્યાન પર આવેલ છે. આવા કિસ્સાઓમાં કામની નાણાંકીય પ્રગતિ અને ભૌતિક પ્રગતિનો સુમેળ ન રહેવાની સંભાવના રહેલી છે. આથી કામની ભૌતિક પ્રગતિ પ્રમાણે નાણાંકીય પ્રગતિ રહે કે જેથી સરકારશ્રી પર સમય વહેલાં અયોગ્ય નાણાંકીય બોજ ન પડે તે માટે નીચે મુજબની જોગવાઈ ટેન્ડરમાં કરવાનો નિર્ણય કરવામાં આવેલ છે. આ જોગવાઈ તમામ કામોના આ પરિપત્રની તારીખ પછી મંજૂર થતાં ડી.ટી.પી. માં અચૂક પણ કરવાની રહેશે.

જોગવાઈ :

જે કોઈ આઈટમનો ભરેલ ભાવ તે આઈટમના ટેન્ડરમાં મૂકેલ અંદાજ ભાવ કરતાં ટેન્ડરમાં મૂકેલ અંદાજ રકમથી સમગ્ર ટેન્ડર જેટલા ટકા ઉંચુ કે નીચું મંજૂર થયું હોય તે ટકાવારીથી ૧૦% થી વધુ ઉંચો રહેતો હોય તેવી આઈટમનું ચૂકવણું રેન્જિંગ બીલ વખતે જે તે આઈટમના અંદાજ ભાવ +/- મંજૂર ટેન્ડરની ટકાવારી + તે આઈટમના અંદાજ ભાવની ૫% ની મર્યાદામાં કરવામાં આવશે. આ રીતે વીથહેલ રાખેલ કામ સંતોષકારક રીતે પૂર્ણ થયે ફાઇનલ બિલ મંજૂર કરતી વખતે વ્યાજભારણ વગર છૂટી કરવામાં આવશે.

ઉક્ત જોગવાઈની સ્પષ્ટ સમજણ માટે આ સાથે આપેલ ઉદાહરણ ધ્યાને લેવું.

અનુ.....૨

(૨)

૧.	ટેન્ડરમાં મૂકેલ અંદાજી રકમ	રૂ. ૧૦૦/-
૨.	મંજૂર થયેલ ટેન્ડરની રકમ	રૂ. ૧૧૦/-
૩.	ટેન્ડરમાં મૂકેલ અંદાજી રકમ સામે ખરેખર મંજૂર થયેલ ટેન્ડરની ટકાવારી	રૂ. ૧૦%
૪.	ટેન્ડરની એક આઈટમનો ટેન્ડરમાં મૂકેલ અંદાજી ભાવ	રૂ. ૧૦/-
૫.	તે આઈટમનો ભરેલ ભાવ	રૂ. ૧૪/-
૬.	તે આઈટમમાં ભરેલ ઊંચા ભાવની ટકાવારી	૪૦%
૭.	તે આઈટમ માટે રનીંગ બીલ વખતે ચૂકવવાપાત્ર ભાવ	રૂ. ૧૦ + કોલમ-૩ પ્રમાણે ૧૦% ઊંચા + અંદાજી ભાવના ૫% = રૂ. ૧૧.૫૦
૮.	ફાઇનલ બિલ વખતે વ્યાજ ભારણા વગર ચૂકવવાપાત્ર થતો વીશ હેલ્ડ રાખેલ ભાવ.	રૂ. ૧૪.૦૦ - રૂ. ૧૧.૫૦ રૂ. ૨.૫૦

જો સંદર આઈટમના ભાવ રૂ. ૧૨/- કે તેથી નીચે ભરેલ હોત તો રનીંગ બિલમાં ભાવ કપાત આ જોગવાઈ મુજબ કરવાની રહેતી નથી.

સર્/

(આર.કે ચૌહાણ)
ખાસ ફરજ પરના અધિકારી
માર્ગ અને મકાન વિભાગ

પ્રતિ,
તમામ અધિકારક ઈજનેરશ્રીઓ, માર્ગ અને મકાન વિભાગ,
તમામ કાર્યપાલક ઈજનેરશ્રીઓ, મા.મ. વિભાગ

નકલ રવાના :

૧. સચિવશ્રીના અંગત મદદનીશશ્રી, મા.મ. વિભાગ.
૨. તમામ મુખ્ય ઈજનેરશ્રી અને અ.સે.શ્રી મા.મ. વિભાગ.
૩. તમામ તાંત્રિક ઉપસચિવશ્રીઓ, મા.મ. વિભાગ
૪. ના.કા.ઈ.શ્રીઓ, મા.મ. વિભાગ પ્રે.પર
૫. નાણા શાખા, મા.મ. વિભાગ
૬. ના.સે.અ. સિલેક્ટ ફાઇલ
૭. શાખા સિલેક્ટ ફાઇલ.

ટેન્ડરમાં ભરેલ અસામાન્ય ઉંચા ભાવોના સંદર્ભે કામ પર
પડતા ખર્ચ પર નિયંત્રણ રાખવા તથા કામની નાણાકીય પ્રગતિ
સાથે મુમેળમાં રહે તે માટે જરૂરી જોગવાઈ કરવા બાબત.

ગુજરાત સરકાર

માર્ગ અને મહાનિ વલિભાગ,

પરિપત્ર ક્ર : ૫૨૨ / ૧૦૨૦૦૮ / (૬૧) / સી

તારીખ : ૦૩/૦૫/૧૩

વેચાણે લીધા- પરિપત્ર ક્રમાંક :- ૫૨૨ / ૧૦૨૦૦૮ / (૬૧) / સી તા. ૨૭/૧૧/૨૦૦૮

આમુખ :-

ટેન્ડરમાં ઈજારદારશ્રીએ દાતા ભરતા Imbalance ભાવો વાળા ટેન્ડરના કિસ્તાઓમાં ઈજારદારશ્રીએ દાતા ઉંચા ભાવની આઈટમોની કામગીરી ક્યાં બાદ નીચા ભાવની આઈટમોની કામગીરી ન કરવામાં આવે તેવી પરિસ્થિતિ પર નિયંત્રણ રાખવા માટે તા. ૨૭-૧૧-૨૦૦૮ નો પરિપત્ર જરૂરી જોગવાઈ સાથે બહાર ધાડવામાં આવેલ. આ પરિપત્ર અંગે વિવિધ સ્તરોએ થયેલ રજૂઆતોને ધ્યાને લેતાં અને તેના પર પુખ્ત વિચારણાના અને આ પરિપત્રના ભીજા કરવાની છેલ્લી તીતી " આ રીતે વીધતેલ રાખેલ રકમ કામ સંતોષકારક રીતે પુર્ણ થયે કલનલ ખીલ મેટુર કરતી વખતે વ્યાજભારણ વગર છુટી કરવામાં આવશે" તેની જગ્યાએ નીચે મુજબનો સુધારો કરવામાં આવે છે.

સુધારો :-

" આ રીતે વીધતેલ રાખેલ રકમ અસાધારણ નીચા ભાવ ભરેલ હોય તેવી આઈટમની નાણાકીય પ્રગતિના પ્રમાણસર રનીગ ખીલમાંથી છુટી કરવાની રહેશે. જે કિસ્તામાં અસાધારણ નીચા ભાવ ભરેલ કોઈપણ આઈટમ ન હોય તેવા કિસ્તામાં અસાધારણ ભાવો ભરેલ આઈટમની સામે વીધતેલ રાખેલ રકમ બાકી રહેતી કામગીરી ચાલ તેના પ્રમાણસર રનીગ ખીલમાંથી છુટી કરવાની રહેશે."

વધુમાં વેચાણે લીધેલ પરિપત્ર ના ઉદાહરણમાં દર્શાવેલ ક્રમાંક - ૮ ૨૬ કરવામાં આવે છે.

ઉપરોક્ત સુધારાનો અમલ આ પરિપત્રની તારીખ પાછી મેટુર થતા ડી.ટી.પી.માં અલુકપણે કરવાનો રહેશે.

(આર.કે.સી.સી.સી.)
આસ કચેરા પરના અધિકારી(વિ.પો.)
માર્ગ અને મકાન વિભાગ.

પ્રતિ,
સર્વે અધિકારક ઈજનેરશ્રીઓ, મા.મ. વિભાગ (પાટનગર પોલીસ વર્તુલ, નેશનલ હાઈવે વર્તુલ સહિત)
સર્વે અધિકારક ઈજનેરશ્રીઓ, (પંચાયત)મા.મ. વિભાગ
સર્વે કાર્યપાલક ઈજનેરશ્રીઓ, મા.મ. વિભાગ.
સર્વે કાર્યપાલક ઈજનેરશ્રીઓ, (પંચાયત) મા.મ. વિભાગ.

નકલ રવાના :

1. અગ્રસચિવશ્રીના અંગત મહાદનીશશ્રી, મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
2. સર્વે મુખ્ય ઈજનેરી અને અ.સ.શ્રીઓ, મા.મ.વિભાગ.
3. સર્વે તાત્કાલિક ઉપસચિવશ્રીઓ, મા.મ. વિભાગ.

કચ્છના સર્વે સમ
પર નક્કી કરવામાં આવેલા કાયદાકીય પ્રકારે સમ
પરિવાર કરવા બાબતે.

મુજબત સરકાર
માર્ગ અને મકાન વિભાગ
પરિપત્ર ક્રમાંક: પરવ-૧૦૨૦૦૮-૧૬૧) સી
તા. ૦૩-૦૫-૨૦૧૩

વંચાણે લીધા: પરિપત્ર ક્રમાંક: પરવ-૧૦૨૦૦૮-૧૬૧) સી તા. ૨૦-૧૧-૨૦૦૮

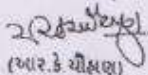
આમુખ:

ટેન્ડર માં ઈજનેરશ્રીઓ દ્વારા ભરાતા Imbalance ભાવો ગણા કેન્ડરના કિસ્સાઓમાં ઈજનેરશ્રીઓ
દ્વારા લીધા ભાવની આઈટમોની કામગીરી કર્યા બાદ નીચા ભાવની આઈટમોની કામગીરી ન કરવામાં આવે
તેવી પરિસ્થિતિ પર નિયંત્રણ રાખવા માટે તા. ૨૦-૧૧-૨૦૦૮ નો પરિપત્ર જરૂરી જોગવાઈ સાથે બહાર
પાડવામાં આવેલ. આ પરિપત્ર અંગે વિવિધ સ્તરોએ થયેલ સુચનાતોને ધ્યાને લેતાં અને તેના પર પુખ્ત
વિચારણાના અંતે આ પરિપત્રના બીજા કક્કરાની છેલ્લી લીટી "આ રીતે વીથહેલ રાખેલ રકમ કામ
કાંતોષકરક રીતે પુર્ણ થયે કાર્યનાલ બીલ મંજૂર કરતી વખતે વ્યાજપત્રણ વગર છૂટી કરવામાં આવશે"
તેની જગ્યાએ નીચે મુજબનો સુધારો કરવામાં આવે છે.

સુધારો:

"આ રીતે વીથહેલ રાખેલ રકમ અસાધારણ નીચા ભાવ ભરેલ હોય તેવી આઈટમની નાણાકીય
પગલિનાં પ્રમાણસર, રનીજ બીલમાંથી છૂટી કરવાની રહેશે. જ કિસ્સામાં અસાધારણ નીચા ભાવ ભરેલ
કોઈપણ આઈટમ ન હોય તેવા કિસ્સામાં અસાધારણ ભાવો ભરેલ આઈટમોની સામે વીથહેલ રાખેલ રકમ
બાકી રહેતી કામગીરી સાથે તેના પ્રમાણસર રનીજ બીલમાંથી છૂટી કરવાની રહેશે."

વધુમાં વંચાણે લીધેલ પરિપત્ર ના ઉદ્દેશ્યમાં દર્શાવેલ ક્રમાંક ૨૯ કરવામાં આવે છે.
ઉપરોક્ત સુધારાનો અમલ આ પરિપત્રની તારીખ પછી મંજૂર થતા ડીટી.પી માં અચૂકપણે
કરવાનો રહેશે.


(આર.કે.ચૌહાણ)
માસ ફરજ પરના અધિકારી(વિ.વો)
માર્ગ અને મકાન વિભાગ

પ્રતિ,
સર્વે અધિકાર ઈજનેરશ્રીઓ, મા.મ. વિભાગ (પાટનગર ચોજના વર્તુલ, નેરુનલ હાઈવે વર્તુલ સહિત),
સર્વે અધિકાર ઈજનેરશ્રીઓ (પંચાયત) મા.મ. વિભાગ,
સર્વે કાર્યપાલક ઈજનેરશ્રીઓ, મા.મ. વિભાગ,
સર્વે કાર્યપાલક ઈજનેરશ્રીઓ (પંચાયત), મા.મ. વિભાગ.

- નકલ રવાના:
- ૧ અગ્ર સચિવશ્રીના અંગત મદદનીશશ્રી મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
 - ૨ સર્વે મુખ્ય ઈજનેર અને અશ્રીઓ, મા.મ. વિભાગ
 - ૩ સર્વે તંત્રિક ઉપ સચિવશ્રીઓ, મા.મ. વિભાગ
 - ૪ ના.હ.ઈ.શ્રીઓ, મા.મ. વિભાગ
 - ૫ નાણાં શાખા, મા.મ. વિભાગ
 - ૬ ના.સે.અ., સી શાખા, મા.મ. વિભાગ, સિલેક્ટ ફાઇલ
 - ૭ શાખા સિલેક્ટ ફાઇલ - ૨૦૧૩

ટેન્ડરમાં ભરેલ અસામાન્ય ઉચા ભાવોના સંદર્ભે કામ પર પડતા ખર્ચ પર નિયંત્રણ રાખવા તથા કામની નાણાકીય પ્રગતિ સાથે સુમેળમાં રહે તે માટે જરૂરી જોગવાઈ કરવા બાબત.

ગુજરાત સરકાર

માર્ગ અને મકાન વિભાગ,

પરિપત્ર ક્ર : પરચ / ૧૦૨૦૦૮ / (૬૧) / સી

તારીખ : ૦૩/૦૫/૧૩

વંચાણે લીધા:- પરિપત્ર ક્રમાંક :- પરચ / ૧૦૨૦૦૮ / (૬૧) / સી તા. ૨૭/૧૧/૨૦૦૮

આમુખ :-

ટેન્ડરમાં ઈજારદારશ્રીઓ દ્વારા ભરાતા Imbalance ભાવો વાળા ટેન્ડરના કિસ્સાઓમાં ઈજારદારશ્રીઓ દ્વારા ઉચા ભાવની આઈટમોની કામગીરી કર્યા બાદ નીચા ભાવની આઈટમોની કામગીરી ન કરવામાં આવે તેવી પરિસ્થિતિ પર નિયંત્રણ રાખવા માટે તા. ૨૭-૧૧-૨૦૦૮ નો પરિપત્ર જરૂરી જોગવાઈ સાથે બહાર પાડવામાં આવેલ. આ પરિપત્ર અંગે વિવિધ સ્તરોએ થયેલ રજૂઆતોને ધ્યાને લેતાં અને તેના પર પુખ્ત વિચારણાના અંતે આ પરિપત્રના બીજા કકરાની છેલ્લી લીટી " આ રીતે વીથહેલ રાખેલ રકમ કામ સંતોષકારક રીતે પુર્ણ થયે કાયમલ બીલ મંજૂર કરતી વખતે વ્યાજભારણ વગર છૂટી કરવામાં આવશે" તેની જગ્યાએ નીચે મુજબનો સુધારો કરવામાં આવે છે.

સુધારો :-

" આ રીતે વીથહેલ રાખેલ રકમ અસાધારણ નીચા ભાવ ભરેલ હોય તેવી આઈટમની નાણાકીય પ્રગતિના પ્રમાણસર રનીંગ બીલમાંથી છૂટી કરવાની રહેશે. જે કિસ્સામાં અસાધારણ નીચા ભાવ ભરેલ કોઈપણ આઈટમ ન હોય તેવા કિસ્સામાં અસાધારણ ભાવો ભરેલ આઈટમની સામે વીથહેલ રાખેલ રકમ બાકી રહેતી કામગીરી થાય તેના પ્રમાણસર રનીંગ બીલમાંથી છૂટી કરવાની રહેશે."

વધુમાં વંચાણે લીધેલ પરિપત્ર ના ઉદાહરણમાં દર્શાવેલ ક્રમાંક - ૮ રદ કરવામાં આવે છે.

ઉપરોક્ત સુધારાનો અમલ આ પરિપત્રની તારીખ પછી મંજૂર થતા ડી.ટી.પી.માં અચુકપણે કરવાનો રહેશે.

(આર.કે.ચૌહાણ)

ખાસ ફરજ પરના અધિકારી(વિ.યો.)

માર્ગ અને મકાન વિભાગ.

પ્રતિ,

સર્વે અધિક્ષક ઈજનેરશ્રીઓ, મા.મ. વિભાગ (પાટનગર યોજના વર્તુળ, નેશનલ હાઈવે વર્તુળ સહિત)

સર્વે અધિક્ષક ઈજનેરશ્રીઓ, (પંચાયત)મા.મ. વિભાગ

સર્વે કાર્યપાલક ઈજનેરશ્રીઓ, મા.મ. વિભાગ.

સર્વે કાર્યપાલક ઈજનેરશ્રીઓ, (પંચાયત) મા.મ. વિભાગ.

નકલ રવાના :

૧. અગ્રસચિવશ્રીના અંગત મદદનીશશ્રી, મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
૨. સર્વે મુખ્ય ઈજનેરી અને અ.સ.શ્રીઓ, મા.મ.વિભાગ.
૩. સર્વે તાંત્રિક ઉપસચિવશ્રીઓ, મા.મ. વિભાગ.
૪. ના.કા.ઈ.શ્રીઓ, મા.મ. વિભાગ
૫. નાણાં શાખા, મા.મ. વિભાગ.
૬. ના.સે.અ. સી શાખા, મા.મ. વિભાગ,સિલેક્ટ ફાઈલ.
૭. શાખા સિલેક્ટ ફાઈલ ૨૦૧૩.

બાંધકામ મટીરીયલ્સ એન કોમ્પોનેન્ટ્સ સેમ્પલની
ગુણવત્તા માટેના પરીક્ષણ પૈકીના ૮૦% પરીક્ષણ
સ્થળ પર તથા ૧૦% પરીક્ષણ સરકાર માન્ય
લેબોરેટરીમાં કરાવવા બાબત.

ગુજરાત સરકાર
માર્ગ અને મકાન વિભાગ
પરિપત્ર ક્રમાંક :- પરચ/૧૦૨૦૦૭/૨૮/ સી
સચિવાલય, ગાંધીનગર
તા.૧૭/૦૫/૨૦૧૯

વંચાણે લીધા :- મા.મ. વિ.નો પરીપત્રનો ક્રમાંક :- પરચ / ૧૦૨૦૦૭ / ૨૮ / સી, તા.૩૧/૧૨/૨૦૦૯

આમુખ :-

માર્ગ અને મકાન વિભાગના બાંધકામના માલસામાનને પરીક્ષણો માટે સંદર્ભમાં દર્શાવેલ પરિપત્ર બહાર પાડવામાં આવેલ હતો. આ પરિપત્રમાં દર્શાવેલ માલસામાન માટે પરીક્ષણોની સંખ્યાનાં ૧૦% નમુનાના પરીક્ષણ ઓછામાં ઓછુ એક પરીક્ષણ ગેરીમાં કરાવવા, ૧૦% નમુનાનાં પરીક્ષણો સરકાર માન્ય લેબોરેટરીનો તથા ૮૦ % નમુનાના પરીક્ષણો પ્લાન્ટ સાઈટ પર કરવાની સુચના આપેલ હતી. સમય જતા ગેરીમાંથી સમયસર પરીક્ષણોના પરીક્ષણમાં કામના ભારણને કારણે સમયમર્યાદામાં મળતા ન હતા. તેમજ જિલ્લા કક્ષાની ગેરી લેબોરેટરીમાં મર્યાદિત મટીરીયલના પરીક્ષણો થતા હોય, કેટલાંક મટીરીયલના પરીક્ષણો ગેરીની અન્ય જિલ્લાની લેબોરેટરીમાં આપવાના થાય છે. ક્ષેત્રિય કચેરીની રજૂઆત અન્વયે આ પરિપત્રમાં સુધારા કરવાની બાબત વિચારણા હેઠળ હતી. ઉક્ત વિચારણાને અંતે પ્રસ્તુત પરિપત્રમાં નીચે મુજબ ફેરફાર કરવામાં આવે છે. જે આ પરિપત્ર કર્યાની તારીખથી અમલમાં મુકવાનો રહેશે.

પરિપત્ર :-

બાંધકામના માલસામાનનાં કરવા પાત્ર પરીક્ષણો પૈકી ૮૦ % પરીક્ષણો પ્લાન્ટ સાઈટ પર, ૧૦ % પરીક્ષણો સરકાર માન્ય લેબોરેટરી અને ૧૦ % પરીક્ષણો ગેરી / સરકારી ઈજનેર કોલેજ / સરકારી પોલીટેકનીક કોલેજમાં કરાવવાના રહેશે. દરેક માલસામાનનું ઓછામાં ઓછુ એક પરીક્ષણ ગેરીમાં કરાવવાનું રહેશે.

ઉક્ત જોગવાઈઓ સિવાય મા.મ. વિભાગના તા.૩૧/૧૨/૨૦૦૯ ના પરિપત્રની અન્ય જોગવાઈ / શરતો યથાવત રહેશે.

(એ. એન. મિસ્ત્રી)

ખાસ ફરજ પરના અધિકારી (વિ.યો.)

માર્ગ અને મકાન વિભાગ

ટેન્ડર માટેની વાટાઘાટોની નિતી
નક્કી કરવા બાબત.

ગુજરાત સરકાર,
માર્ગ અનેમકાનવિભાગ,
બ્લોક નં. ૧૪/૨, સરદારભવન,
સચિવાલય, ગાંધીનગર
ક્રમાંક : એસ / ૨૨ / ૨૦૧૭ / ૬૩૯ / ૩
તા.૦૮/૦૬/૨૦૧૮


આમુખ:-

માર્ગ અને મકાનવિભાગનાવિવિધકામોમાટે જાહેર નિવિદાથી ટેન્ડર માંગવામાં આવે છે. ક્યારેક ઈજારદારે ભરેલ ટેન્ડરનાભાવ જે તે વિસ્તારમાં ટેન્ડર મંજૂરીના નિર્ણય કરવાના સમયે જે તે ટેન્ડરના કામના વિસ્તારમાં મંજૂર થયેલ અન્ય ટેન્ડરની સરખામણીમાં ઉચ્ચ જણાય તેવા સંજોગોમાં ઈજારદારશ્રીને વાટાઘાટ માટે બોલાવવામાં આવે છે. ક્યારેક જે તે ટેન્ડરભરનાર ઈજારદાર વારંવાર વાટાઘાટની તારીખ અને સમય ફાળવ્યા બાદ સક્ષમ અધિકારી પાસે વાટાઘાટ માટે આવતા નથી / વેલીડીટી લંબાવી આપતા નથી. તેમજ વેલીડીટી પીરીયડ પુરો થાય ત્યાં સુધી પોતે વાટાઘાટ કરવા માંગતા નથી તે પ્રકારનો પત્ર પણ આપતા નથી. તે કારણોસર ટેન્ડરની વેલીડીટી પૂર્ણ થવાથી ટેન્ડર ફરીવાર માંગવાની જરૂરીયાત ઉપસ્થિત થાય છે. જેના કારણે પ્રજાલક્ષી કામોમાં વિલંબ પણ થાય છે. પુખ્ત વિચારણાને અંતે નીચે મુજબનો પરિપત્ર કરવામાં આવે છે.

પરિપત્ર :-

ટેન્ડર મંજૂરીની દરખાસ્ત કરતી સમયે જે તે ક્ષેત્રિય કચેરીમાંથી જે તે વિસ્તારનાં સમાનપ્રકારનાં છેલ્લા છ માસમાં મંજૂર થયેલ કામોની વિગતો સાથે કેટલી રકમ સુધીનું ટેન્ડર મંજૂર કરવાપાત્ર રહે છે. તે વિગત સાથે દરખાસ્ત કરવાની રહેશે. ઈજારદારશ્રીને ટેન્ડર વેલીડીટી તેમજ ટેન્ડર મંજૂરીનો સમયગાળો ધ્યાનમાં લઈ વધુમાં વધુ ત્રણ વખત વાટાઘાટ માટે જાણ કરવામાં આવશે. જો ઈજારદારવાટાઘાટકરવા માંગતા ન હોય તો તેમણે વાટાઘાટની સુચના મળ્યાબાદ તરતજ તેઓ વાટાઘાટ કરવા માંગતા નથી તે મુજબનો પત્ર પાઠવવાનો રહેશે. જો ઈજારદાર ટેન્ડરની વેલીડીટી પૂર્ણ થવાના સમયવાળા સુધીમાં પણ આ પ્રકારનો પત્ર પાઠવશે નહીં અથવા વાટાઘાટ કરશે નહીં તો તેમનું ટેન્ડર રદ ગણવામાં આવશે અને તેમની બાનાની રકમ જપ્ત કરવામાં આવશે તેમજ ઈજારદાર પર શિક્ષાત્મક કાર્યવાહી હાથ ધરવામાં આવશે. આ પરિપત્રની તારીખથી Notice Inviting Tenders માં નીચે મુજબની વધારાની વિગત ઉમેરવાની રહેશે.

If found necessary contractor will be intimated for negotiation. He will be intimated maximum three times within validity period for negotiation. If contractor does respond in time, his earnest money will be forfeited and his tender will be rejected. Punitive action will be taken on such contractor.


(એ. એન. મિસ્ત્રી)
ઉપસચિવ (રા.ર.)
માર્ગ અનેમકાનવિભાગ
ગાંધીનગર

ઇજારદારશ્રીને કરેલ કામનું ચૂકવણું
RTGS/NEFT પદ્ધતિએ કરવા બાબત

ગુજરાત સરકાર
માર્ગ અને મકાન વિભાગ
બ્લોક નં.૧૪/૨, સરદાર ભવન,
સચિવાલય, ગાંધીનગર
પરિપત્ર ક્રમાંક:SSR-૧૦૨૦૧૭-૫૭-સી
તા.૩૦/૦૪/૨૦૧૮

આમુખ:-


ભારત સરકાર દ્વારા ડીઝીટલ ટ્રાન્ઝેક્શનનો વ્યાપક ઉપયોગ થાય અને બેંકો દ્વારા ઉપલબ્ધ વિવિધ ઓનલાઇન બેંકીંગ સેવાઓનો ઉપયોગ વ્યાપક થાય તે માટે દરેક રાજ્યને સુચનાઓ આપેલ છે અને રાજ્યોને સક્રીય સહયોગ આપવા જણાવેલ છે. ગુજરાત સરકાર દ્વારા પણ વિવિધ સરકારી કચેરીઓમાં કેશલેશ ટ્રાન્ઝેક્શન થાય એ મુજબની વ્યવસ્થા ગોઠવવા માટે વખતોવખત સૂચના આપવામાં આવેલ છે. ઇજારદારશ્રીઓના કરેલ કામનું ચૂકવણું RTGS/NEFTથી કરવાની પદ્ધતિથી ઇજારદારશ્રીઓને ઝડપથી નાણા મળી રહે છે. આ નેટ બેંકીંગ પદ્ધતિ ખૂબ જ અસરકારક અને હકારાત્મક પુરવાર થયેલ છે. ઇજારદારશ્રીએ કરેલ કામનું ચૂકવણું આજના આધુનિક બેંકીંગ પ્રમાણે RTGS/NEFTથી કરવા અંગે મળેલ વિવિધ રજૂઆતો અન્વયે પ્રસ્તુત બાબત સરકારશ્રીની વિચારણા હેઠળ હતી.

પરિપત્ર:-

ગુજરાત તિજોરી નિયમો, ૨૦૦૦ના નિયમ-૩૩૭ (પ્રકરણ-૧૪) અનુસાર જે તિજોરીઓની રોકડ લેવડ-દેવડ બેંક મારફતે થતી હોય ત્યાં શાખપત્ર અંગેના નિયમો પ્રકરણ-૧૩ની જોગવાઈને આધિન રહીને લાગુ પડે છે તેમજ માર્ગ અને મકાન વિભાગના કાર્યપાલક ઇજનેરશ્રીઓ ઉપાડ અને વહેંચણી અધિકારી તરીકે Cheque Drawingના Power ધરાવતા હોઇ, વિભાગીય કચેરી હસ્તકના ઇજારદારશ્રી દ્વારા કરેલ કામોના ચૂકવણાં માટે જીલ્લા તિજોરી ખાતેથી LC એડવાઇઝ મંજૂર કરાવી, LCનો ચેક કાઢી, બેંક મારફતે જે તે ઇજારદારશ્રીને RTGS/NEFTહેઠળ ચૂકવણું કરવાનું રહેશે.

ઉપરોક્ત તમામ સુચનાનો અમલ યુસ્તપણે તાત્કાલિક અસરથી કરવાનો રહેશે.

આ પરિપત્ર સરખાકમાંકની ડાઇલ ઉપર તા.૦૬/૧૨/૨૦૧૭થી મળેલ નાણાં વિભાગની સંમતિથી બહાર પાડવામાં આવે છે.


(એ.એન.મિસ્ત્રી)
ખાસ કરજ પરના અધિકારી (વિ.થી.)
માર્ગ અને મકાન વિભાગ
ગાંધીનગર

પ્રતિ.

૧. સચિવશ્રીના અંગત સચિવશ્રી.માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૨. સર્વે મુખ્ય ઇજનેરશ્રીઓ. માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૩. સર્વે મુખ્ય ઇજનેરશ્રીઓ, નર્મદા, જળસંપત્તિ પાણી પુરવઠા અને કલ્પસર વિભાગ, સચિવાલય, ગાંધીનગર
૪. મેનેજીંગ ડીરેક્ટરશ્રી. ગુજરાત રાજ્ય માર્ગ વિકાસ નિગમ, નિર્માણલવન, ગાંધીનગર
૫. મુખ્ય ઇજનેરશ્રી અને ડાયરેક્ટરશ્રી, સ્ટાક ટ્રેનીંગ કોલેજ, ગાંધીનગર
૬. ડાયરેક્ટરશ્રી, ગુજરાત એન્જીનીયરીંગ રીસર્ચ ઇન્સ્ટીટ્યુટ (ગેરી), વડોદરા
૭. નાણાં સલાહકારશ્રી, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૮. સર્વે અધિક્ષક ઇજનેરશ્રીઓ, માર્ગ અને મકાન વિભાગ (રાજ્ય, પંચાયત, ને.હા., પાટનગર યોજના વર્તુળ, વિદ્યુત વર્તુળ સહીત)
૯. એકાઉન્ટન્ટ જનરલશ્રી, રાજકોટ/અમદાવાદ
૧૦. સર્વે કાર્યપાલક ઇજનેરશ્રીઓ (ઉક્ત વર્તુળ હેઠળના)
૧૧. સર્વે તાંત્રિક અધિકારીશ્રીઓ, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૧૨. સર્વે તાંત્રિક શાખાઓ, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૧૩. પ્રમુખશ્રી, ગુજરાત કોન્ટ્રાક્ટર્સ એસોસીએશન, ગજ્જર હોલ, લો ગાર્ડન, લો કોલેજ રોડ, અમદાવાદ.
૧૪. શાખા સીલેક્ટ કાઇલ-૨૦૧૮

ગુજરાત સરકાર
માર્ગ અને મકાન વિભાગ
બ્લોક નં.૧૪/૨, સરદાર ભવન,
સચિવાલય, ગાંધીનગર
ઠરાવ ક્રમાંક TNC-10-2017-01-C
તા.૧૧/૦૭/૨૦૧૭

ઠરાવ

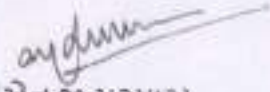
ટેન્ડરમાં જથ્થાવધારા તથા જથ્થાવધારાના ભાવના માપદંડ બાબતે બી-૧ અને બી-૨ ટેન્ડરના કલોઝ-૧૪.૨ માં જણાવ્યા મુજબ જથ્થાવધારા માટે ૩૦ ટકા સુધીનો જથ્થો ટેન્ડરના ભાવથી અને ૩૦ ટકાથી વધુ જથ્થામાં વધારો હોય તો જે તે વર્ષમાં કામગીરી કરેલ હોય તે વર્ષના એસ.ઓ.આર.થી કરવાની જોગવાઈ છે.

સદરહુ જોગવાઈમાં સુધારણા કરવા બાબતે સરકારશ્રીમાં ઘણા લાંબા સમયથી વિચારણા હેઠળ હતું. જે અન્વયે નીચે મુજબનો સુધારો કરવામાં આવે છે.

EXISTING CLAUSE	AMENDMENT
Form B-1 Clause- 14.2 Form B-2 Clause- 14.2 Except that when the quantity of any item exceeds the quantity as in the tender by more than 30% the contractor will be paid for the quantity in excess of 30% at the rate entered in the SOR of the year during which the excess in quantity is first executed and for the material consumed in excess quantity the rate for the material to be charged would be basic rate taken into account for fixing the rate for the SOR above instead of the rate stipulated in Schedule-A.	Form B-1 Clause- 14.2 Form B-2 Clause- 14.2 Except that when the quantity of any item exceeds the quantity as in the tender by more than 10% the contractor will be paid for the quantity in excess of 10% at the rate entered in the SOR of the year during which the excess in quantity is first executed or tender rate whichever is less.

ઉપરોક્ત તમામ સુચનાનો અમલ ચુસ્તપણે તાત્કાલિક અસરથી કરવાનો રહેશે.

ગુજરાત રાજ્યના રાજ્યપાલશ્રીના હુકમથી અને તેમના નામે,


(એન.કે.પરમાર)
ખાસ ફરજ પરના અધિકારી (વિ.યો.)
માર્ગ અને મકાન વિભાગ
ગાંધીનગર

પ્રતિ.

૧. નામ.રાજ્યપાલશ્રીના સચિવશ્રી, ગુજરાત રાજ્ય, રાજભવન, ગાંધીનગર
૨. માન. મુખ્યમંત્રીશ્રીના અગ્રસચિવશ્રી, ગુજરાત રાજ્ય, ગાંધીનગર
૩. માન.નાયબ મુખ્યમંત્રીશ્રીના અંગત સચિવશ્રી, ગુજરાત રાજ્ય, ગાંધીનગર
૪. માન. રાજ્ય કક્ષાનામંત્રીશ્રી (માર્ગ અને મકાન)ના અંગત સચિવશ્રી, ગુજરાત રાજ્ય, ગાંધીનગર
૫. અંગત સચિવશ્રી, સચિવશ્રીનું કાર્યાલય, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૬. અંગત સચિવશ્રી, સચિવશ્રીનું કાર્યાલય, નર્મદા, જળસંપત્તિ પાણી પુરવઠા અને કલ્પસર વિભાગ, સચિવાલય, ગાંધીનગર
૭. અંગત સચિવશ્રી, અગ્રસચિવશ્રીનું કાર્યાલય, આરોગ્ય અને પરિવાર કલ્યાણ વિભાગ, સચિવાલય, ગાંધીનગર
૮. અંગત સચિવશ્રી, અધિક મુખ્ય સચિવશ્રીનું કાર્યાલય શહેરી વિકાસ અને શહેરી ગૃહ નિર્માણ વિભાગ, સચિવાલય, ગાંધીનગર
૯. અંગત સચિવશ્રી, અગ્રસચિવશ્રીનું કાર્યાલય, પંચાયત, ગ્રામ ગૃહનિર્માણ અને ગ્રામ વિકાસ વિભાગ, સચિવાલય, ગાંધીનગર
૧૦. એકાઉન્ટન્ટ જનરલશ્રી, રાજકોટ/અમદાવાદ
૧૧. સર્વે મુખ્ય ઇજનેરશ્રીઓ, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૧૨. સર્વે મુખ્ય ઇજનેરશ્રીઓ, નર્મદા, જળસંપત્તિ પાણી પુરવઠા અને કલ્પસર વિભાગ, સચિવાલય, ગાંધીનગર
૧૩. મેનેજીંગ ડીરેક્ટરશ્રી, ગુજરાત રાજ્ય માર્ગ વિકાસ નિગમ, નિર્માણભવન, ગાંધીનગર
૧૪. મુખ્ય ઇજનેરશ્રી અને ડાયરેક્ટરશ્રી, સ્ટાક ટ્રેનીંગ કોલેજ, ગાંધીનગર
૧૫. ડાયરેક્ટરશ્રી, ગુજરાત એન્જીનીયરીંગ રીસર્ચ ઇન્સ્ટીટ્યુટ (ગેરી), વડોદરા
૧૬. ઉપસચિવશ્રી, ગુજરાત તકેદારી આયોગ, તકેદારી ભવન, ગાંધીનગર
૧૭. નાણાં સલાહકારશ્રી, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૧૮. સર્વે અધિક્ષક ઇજનેરશ્રીઓ, માર્ગ અને મકાન વિભાગ (રાજ્ય, પંચાયત, ને.હ., પાટનગર યોજના વર્તુળ, વિદ્યુત વર્તુળ સહીત)
૧૯. સર્વે કાર્યપાલક ઇજનેરશ્રીઓ (ઉક્ત વર્તુળ હેઠળના)
૨૦. સર્વે તાંત્રિક અધિકારીશ્રીઓ, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૨૧. સર્વે તાંત્રિક શાખાઓ, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૨૨. પ્રમુખશ્રી, ગુજરાત કોન્ટ્રાક્ટર્સ એસોસીએશન, ગજજરા હોલ, લો ગાર્ડન, લો કોલેજ રોડ, અમદાવાદ
૨૩. શાખા સીલેક્ટ ફાઇલ-૨૦૧૭

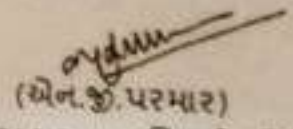
વેતને જાને જી લેસ ટી ના અમલવારી તથા
પરિવેશ રેટ (બી-૧) ટેન્ડર ફોર્મના માપદંડોમાં
સુધારો થતા બી-૧ અને બી-૨ ફોર્મના કલોઝમાં
સુધારા બાબત

પરિપત્ર ક્રમાંક: એસએસઆર-૧૦-૨૦૧૭-૫૦-સી
માર્ગ અને મકાન વિભાગ
બ્લોક નં. ૧૪, નવા સચિવાલય,
ગાંધીનગર
તા.૧૧/૦૮/૨૦૧૭

સુધારો:-

સંદર્ભ:- માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગરના પરિપત્ર ક્રમાંક: એસએસઆર-૧૦-૨૦૧૭-૫૦-સી
તા.૨૯/૦૮/૨૦૧૭

સંદર્ભમાં નિર્દિષ્ટ માર્ગ અને મકાન વિભાગના તા.૨૯/૦૮/૨૦૧૭ના પરિપત્રના ફોર્મ બી-૧ કલોઝ નં.૨૪
માં કરેલ સુધારો કે જેમાં જણાવેલ છે કે "ઇજારદારશ્રીને તેમણે કરેલ કામગીરી અંગે જ્યારે પણ બીલની ચૂકવણી
કરવાની થાય ત્યારે ઉપરોક્ત સૂચવેલ પદ્ધતિ પ્રમાણે તે કામ કરવામાં આવેલ છે કે કેમ? તેની ખરાબ સંબંધિત
અધિકૃત ઇજનેરશ્રી પાસે કરાવ્યા બાદ જ બીલનું ચૂકવણું કરવામાં આવશે" ને આથી રદ કરવામાં આવે છે.
આથી તા.૨૯/૦૮/૨૦૧૭ના પરિપત્રના ઉપરોક્ત સિવાયની બાકીની સૂચનાઓ યથાવત રહે છે. આ
સૂચનાનો યુસ્તપણે તાત્કાલિક અસરથી અમલ કરવાનો રહેશે.


(એન.કે. પરમાર)

ખાસ કરજ પરના અધિકારી (વિ.ચો.)
માર્ગ અને મકાન વિભાગ
ગાંધીનગર

પ્રતિ.

૧. અંગત સચિવશ્રી, સચિવશ્રીનું કાર્યાલય, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર
૨. અંગત સચિવશ્રી, સચિવશ્રીનું કાર્યાલય, નર્મદા, જળસંપત્તિ પાણી પુરવઠા અને કલ્પસર વિભાગ, સચિવાલય,
ગાંધીનગર
૩. અંગત સચિવશ્રી, અગ્રસચિવશ્રીનું કાર્યાલય, આરોગ્ય અને પરિવાર કલ્યાણ વિભાગ, સચિવાલય, ગાંધીનગર
૪. અંગત સચિવશ્રી, અધિક મુખ્ય સચિવશ્રીનું કાર્યાલય, શહેરી વિકાસ અને શહેરી ગૃહ નિર્માણ વિભાગ,
સચિવાલય, ગાંધીનગર
૫. અંગત સચિવશ્રી, અગ્રસચિવશ્રીનું કાર્યાલય, પંચાયત, ગ્રામ ગૃહનિર્માણ અને ગ્રામ વિકાસ વિભાગ,
સચિવાલય, ગાંધીનગર
૬. એકાઉન્ટન્ટ જનરલશ્રી, રાજકોટ/અમદાવાદ

જે ઈજારદારો રજીસ્ટ્રેશન ધરાવતા હોય
તેમના જ ટેન્ડર ખોલવા બાબત

ગુજરાત સરકાર
માર્ગ અને મકાન વિભાગ
પરિપત્ર ક્રમાંક:- ટીએનસી-૧૦-૨૦૧૬-(FA-591-16)-૦૨-સી
સચિવાલય, ગાંધીનગર
તા.૦૩-૦૯-૨૦૧૬

વંચાણે લીધા:- (૧) ઠરાવ ક્રમાંક:- આરજીએન-૬૦૮૯-૮-પાર્ટ-૧-સી તા.૨૭-૦૧-૧૯૯૮
(૨) ઠરાવ ક્રમાંક:- આરજીએન-૬૦૮૯-૮-પાર્ટ-૧-સી તા.૦૬-૦૮-૨૦૧૧


પરિપત્ર :-

કેટલીક મા.મ. વિભાગીય કચેરીઓ દ્વારા કોન્ટ્રાક્ટર તરફથી રજીસ્ટ્રેશન રીન્યુઅલ/કેટેગરી રીન્યુઅલની અરજી કરવામાં આવેલ હોય, પણ તેમનું રજીસ્ટ્રેશન રીન્યુઅલ/કેટેગરી રજીસ્ટ્રેશન જેતે ટેન્ડર ખોલવાની તારીખે ન મળેલ હોય / આપવામાં આવેલ ન હોય તેમ છતાં તેમનાં ટેન્ડર ખોલવામાં આવેલ હતાં. પરિણામે આ ટેન્ડર ફરીવાર મંગાવવાના થાય છે તેમજ તેના કારણે કામના અમલીકરણમાં વિલંબ થાય છે. આથી હવે આ બાબતે નીચે મુજબની કાર્યપદ્ધતિ યુસ્તપણે અમલમાં મુકવાની રહેશે.

કાર્યપાલક ઇજનેરશ્રી/અધિક્ષક ઇજનેરશ્રી ધ્વારા ટેન્ડર ખોલવાની તારીખે જે ઈજારદારો જેતે ટેન્ડર માટે પાત્રતા પ્રમાણેની કક્ષામાં રજીસ્ટ્રેશન ધરાવતા હોય તેમજ જેતે ટેન્ડર માટેની જરૂરી કેટેગરી/સ્પેશીલ કેટેગરીમાં પણ રજીસ્ટ્રેશન ધરાવતાં હોય, આમ આ બન્ને શરતો પુર્ણ કરતા હોય તેવા ઈજારદારોના જ ટેન્ડર ખોલવાનાં રહેશે.

ટેન્ડર ખોલવાની તારીખે જે ઈજારદારની રજીસ્ટ્રેશન રીન્યુઅલ/કેટેગરી રજીસ્ટ્રેશનની પ્રક્રિયા પુર્ણ થયેલ ન હોય, તેમનાં ટેન્ડર ખોલવાનાં રહેશે નહીં. તેમ છતાં આ પ્રકારનાં પાત્રતા ન ધરાવતાં ઈજારદારોનાં ટેન્ડર ખોલવામાં આવશે તો સંબંધિતોની જવાબદારી નક્કી કરવામાં આવશે તેની ગંભીરતાથી નોંધ લેવી.

આ પરિપત્ર ગુજરાત રાજ્ય બહાર રજીસ્ટર્ડ થયેલ કોન્ટ્રાક્ટર ધ્વારા જો ગુજરાતમાં વિભાગના કામોના ટેન્ડર ભરેલ હોય, તેવા કિસ્સામાં લાગુ પડશે નહીં.


(એ. એન. મિસ્ત્રી)
ઉપ સચિવ(રા.ર.)
માર્ગ અને મકાન

નકલ રવાના :-

- (૧) મા.નાયબ મુખ્ય મંત્રીશ્રી અને મંત્રીશ્રી (મા.મ.) વિભાગના અંગત સચિવશ્રીની જાણ સારૂ.
- (૨) મા.રા.ક..મંત્રીશ્રીનાં અંગત સચિવશ્રીની જાણ સારૂ.
- (૩) મુ.ઇ.(મા.મ.) અને અ.સ.શ્રી, મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
- (૪) મુ.ઇ.(પંચા.) અને અ.સ.શ્રી, મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
- (૫) મુ.ઇ.(ને.હા.) અને અ.સ.શ્રી, મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
- (૬) મુ.ઇ.(પા.યો.) અને અ.સ.શ્રી, મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
- (૭) મુ.ઇ.(ગુ.નિ.) અને અ.સ.શ્રી, મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
- (૮) નિયામકશ્રી (એસટીસી) સ્ટાફ સ્ટ્રેનીંગ કોલેજ, ગાંધીનગર
- (૯) મુ.ઇ.શ્રી (પી એન્ડ પી), મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
- (૧૦) નાણાંકીય સલાહકારશ્રી, (મા.મ.) વિભાગ, નાણાં વિભાગ, સચિવાલય, ગાંધીનગર
- (૧૧) સર્વે અ.ઇ.શ્રીઓ (મા.મ.) વર્તુળ, પેટા/ મા.મ.વર્તુળ/ ને.હા.વર્તુળ/ એક્સપ્રેસ -વે -
વર્તુળ/ પાટનગર યોજના વર્તુળ.
- (૧૨) સર્વે કા.ઇ.શ્રીઓ ઉપર્યુક્ત વર્તુળો હસ્તકના સર્વે વિભાગો.
- (૧૩) સર્વે તાંત્રિક અધિકારીશ્રીઓ (ના.કા.ઇ.શ્રીઓ સહિત)
- (૧૪) સર્વે પ્રોજેક્ટ શાખાઓ મા.મ. વિભાગ, સચિવાલય, ગાંધીનગર
- (૧૫) સીલેક્ટ ફાઇલ સી - શાખા, ૨૦૧૬

જે કામ માટે એકજ ટેન્ડર આવેલ હોય તે
ટેન્ડર પુન : માંગવા બાબત

ગુજરાત સરકાર,
માર્ગ અને મકાન વિભાગ
સુચના ક્રમાંક : TNC-10-2017-03-C(R&B)
સચિવાલય, ગાંધીનગર
તા. ૧૮/૦૨/૨૦૧૭

સંદર્ભ :- પીડીડબલ્યુ / ૧૦૨૦૦૭ / (ભાગ - ૧) સ

પ્રસ્તાવના :-

અનુભવે પ્રસ્થાપિત થયેલ છે કે, બાંધકામની કામગીરી માટે જાહેર નિવિદાથી ટેન્ડર માંગવામાં આવે છે ત્યારે કેટલીક વાર એક જ ઈજારદાર દ્વારા ટેન્ડર ભરવામાં આવે ત્યારે આ ટેન્ડર વિભાગીય કક્ષાએ ખોલ્યા બાદ વર્તુળ કચેરીમાં તથા કેટલાંક કિસ્સામાં સરકારમાં મંજૂરી અર્થે રજૂ કરવામાં આવે છે, તેમજ કેટલીક વાર ટેન્ડર નામંજૂર કરી પુન: માંગવાનો નિર્ણય કરવામાં આવે છે.

પ્રધાનમંત્રી ગ્રામ સડક યોજનાની માર્ગ દર્શિકા પ્રમાણે પ્રથમવારનું સીગલ ટેન્ડર નહી ખોલવા અને આવું સીગલ ટેન્ડર ફરીથી માંગવાની કાર્યવાહી કરવાની રહે છે. કેન્દ્રીય તકેદારી આયોગની માર્ગદર્શિકા મુજબ પણ એક માત્ર ટેન્ડર આવેલ હોય, તેવા કિસ્સામાં આવું ટેન્ડર મંજૂર નહી કરીને ફરીથી માંગવાની કાર્યવાહી કરવાની રહે છે અને ત્યાર પછીના પ્રયત્નોમાં પણ એક જ ટેન્ડર આવે તો આવું ટેન્ડર જો વ્યાજબી ભાવ વાળું હોય તેવા સંજોગોમાં ટેન્ડર મંજૂર કરવા વિચારણા કરી શકાશે.

ઠરાવ :-

પુખ્ત વિચારણાને અંતે ઉક્ત સંજોગોમાં નીચે મુજબની કાર્યપદ્ધતિ નક્કી કરવાનું ઠરાવવામાં આવે છે.

(૧) જે કામ / પેકેજ માટે માત્ર એક જ ટેન્ડર ભરાઈને આવેલ હોય તેવા કામ / પેકેજના ટેન્ડરને Single Tender ગણવાનું રહેશે. આ પ્રકારના કિસ્સામાં ટેન્ડર ખોલવાનું રહેશે નહી તથા ટેન્ડર પુન : માંગવાનું રહેશે. માત્ર વિશિષ્ટ સંજોગો, જેવા કે કુદરતી આપત્તી અને તાકીદની પરિસ્થિતિમાં માંગેલ ટેન્ડરોમાં પુરતાં કારણો તેમજ અભિપ્રાય સાથે Single Tender સ્વીકારવા માટે રજૂ કરવામાં આવે તો તેવા સંજોગોમાં ટેન્ડર મંજૂર કરવા બાબતે વિચારણાં કરી શકાશે.

(૨) બીજી વાર માંગવામાં આવેલ ટેન્ડરમાં પણ જો એક જ ટેન્ડર ભરાઈને આવે, તો તે ખોલીને આવું ટેન્ડર જો વ્યાજબી ભાવ વાળું હોય તેવા સંજોગોમાં ટેન્ડર મંજૂર કરવા બાબતે વિચારણા કરવાની રહેશે.

આ હુકમો તાત્કાલીક અસરથી અમલમાં આવે છે આ ઠરાવ નાણા વિભાગની ફાઈલ ક્રમાંક : ટીઈએન / ૨૦૧૬ / એફએ (મા.મ.) પર મળેલ સરકારશ્રીની મંજૂરી અન્વયે બહાર પાડવામાં આવે છે.

ગુજરાત રાજ્યના રાજ્યપાલશ્રીના હુકમથી અને તેમના નામે.

(એ.એન. મિસ્ત્રી)

ઉપ સચિવ (રા.ર)

માર્ગ અને મકાન વિભાગ

પ્રતિ,

માન.મંત્રીશ્રી (મા.મ.) ના અંગત સચિવશ્રી,સચિવાલય, ગાંધીનગર

માન. રા.ક.મંત્રીશ્રી(મા.મ.)ના અંગત સચિવશ્રી,સચિવાલય, ગાંધીનગર

માન. મંત્રીશ્રી(ન.જ. એન પ્રા.પુ અને કલ્પસર વિભાગ)ના અંગત સચિવશ્રી, સચિવાલય, ગાંધીનગર

નર્મદા અને જળ સંપતિ અને પાણી પુરવઠા વિભાગ, સચિવાલય, ગાંધીનગર

આરોગ્ય અને પરીવાર કલ્યાણ વિભાગન, સચિવાલય ગાંધીનગર

પંચાયત, ગ્રામ ગૃહ નિર્માણ, અને ગ્રામ વિકાસ વિભાગ, સચિવાલય ગાંધીનગર

શહેરી વિકાસ અને શહેરી ગૃહ નિર્માણ વિભાગ, સચિવાલય, ગાંધીનગર

એકાઉન્ટન્ટ જનરલ, ઓડીટ – ૧, ઓડીટ ભવન, નવરંગપુરા અમદાવાદ – ૯.

એકાઉન્ટન્ટ જનરલ, ઓડીટ – ૨, રેસકોર્ષ, રાજકોટ

એકાઉન્ટન્ટ જનરલ,(એ એન્ડ ઈ), રેસકોર્ષ, રાજકોટ

ડેપ્યુટી એકાઉન્ટન્ટ જનરલ (એ એન્ડ ઈ), પાંચમો માળ, ઓડીટ ભવન નવરંગપુરા, અમદાવાદ – ૯

સચિવશ્રી, ગુજરાત તકેદારી આયોગ, ગાંધીનગર

સર્વે અ.ઈ.શ્રીઓ / મા.મ. વિભાગ, પંચાયત (મા.મ.) વર્તુળ, / રા.ધો.મા.મ. વર્તુળ/ રા.મા. યોજના વર્તુળ/ પા.યોજના વર્તુળ / એ.વે. વર્તુળ / વિદ્યુત વર્તુળ સહિત.

સર્વે કા.ઈ.શ્રીઓ, ઉપરોક્ત વર્તુળ હેઠળના સર્વે વિભાગ

નિયામકશ્રી, ગેરી વડોદરા

મેનેજિંગ ડિરેક્ટરશ્રી, ગુ.રા.મા. વિકાસ નિગમ લી. ગાંધીનગર

મુખ્ય કારોબારી અધિકારી, ગુજરાત મેરીટાઈમ બોર્ડ સે.૧૦, ગાંધીનગર.

નિયામકશ્રી ઉપવન બગીચા, ગાંધીનગર

નાણાંકીય સલાહકારશ્રી, મા.મ વિભાગ, ગાંધીનગર

સર્વે તાંત્રિક અધિકારીશ્રીઓ (ના.કા.ઈશ્રીઓ સહિત) મા.મ વિ, સચિવાલય, ગાંધીનગર

સર્વે પ્રોજેક્ટ શાખાઓ, મા.મ. વિ. સચિવાલય, ગાંધીનગર

સીલેક્ટ ફાઈલ – ૨૦૧૭

ગુજરાત સરકાર
માર્ગ અને મકાન વિભાગ
પરિપત્ર ક્રમાંક- ટીએનસી/૧૦/૨૦૦૨ (૧૪)/સ,
સચિવાલય, ગાંધીનગર
તારીખ. ૨૮/૪/૨૦૦૩

વિષય :- રાજ્ય સરકારના બાંધકામ માટે વપરાતા ગૌણ ખનિજોની રોયલ્ટી ભરવા બાબત.

સંદર્ભ :- મા.મ.વિ.નો તા. ૨૩-૧૦-૮૮ નો પરિપત્ર ક્રમાંક- ટીએનસી /૨૨૮૬/યુઓ-૩૮/
(૧૯)-સ

પરિપત્ર :-

માર્ગ અને મકાન વિભાગનાં સંદર્ભમાં દર્શાવેલ તા.૨૩/૧૦/૮૮ નો પરિપત્ર અમલી બનતાં આ પરિપત્ર મુજબ પરિપત્રની તારીખથી સીક્યોરીટી ડીપોઝીટ પરત કરવા માટે રોયલ્ટી ભર્યા અંગેનાં પ્રમાણપત્રનો આગ્રહ રાખવાનો રહેશે નહિં. તેવું નક્કી કરવામાં આવેલ. આ સુધારો ટેન્ડરનાં કલોઝ - ૩૬ (બી-૧) અને ટેન્ડર કલોઝ-૩૫ (બી-૨) ફોર્મમાં ઉમેરવામાં આવેલ. પરંતુ ટેન્ડર કલોઝ નંબર-૧ માં આ ઠરાવ સંદર્ભે જરૂરી સુધારો જે તે સમયે કરવામાં આવેલ ન હોવાથી, ટેન્ડરનાં કલોઝ-૧ અને કલોઝ-૩૬ (બી-૧) કલોઝ-૩૫ (બી-૨) વચ્ચે વિસંગતતા રહેવા પામેલ છે. આ વિસંગતતા દૂર કરવાની બાબત સરકારશ્રીનાં સક્રિયા વિચારણા હેઠળ હતી. આ વિસંગતતા દૂર કરવાની બાબતે પુખ્ત વિચારણાનાં અંતે ટેન્ડર ફોર્મ બી-૧ અને બી-૨ નાં કલોઝ-૧ નાં ફકરા-૨ માં (મા.મ.) વિભાગનાં તા.૨૩-૧૦-૮૮ નાં પરિપત્રનાં સંદર્ભે "Including the Royalty charge if No Due Certificate' is not produced by the contractor" શબ્દો દુર કરી, કલોઝ નં.૧ માં નીચે મુજબનો સુધારો કરવામાં આવે છે.

Fifty percentage of the Security Deposit alongwith performance bond shall become refundable within fifteen days after the final completion certificate is issued as per clause-7. All dues under this contract or other contract or otherwise shall be recovered from the aforesaid amount of fifty percentage of the said security deposit and the balance shall be refunded within fifteen days after the final certificate is issued as per clause-7. The remaining fifty percentage of the security deposit shall be refunded after the expiry of the Defect Liability period as per Clause 17 and 17A, after deducting there from the amount of expenses, if any, due to Govt. under this contract. (See Performance Bond on Page No. 44).

આ ઉપરાંત અગાઉ તા.૨૩/૧૦/૮૮ નાં પરિપત્રમાં દર્શાવેલ શરતોમાં વધારાની ૧-એ શરત ઉમેરવામાં આવે છે.

૧:એ – "ફાઈનલ બીલની નકલ જીલ્લાના સંલગ્ન ઉદ્યોગ અને ખાણ વિભાગનાં જીલ્લા ભુસ્તર અધિકારીને આપવાની રહેશે."

આ સૂચનાનો અચુક અમલ થાય તે જોવા સર્વે સંબંધિતોને જણાવવામાં આવે છે.

(અશોક પંડ્યા)

ઉપ સચિવ,
માર્ગ અને મકાન વિભાગ

પ્રતિ,

સર્વે અધિક્ષક ઈજનેરશ્રીઓ, મા.મ.વર્તુળો, પંચાયત મા.મ.વર્તુળો, એક્સપ્રેસવે વર્તુળ, રાષ્ટ્રીય ધોરી માર્ગ વર્તુળ, પાટનગર યોજના વર્તુળ સહિત.

સર્વે કાર્યપાલક ઈજનેરશ્રીઓ (ઉપરોક્ત વર્તુળો હેઠળના વિભાગો સહિત)

નકલ રવાના :-

ઉદ્યોગ ખાણ અને ઉર્જા વિભાગ, સચિવાલય, ગાંધીનગર.

નર્મદા જળ સંપત્તિ અને પાણી પુરવઠા વિભાગ, સચિવાલય, ગાંધીનગર.

નિયામકશ્રી, ભુસ્તર વિજ્ઞાન અને ખનીજ ખાતુ, બ્લોક નં.૧૩, ત્રીજા માળે જુના સચિવાલય, ગાંધીનગર.

નિયામકશ્રી, ગુજરાત ઈજનેરી સંશોધન સંસ્થા, વડોદરા.

નિયામકશ્રી, એન્જીનીયરીંગ સ્ટાફ કોલેજ, ગાંધીનગર.

મેનેજીંગ ડીરેક્ટરશ્રી, ગુજરાત રાજ્ય બાંધકામ નિગમ લી., ગાંધીનગર.

મેનેજીંગ ડીરેક્ટરશ્રી, ગુજરાત રાજ્ય માર્ગ વિકાસ નિગમ લી., ગાંધીનગર.

સર્વે તાંત્રિક અધિકારીશ્રીઓ (ના.કા.ઈ.શ્રીઓ સહિત), માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.

સર્વે પ્રોજેક્ટ શાખાઓ માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.

સીલેક્ટ ફાઈલ.

NOTIFICATION

**Labour and Employment Department
Sachivalaya, Gandhinagar
Dated the 3rd January, 2005**

BUILDING AND OTHER CONSTRUCTION WORKERS WELFARE CESS RULES, 1998

No.GHR/205/04/CWA/204/841/M-3

In exercise of the powers conferred by Clause No.1 and (g) of Rule-2 of the Building and Other Construction Workers Welfare Cess Rules pass the Government of Gujarat hereby appoints the following officer to be the Cess Collector and Assessing Officer not below the rank of Gazetted Officer for the purpose of collecting of cess under Section-3 and assessment of cess under Section-5 of the Building and Other Construction Worker's Welfare Cess Act, 1996 (28 of Para).

- (1) All Heads of Departments of Government of Gujarat in relation for another construction work of Government.
- (2) All Sections of Heads of the Public Section under
- (3) All Executive Heads of local authorities except Gram Panchayat, Dist. Panchayat, where an approval of the building and other construction work / Local authority is required.

By order and in the name of the Govenor of Gujarat.

Sd/- (Shambhai Patel)
Joint Secretary to Government

બાંધકામ મટીરીયલ્સ તેમજ કોમ્પોનેન્ટ્સ સેમ્પલની ગુણવત્તા માટેના પરીક્ષણ પૈકીના ૮૦% પરીક્ષણ સ્થળ પર તથા ૧૦% પરીક્ષણ સરકાર માન્ય લેબોરેટરી / ગેરી દ્વારા તથા ૧૦% ગેરી લેબોરેટરીમાં કરવા બાબત

ગુજરાત સરકાર
માર્ગ અને મકાન વિભાગ,
પરિપત્ર ક્રમાંક : પરચ / ૧૦૨૦૦૭ / ૨૮ / સ
સચિવાલય, ગાંધીનગર.
તા. ૩૧/૧૨/૨૦૦૯

પરિપત્ર :-

બાંધકામ મટીરીયલ્સ તેમજ કોમ્પોનેન્ટ્સ સેમ્પલની ગુણવત્તા માટેના પરીક્ષણ હાલ ગેરી કે સરકાર માન્ય સંસ્થા (લેબોરેટરી) મારફતે કરવામાં આવે છે, કામોની પ્રગતિની સમીક્ષા દરમ્યાન ક્ષેત્રીય અધિકારીઓ તરફથી જાણવા મળેલ છે કે ઉક્ત હયાત પ્રક્રિયામાં ટેસ્ટીંગના પરિણામો વિલંબથી મળે છે, જેમાં સમય પણ ખૂબ વ્યતિત થાય છે. ઈજારદાર એસોસિએશન તરફથી આવી રજઆતો મળી છે, આથી આ મુશ્કેલી ધ્યાને લેતાં ઈજારદારશ્રી દ્વારા જે તે કામ માટે સ્થાપવામાં આવતી લેબોરેટરીમાં સ્થળ પર જ પરીક્ષણ કરવામાં આવે તો વિલંબ નિવારી શકાય તે બાબત વિચારણા હેઠળ હતી, પુખ્ત વિચારણાના અંતે નીચે મુજબની નીતિ હાલના તબક્કે અનુસરવા નક્કી કરવામાં આવ્યું છે.

નીચે જણાવેલ પરીક્ષણોમાં પ્રવર્તમાન પદ્ધતિમાં ફરફાર કરી ફીક્વન્શી અનુસાર જરૂરી પરીક્ષણો પૈકી ૧૦% સરકાર માન્ય લેબોરેટરી / ગેરી તથા ૧૦% ગેરી લેબોરેટરી અને ૮૦% ફીલ્ડ લેબોરેટરી દ્વારા કરાવવાના રહેશે. પરંતુ ગેરીમાં નીચેના દરેક પૈકી ઓછામાં ઓછું ૧ (એક) પરીક્ષણ ગેરી લેબોરેટરીમાં કરવાનું રહેશે તથા ઓછામાં ઓછું એક પરીક્ષણ ગેરી / સરકાર માન્ય લેબોરેટરીમાં કરાવવાનો રહેશે. જેમાં નીચે દર્શાવેલ પરીક્ષણો સ્થળ પર કરવાના રહે છે.

એ	એગ્રીગેટ	(૧) ગ્રેડેશન (૨) ફલેકીનેશ અને ઈલોંગેશન વેલ્યુ (૩) ઈમ્પેક્ટ વેલ્યુ (૪) વોટર એબસોર્પશન
બી	માટી	(૧) ફીલ્ડ એફડીડી અને એફએમસી (૨) સીવ એનાલીસીસ
સી	રેતી	(૧) ગ્રેડેશન
ડી	ઈટો	(૧) ડાયમેનશન અને ટોલરન્સ ટેસ્ટ (૨) વોટર એબસોર્પશન
ઈ	કોંક્રીટ	(૧) નોન ડીસ્ટ્રક્ટીવ ટેસ્ટ (અલ્ટ્રા સોનીક ટેસ્ટીંગ પદ્ધતિથી) (૨) સ્લમ્પ ટેસ્ટ (૩) કોમ્પ્રેસીવ સ્ટ્રેન્થ
એફ	બીટુમીનસ મીક્સ	(૧) ડામરની ટકાવારી
જી	ડ્રાય મીક્ષ મટીરીયલ	(૧) ગ્રેડેશન

શરતો :-

૧. ઈજારદારે કામની ગુણવત્તા માટે ધારા ધોરણ પ્રમાણેની અને ઉપર જણાવેલ પરીક્ષણો માટે પ્રમાણિત થયેલ જરૂરી તમામ સાધનો સહિતની ફીલ્ડ ટેસ્ટીંગ લેબોરેટરી સ્વ ખર્ચે કામના સ્થળે યોગ્ય જગ્યા ઉપર સ્થાપવાની રહેશે. રસ્તાના કામ માટે લાગુ પડતા પ્લાન્ટના સ્થળને કામનું સ્થળ ગણી શકાય. પરંતુ કામનું સ્થળ લેબોરેટરીથી દુર હોય તો ઈજારદારશ્રી દ્વારા મોબાઈલ લેબોરેટરીની જરૂરી વ્યવસ્થા રાખવાની રહેશે.
૨. કા.ઈ.શ્રી જયારે સ્થળ પર તેઓનું ચેકીંગ કરવા જાય ત્યારે ટેસ્ટીંગ તેઓએ તેમની રૂબરૂમાં પણ કરવાનું રહેશે.
૩. ધારા ધોરણ પ્રમાણેના પરીક્ષણોની સંખ્યા પૈકી ૮૦% પરીક્ષણ ફીલ્ડ લેબોરેટરીમાં ઈજારદારના અધિકૃત કવોલીફાઈડ ઈજનેર કે જેઓને સંબંધિત કાર્યપાલક ઈજનેરશ્રીએ I-CARD આપેલ હોય તેમના દ્વારા ખાતાના ના.કા.ઈ. / મ.ઈ. /

- અ.મ.ઈ. ની હાજરીમાં જ કરવાના રહેશે અને પરિણામોમાં સંયુક્ત સહીઓ કરવાની રહેશે જ્યારે ૧૦% પરીક્ષણ ગેરી / સરકાર માન્ય લેબોરેટરી (ઓછામાં ઓછું એક પરીક્ષણ) અને ૧૦% ગેરી લેબોરેટરી (ઓછામાં ઓછું એક પરીક્ષણ) મારફતે કરાવવાના રહેશે.
૪. કુલ પરીક્ષણોના ૮૦% પરીક્ષણ એક જ સ્થળે સમયે એકજ તબક્કામાં નહીં કરતાં કામની પ્રગતિ મુજબ જે તબક્કાએ જે તે કામગીરીને અનુરૂપ જે મટીરીયલ્સ વાપરવાનું થતું હોય તદઅનુસાર શરૂઆતના તબક્કામાં રાખવું વ્યયેના તબક્કામાં તેમજ આખરી તબક્કામાં કરાવવાનું રહેશે. આમ છતાં આ બાબતે સ્થાનિક કક્ષાએથી ના.કા.ઈ.શ્રીએ જરૂરીયાત મુજબ તબક્કાવાર પરીક્ષણો નક્કી કરવાના રહેશે.
૫. ગુણવત્તા નિયમન ધારા-ઘોરણ પંચાણેના બધા જ રજીસ્ટર નિયમિત રીતે નિભાવવાના રહેશે, અને તે જે સ્થળે લેબોરેટરીમાં ઉપલબ્ધ રહે તેમ રાખવાના રહેશે.
૬. જો કોઈ કારણસર ટેસ્ટીંગના સાધન અપ્રાપ્ય હોય અથવા વસાવવામાં સમય જાય તેમ હોય કે વ્યવહારૂ ન હોય (જેમ કે ઈલેક્ટ્રોમેટ્રિક બેરીંગ) તો આવા પરીક્ષણો ગેરી / સરકાર માન્ય સંસ્થાઓમાં કરાવી શકાશે. અને આ બાબતનો નિર્ણય સંબંધિત કા.ઈ.શ્રી / ના.કા.ઈ.શ્રીએ કરવાનો રહેશે. ગેરીમાં ન થઈ શકે તેવા ટેસ્ટ સરકાર માન્ય લેબોરેટરીમાં કરાવી શકાય.
૭. વિભાગના ક્ષેત્રિય તાંત્રિક સ્ટાફે ના.કા.ઈ. / મ.ઈ. / અ.મ.ઈ. એ તેમજ ઈજારદારના તાંત્રિક સ્ટાફ દ્વારા ગેરીમાં પરીક્ષણ જાતે કરવાનો સંતોષકારક અનુભવ મેળવી આ બાબતનું ગેરીનું પ્રમાણપત્ર પણ મેળવવાનું રહેશે. જે તે જિલ્લા / પ્રાદેશિક સ્તરે ગેરીની લેબોરેટરીમાં કોર્ષ કન્ડક્ટ કરવા માટે જરૂરી ફી જે તે વિભાગના કા.ઈ.શ્રીએ ચુકવવાની રહેશે અને આ કાર્યવાહી સમયબદ્ધ પૂર્ણ થાય તે માટે સંબંધિત અ.ઈ.શ્રીએ આ કામગીરીની વખતોવખત સમીક્ષા કરવાની રહેશે.
૮. આ પરિપત્રથી ઉપર જણાવેલા પરીક્ષણો પૈકી ૮૦% પરીક્ષણો ક્ષેત્રિય લેબોરેટરીમાં કરવાનો સમય તા. ૧/૦૧/૨૦૧૦ થી કરવાનો રહેશે.
૯. ગેરીમાં ટેસ્ટીંગ કરાવતાં સમયે ગેરીનો ટેસ્ટીંગ ચાર્જ ત્વરીત ભરવાનો રહેશે. જેથી પરીક્ષણના પરીણામો સમયસર મેળવી શકાય.

(આર. કે. ચૌહાણ)

ખાસ ફરજ પરના અધિકારી (વિ.યો.)

માર્ગ અને મકાન વિભાગ.

પ્રતિ,

૧. માન. મંત્રીશ્રી (મા.મ.) વિભાગના અંગત સચિવશ્રીની જાણ સારૂ.
૨. મુ.ઈ.શ્રી (મા.મ.) અને અ.સ.શ્રી, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.
૩. મુ.ઈ.શ્રી (પંચા.) અને અ.સ.શ્રી, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.
૪. મુ.ઈ.શ્રી (ને.હા.) અને અ.સ.શ્રી, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.
૫. મુ.ઈ.શ્રી (પા.યો.) અને અ.સ.શ્રી, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.
૬. મુ.ઈ.શ્રી (ગુ.નિ.) અને અ.સ.શ્રી, માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.
૭. નિયામકશ્રી (એસટીસી) સ્ટાફ ટ્રેનીંગ કોલેજ, ગાંધીનગર
૮. મુ.ઈ.શ્રી (પીએનપી) માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.
૯. નાણાં સલાહકારશ્રી, (મા.મ.વિ.) નાણાં વિભાગ, સચિવાલય, ગાંધીનગર.
૧૦. સર્વે અ.ઈ.શ્રીઓ, મા.મ. વર્તુળ, પેટા / મા.મ. વર્તુળ / ને.હા. વર્તુળ / એક્સપ્રેસ-વે વર્તુળ / પાટનગર યોજના વર્તુળ.
૧૧. સર્વે કા.ઈ.શ્રીઓ ઉપર્યુક્ત વર્તુળો હસ્તકના સર્વે વિભાગો.
૧૨. સર્વે તાંત્રિક અધિકારીશ્રીઓ (ના.કા.ઈ.શ્રીઓ સહિત).
૧૩. સર્વે પ્રોજેક્ટ શાખાઓ (રસ્તાને લગતી) માર્ગ અને મકાન વિભાગ, સચિવાલય, ગાંધીનગર.
૧૪. સિલેક્ટ

ફાઈલ.

**Acceptance of Bank Guarantee as
Security Deposit and Earnest
Money Deposit.**

Government of Gujarat

Finance Department

GR. No.: FD/MSM/e-file/4/2023/0057/D.M.O.

Date: 21/04/2023

Read: FD GR. No.: EMD/4/2022/0002/DMO Dt. 20/05/2022

Preamble:

Tendering authorities of the State Government and its Boards/Corporations/PSUs frequently take Bank Guarantee from the bidders towards Security Deposit and Earnest Money Deposit. The State Government had issued the list of eligible banks vide above read resolutions of this department dated 20/05/2022.

After careful consideration, the Government has decided to approve the list of Banks whose Bank Guarantees would be accepted for the purpose mentioned above. It has now been decided to resolve as follows:

Resolution:

Government Departments and State Government Boards / Corporations / PSUs would accept Bank Guarantee (towards Security Deposit and Earnest Money Deposit) issued by any of the banks included in the **Annexure I**, attached to this Resolution.

The tendering authority will be required to ascertain the authenticity of the Bank Guarantee and set up necessary internal control procedures.

By order and in the name of the Governor of Gujarat.


(S. Chhakechhuak)

Additional Secretary (Budget)
Finance Department

To,

The Secretary to His Excellency Governor of Gujarat, Raj Bhavan, Gandhinagar

Principal Secretary to Hon. Chief Minister

PS to Hon. Finance Minister

PS to all Hon. Ministers, State Ministers and Deputy Ministers

PS to Chief Secretary

PS to Principal Secretary, Finance Department

PS to Secretary (EA), Finance Department

PS to Secretary (Expenditure), Finance Department

PS to Additional Secretary (B), Finance Department

All Administrative Departments, Sachivalaya, Gandhinagar

System Manager, Finance Department for put up on GSWAN website

Select File DMO-Finance Department

Annexure I.**Finance Department, GR. No.: FD/MSM/e-file/4/2023/0057/D.M.O.**

Date: 21/04/2023

(A) Guarantees issued by the following banks will be accepted as SD/EMD on permanent basis:

❖ All Nationalized Banks

(B) Guarantees issued by the following Banks will be accepted as SD/EMD for the period up to March 31, 2024. The validity cut-off date in the GR is with respect to the date of issue of Bank Guarantee irrespective of the date of termination of Bank Guarantee.

Sr No	Name of Banks	Sr No	Name of Banks
1	AXIS Bank	17	Kotak Mahindra Bank
2	AU Small Finance Bank	18	South Indian Bank
3	Bandhan Bank	19	Standard Chartered Bank
4	BNP Paribas	20	Tamilnadu Mercantile Bank
5	City Union Bank	21	Utkarsh Small Finance Bank
6	CSB Bank	22	The Kalupur Commercial Co-op. Bank
7	DBS Bank India Limited	23	Ahmedabad Mercantile Co-op. Bank
8	DCB Bank	24	Nutan Nagarik Sahakari Bank Ltd.
9	Equitas Small Finance Bank	25	Rajkot Nagarik Sahakari Bank Ltd.
10	FEDERAL Bank	26	Saraswat Co-Operative Bank Ltd
11	HDFC Bank	27	SVC Co-Operative Bank LTD.
12	HSBC Bank	28	The Gujarat State Co-operative Bank
13	ICICI Bank	29	The Mehsana Urban Co-Op. Bank Ltd
14	IndusInd Bank	30	The Surat District Co-Operative Bank Ltd
15	Karnataka Bank	31	The Surat People's Co-Op. Bank Ltd
16	Karur Vysya Bank	32	Saurashtra Gramin Bank

All the eligible banks are instructed to collect the original documents/papers of guarantee from the concerned tendering authority.


(S. Chhakchhuak)

Additional Secretary (Budget)

Finance Department

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સરકારના વિવિધ વિભાગો/
ખાતાઓ દ્વારા જી.એસ.ટી. કાયદા
હેઠળ TDS માટે નોંધણી નંબર
લેવા બાબત.

ગુજરાત સરકાર

નાણાં વિભાગ

પરિપત્ર ક્રમાંક:- જીએસટી/૧૦૧૭/૧૦૯૭/જીએસટી સેલ

સચિવાલય, ગાંધીનગર.

તા. ૧૫/૦૬/૨૦૧૮

૧. વંચાણે લીધો :- નાણાં વિભાગનો તા.૧૯/૦૭/૨૦૧૭ નો પરિપત્ર ક્રમાંક-
જીએસટી/૧૦૧૭/૧૦૯૭/ જીએસટી સેલ
૨. વંચાણે લીધો :- નાણાં વિભાગનો તા.૨૫/૧૦/૨૦૧૭ નો પરિપત્ર ક્રમાંક-
જીએસટી/૧૦૧૭/૧૦૯૭/ જીએસટી સેલ
૩. વંચાણે લીધો :- નાણાં વિભાગનો તા.૦૮/૦૫/૨૦૧૭ નો પરિપત્ર ક્રમાંક-
જીએસટી/૧૦૧૭/૧૦૯૭/ જીએસટી સેલ
૪. નાણા વિભાગનું તા.૧૪-૯-૨૦૧૮નું જાહેરનામું ક્રમાંક. (GHN-89)/GST-
2018/S.1(4)TH.

ગુજરાત ગુડ્સ એન્ડ સર્વિસીસ ટેક્સ એક્ટ, ૨૦૧૭ તથા સેન્ટ્રલ ગુડ્સ એન્ડ સર્વિસીસ ટેક્સ એક્ટ, ૨૦૧૭ ની કલમ ૫૧ અનુસાર જ્યારે કોઈ સરકારી વિભાગ, સ્થાનિક સત્તામંડળ અને સરકાર હસ્તકના જાહેર સાહસો રૂ.૨,૫૦,૦૦૦/- થી વધુની કિંમતનું ટેન્ડર બહાર પાડીને વેરાપાત્ર યીજપરતુઓ ખરીદે કે વેરાપાત્ર સેવાઓ મેળવે તો કુલ ૨% (બે ટકા) ટેક્સ ડીડક્શન એટ સોર્સ કરવાનું થાય, જેમાં ૧% (એક ટકો) ગુજરાત ગુડ્સ એન્ડ સર્વિસીસ ટેક્સ અને ૧% (એક ટકો) સેન્ટ્રલ ગુડ્સ એન્ડ સર્વિસીસ ટેક્સ હેઠળ કાપવાનો થાય અને **SGST: 00060010101** તથા **CGST: 00050010101** મદદે, જે મહિનામાં ડીડક્શન થયું હોય તેના અંત પછીનાં ૧૦ દિવસની અંદર, સરકારી તિજોરીમાં જમા કરાવવાના રહેશે. વધુમાં, આ કપાત સામે કોન્ટ્રાક્ટરને ટી.ડી.એસ.ની કપાત કરનારે નમૂના **GSTR-7A** માં પ્રમાણપત્ર આપવાનું રહેશે તથા ઠરાવેલ સમય મર્યાદા ગુજબ નમૂના **GSTR-7** માં પત્રક ભરવાનું રહેશે.

આ કલમનો અમલ જી.એસ.ટી. કાઉન્સિલની ભલામણ મુજબ તા.૩૦-૯-૨૦૧૮ સુધી મુલતવી રાખેલ હતો, જેનો અમલ હવે સંદર્ભમાં વંચાણે લીધેલા તા.૧૪-૯-૨૦૧૮ના જાહેરનામા અનુસાર તા.૧-૧૦-૨૦૧૮ થી કરવાનો થાય છે, જેના માટે ગુજરાત જીએસટી અધિનિયમ, ૨૦૧૭ની કલમ ૨૫ તથા ગુજરાત જીએસટી રૂલ્સ, ૨૦૧૭ના નિયમ ૧૨ (૧) અન્વયે ટેન્ડર દ્વારા ખરીદી કરનાર કે સેવા મેળવનાર સરકારી સક્ષમ અધિકારીએ નમૂના **GST REG-07** માં અરજી કરીને નોંધણી દાખલો મેળવવાનો રહે છે.

ઉક્ત જોગવાઈઓનો અમલ તમામ સરકારી વિભાગ, સ્થાનિક સત્તામંડળ અને સરકાર હસ્તકળા જાહેર સાહસોએ તા.૧-૧૦-૨૦૧૮ થી કરવાનો હોઈ, તાત્કાલિક અસરથી જીએસટી નેટવર્ક ઉપર ઓન-લાઈન વિગતો ભરીને તથા જરૂરી પૂરાવા અપલોડ કરીને નોંધણી દાખલો મેળવી લેવો જરૂરી બને છે. આથી, સર્વે વિભાગો, ખાતાના વડા, તાબાની તમામ કચેરીઓ અને સ્થાનિક સ્વરાજ્યની તમામ સંસ્થાઓ, જેવી કે મહાનગરપાલિકા, નગરપાલિકા, શહેરી વિહારા સત્તામંડળ, જિલ્લા પંચાયત, તાલુકા પંચાયત, ગ્રામ પંચાયત તેમજ સરકારી બોર્ડ અને કોર્પોરેશન, સરકારી કંપનીઓ, એસપીવી, વગેરે ને તેમના કાર્યક્ષેત્ર અને કામગીરી અનુસાર લાગુ પડવાપાત્ર હોય તો સત્વરે નોંધણી દાખલો મેળવી લેવા જણાવવામાં આવે છે. સદર કામગીરી માટે કોઈ કાયદાકીય માર્ગદર્શન કે ટેકનિકલ માર્ગદર્શન માટે જરૂર જણાય તો નજીકની રાજ્ય કર કચેરી અથવા જીએસટી નેટવર્કની હેલ્પલાઈન અથવા રાજ્ય કર કમિશનર દ્વારા અમદાવાદ અને અન્ય કચેરીઓમાં શરૂ કરવામાં આવેલ હેલ્પ ડેસ્કનો સંપર્ક કરવા જણાવવામાં આવે છે.

ગુજરાતના રાજ્યપાલશ્રીના હુકમથી અને તેમનાં નામે



(કે.એચ.પાઠક)

સંયુક્ત સચિવ (ટેક્સ)

નાણાં વિભાગ.

નકલ રવાના જાણ તથા જરૂરી અમલ સારૂ:-

- સચિવાલયનાં સર્વે વિભાગના અધિક મુખ્ય સચિવશ્રી/અગ્ર સચિવશ્રી/ સચિવશ્રી
- તમામ કલેક્ટરશ્રી તથા ડીડીઓશ્રી
- તમામ બોર્ડ/ કોર્પોરેશન
- તમામ સ્થાનિક સ્વરાજ્યની સંસ્થાઓ

**NOTIFICATION
FINANCE DEPARTMENT.**

Sachivalaya, Gandhinagar.
Dated the 14th September, 2018.

Notification No. 50/2018-State Tax

Gujarat
Goods
and
Services
Tax Act,
2017

No.(GHN-89)/GST-2018/S.1(4)TH:- In exercise of the powers conferred by sub-section (3) of section 1 of the Gujarat Goods and Services Tax Act, 2017 (Guj.25 of 2017) and in supersession of the Government Notification, Finance Department No.(GHN-82)/GST-2017/S.1(3)/TH dated the 15th September, 2017, Notification No. 33/2017-State Tax, except as respects things done or omitted to be done before such supersession, the Government of Gujarat hereby appoints the 1st day of October, 2018, as the date on which the provisions of section 51 of the said Act shall come into force with respect to persons specified under clauses (a), (b) and (c) of sub-section (1) of section 51 of the said Act and the persons specified below under clause (d) of sub-section (1) of section 51 of the said Act, namely:-

- (a) an authority or a board or any other body, -
- (i) set up by an Act of Parliament or a State Legislature;
 - or
 - (ii) established by any Government,
- with fifty-one percent. or more participation by way of equity or control, to carry out any function;
- (b) Society established by the Central Government or the State Government or a Local Authority under the Societies Registration Act, 1860 (21 of 1860);
- (c) public sector undertakings.

This notification shall be deemed to have been issued on the 13th day of September, 2018.

By order and in the name of the Governor of Gujarat,


K H Pathak

Joint Secretary to Government.

રાજ્યમાં બાંધકામ માટે વપરાતા ગૌણ
ખનિજોની રોયલ્ટીની વસુલાત અંતિમ
વપરાશકાર પાસેથી કરવા બાબત

ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ

"જલસેવા ભવન" સે.૧૦-એ ગાંધીનગર.

પરિપત્ર નં. એબી/સીમે-૧-૨/૨૦૧૦-૧૧/ફા.નં.૨૫/૩૦૯૫/સને ૨૦૧૧ ૩૬૫૮
તા. ૧૫/૬/૨૦૧૧

વંચાણે લીધા :- (૧) ગુજરાત પા.પુ. અને ગ.વ્ય.બોર્ડ ગાંધીનગરનો પરિપત્ર નં.

P.H.W.Dn. MOUASA	
Inward No.	૨૫૭૭
Date :	૨૦/૫/૧૫
E.E. :	(૨)
D.A. :	
H.C. :	
Marking	

એબી/ સીમે-૧-૨/૨૦૧૦-૧૧/ફા.નં.૨૫/૩૦૯૫/સને ૨૦૧૧
તા. ૧૨-૫-૨૦૧૧

(૨) ગુજરાત સરકારના નર્મદા, જળસંપત્તિ, પા.પુ. અને કલ્પસર
વિભાગ, સચિવાલય, ગાંધીનગરના ઠરાવ ક્રમાંક જીઇએન-
૨૦૧૦-૫૯૫-(૬)એમઆઇસેલ (ક-૧) તા. ૨૯-૪-૨૦૧૧

ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ ગાંધીનગરના સંદર્ભ-૧
હેઠળના પરિપત્રથી બાંધકામ માટે વપરાતા ગૌણ ખનિજોની રોયલ્ટી બાબતે
કાર્યવાહી કરવા સુચનાઓ પરિપત્રિત કરવામાં આવેલ છે.

ત્યારબાદ ગુજરાત સરકારના નર્મદા, જળસંપત્તિ, પા.પુ. અને કલ્પસર
વિભાગ, સચિવાલય, ગાંધીનગરના સંદર્ભ-૨ હેઠળના ઠરાવથી (નકલ સામેલ છે)
બાંધકામમાં વપરાતા ગૌણ ખનિજોની રોયલ્ટીની વસુલાત અંતિમ વપરાશકાર
પાસેથી કરવા બાબતે કાર્યપદ્ધતિ ઠરાવવામાં આવેલ છે જે મુજબ બોર્ડ હસ્તકની
ક્ષેત્રિય કચેરીઓમાં અમલ કરવા નકકી થયેલ હોઇ નીચે મુજબની કાર્યપદ્ધતિનો
અમલ કરવાનો રહે છે.

(૧) હાલમાં બાંધકામમાં વપરાતા નીચેના ખનિજો માટે આ કામે પદ્ધતિનો
અમલ કરવાનો રહેશે.

- સાદી રેતી/માટી/કંકર/ગ્રેવલ
- બ્લેક ટ્રેપ (કપચી, ગ્રીટ, મેટલ, રબલ, વિગેરે)
- બિલ્ડીંગ સ્ટોન/લાઇમ સ્ટોન/સેન્ડ સ્ટોન/ક્વાર્ટઝાઇટ

AS
જન મુલેશ્વર
d

- સોફ્ટ મુરમ/હાર્ડ મુરમ
- ઇંટ માટી/ઇંટ

(૨) રોયલ્ટીની વસુલાત માટેની કાર્યપધ્ધતિ

સરકારી બાંધકામમાં વપરાતા ગૌણ ખનિજોની રોયલ્ટી વખતો વખત ચુકવાતા રનીંગ બીલમાંથી કપાત કરવાની રહેશે અને આખરી બીલમાંથી બાકી રહેતી તમામ રોયલ્ટીની રકમની વસુલાત જે તે ઠેકેદારની સીક્યોરીટી ડીપોઝીટ છુટી કરતા પહેલાં જે તે સંલગ્ન વિભાગે વસુલવાની રહેશે સરકારશ્રીને બાંધકામમાં વપરાયેલ ખનિજોની પુરેપુરી રોયલ્ટી મળી રહે તે માટે પરિશિષ્ટ-૧ માં જણાવેલ દર અનુસાર મુજબ કપાત કરવાની રહેશે.

ઉપરોક્ત વસુલાત કરેલ રોયલ્ટીની રકમ નીચેના સદરે સમય મર્યાદામાં સબધિત વિભાગે જમા કરાવવાની રહેશે.

૦૮૫૩-નોન ફેરસ માઇનીંગ એન્ડ મેટલર્જીકલ ઇન્ડસ્ટ્રીઝ


૧૦૨- મીનરલ કન્સેશન ફી, રેન્ટ એન્ડ રોયલ્ટી

૦૧ - રીસીપ્ટ અન્ડર ગુજરાત માઇનોર મીનરલ રૂલ્સ-૧૯૬૬

- (૩) બાંધકામમાં વપરાતા ગૌણ ખનિજોના પ્રવર્તમાન રોયલ્ટી દર પરિશિષ્ટ-૧ માં દર્શાવેલ છે.
- (૪) રાજ્ય સરકાર દ્વારા ગૌણ ખનિજોના રોયલ્ટી દરોની જ્યારે જ્યારે ફેરવિચારણા થશે ત્યારે તે મજબૂના દરે રોયલ્ટી વસુલ/કપાત કરવાની રહેશે.
- (૫) સરકારી, અર્ધસરકારી કામોમાં વપરાયેલ ગૌણ ખનિજોની કપાત કરેલ રોયલ્ટીની વિગત પરિશિષ્ટ-૨ માં દર માસે ૧૦ તારીખ સુધીમાં જે તે સબધિત કચેરીએ ભૂસ્તર વિજ્ઞાન અને ખનિજ ખાતાની સંલગ્ન જીલ્લા કચેરીને મોકલી આપવાની રહેશે.
- (૬) આ કાર્યપધ્ધતિની તા. ૧-૪-૨૦૧૧ પછીના ડ્રાફ્ટ ટેન્ડર પેપર્સમાં જોગવાઈ કરવાની રહેશે અને તે પહેલાંના કામોને લાગુ પડશે નહીં અને આવા કામોમાં હાલની એડવાન્સ પ્રથા મુજબ નિયમોનુસાર ખનિજો મેળવી ઉપયોગ કરવાનો રહેશે.

ઉકત પરિપત્રનો અમલ બોર્ડ હસ્તકની સર્વે ક્ષેત્રિય કચેરીઓ દ્વારા અચૂક કરવાનો રહેશે.

બિડાણ : ઉપર મુજબ


(ડૉ. જયપાલસિંહ)

સભ્ય સચિવ

પ્રતિ,

- મુખ્ય ઇજનેરશ્રી ઝોન-૧/૨/૩/૪, વડોદરા/અમદાવાદ/રાજકોટ/ભુજ
- મુખ્ય ઇજનેરશ્રી મટીરીયલ સેલ/યાંત્રિક
- પ્રોજેક્ટ ડાયરેક્ટરશ્રી એડીબી/અર્બન સેલ ગાંધીનગર.
- નિયામકશ્રી ગુજરાત જલસેવા તાલીમ સંસ્થા ગાંધીનગર
- અધિક્ષક ઇજનેરશ્રી (સર્વે)
- કાર્યપાલકશ્રી (સર્વે)
- સીનીયર મેનેજરશ્રી (નાણાં-હિસાબ) સર્વે
- નાયબ મેનેજરશ્રી (નાણાં-હિસાબ) સર્વે
- સીસ્ટમ મેનેજરશ્રી, કોમ્પ્યુટર સેલ, વડી કચેરી, ગાંધીનગર.

નકલ રવાના

- માન. અધ્યક્ષશ્રીના કાર્યકારી, સચિવશ્રી, બોર્ડ કચેરી, ગાંધીનગર.
- સભ્ય સચિવશ્રી, અંગત મદદનીશશ્રી, બોર્ડ કચેરી, ગાંધીનગર.
- નાણાં નિયંત્રકશ્રી, બોર્ડ કચેરી, ગાંધીનગર.
- મુખ્ય વહીવટી અધિકારીશ્રી, બોર્ડ કચેરી, ગાંધીનગર.

જાનકા નં. ૨૧૦૧/૧૫૩૦ ૧૨૦૧૨ તા. ૨૦/૦૩/૧૩

આ સંબંધેનાં સર્વેના પુસ્તિકાના નાયબ સચિવશ્રીને જોડવામાં આવેલ છે.
જારી કરવામાં આવેલ પુસ્તિકાના નામ (પુસ્તિકા-નોંધ/૨૦૧૨/૨૦૧૩)
તારીખ ૨૦/૦૩/૧૩ નામના સર્વેના પુસ્તિકાના નામ ૨૦/૦૩/૧૩.



કાર્યપાલક ઇજનેર
જા.આ.બાંધકામ વિભાગ
ગુ.પા.પુ. અને ગ.વ્ય. બોર્ડ
મોડાસા.



1. 8/11
1. 8/11

ખનિજોની રોયલ્ટીની વસુલાત અંતિમ
વપરાશકાર પાસેથી કરવા બાબત"

ગુજરાત સરકાર,
નર્મદા, જળસંપત્તિ, પાણી પુરવઠા અને કલ્પસર વિભાગ,
ઠરાવ ક્રમાંક:-જીઈએન-૨૦૧૦-૫૯૫-(૬)-એમઆઈસેલ (ક-૧),
સચિવાલય, ગાંધીનગર.

તા. /૪/૨૦૧૧.

29 APR 2011

વંચાણે લીધા:-

- SM
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P.R.W. & S.B.
M.S.S.
- (૧) ઉદ્યોગ અને ખાણ વિભાગ, સચિવાલય, ગાંધીનગર પરિપત્ર ન.એનસીઆર-૧૦૯૦-૩૦૮૩-છ
તા.૧૨-૧-૧૯૯૪.
- (૨) ઉદ્યોગ અને ખાણ વિભાગ, સચિવાલય, ગાંધીનગર પરિપત્ર ન.એનસીઆર-૧૦૯૦-૩૦૮૩-છ
તા.૯-૫-૧૯૯૪.

ઠરાવ:-

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M.S.S.

રાજ્ય સરકારે સપ્ટેમ્બર-૨૦૦૩ માં જાહેર કરેલ ખનિજ નીતિ અનુસાર ખનિજ જથ્થાની
રોયલ્ટી પુરપુરી મળી રહે તે માટે રસ્તા અને મકાન, સિયાઈ, પંચાયત, નિગમો વિગેરેના
ઠેકેદારોના કામોના બિલોમાંથી સીધી કપાત કરવાની પ્રથા અમલમાં મૂકવાની જાહેરાત કરાયેલ
છે. રાજ્ય સરકારશ્રીના પરિપત્ર તા.૯-૫-૧૯૯૪ મુજબ ઠેકેદારોએ વપરાશ કરેલ ખનિજ જથ્થા
મુજબના રોયલ્ટીના આધાર/પુરાવાની ચકાસણી કરી સંલગ્ન ભૂસ્તર વિજ્ઞાન અને ખનિજ
ખાતાની જિલ્લા કચેરીઓ દ્વારા "નો ડયુ" પ્રમાણપત્ર આપવાની પ્રથા અમલમાં છે. ઠેકેદારો દ્વારા
નો ડયુ સર્ટીફિકેટ રજુ થયા બાદજ સિકયોરીટી ડીપોઝીટ છૂટી કરવામાં આવે છે. ઉપરોક્ત
પદ્ધતિમાં વિલંબ થતો નિવારવા હાલમાં પરિપત્ર તા.૧૮-૮-૨૦૦૯થી ઝડપી ચકાસણી કરી
તાત્કાલિક આજું પ્રમાણપત્ર આપવાની જોગવાઈઓ કરેલ છે.

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હાલની પદ્ધતિ પારદર્શક અને સરળ બનાવવા અને બાંધકામમાં વપરાતા ગૌણ
ખનિજની રોયલ્ટી પૂરેપૂરી મળી રહે તે માટે તા.૧-૭-૨૦૧૦ ના રોજ માન. મુખ્ય મંત્રીશ્રીના
અધ્યક્ષસ્થાને મળેલ બેઠકમાં થયેલ સૂચન મુજબ રાજ્યમાં મળી આવતાં ગૌણ ખનિજોની રોયલ્ટી
લીઝ ધારક પાસેથી ન લેતાં અંતિમ વપરાશકાર (End user) પાસેથી લેવામાં આવે તો

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In. No. 132X
Date 4/6/11

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બાંધકામના ઠેકેદારો વિગેરેને કામમાં સરળતા રહેશે. સરકારી બાંધકામોમાં રોયલ્ટી, વખતો વખત ચુકવાતા બિલોમાંથી કપાત કરી (At source) વસુલાત કરવાનું નક્કી કરવામાં આવેલ હતું. જે ધ્યાને લઈ સરકાર દ્વારા પુખ્ત વિચારણાને અંતે નીચે મુજબની કાર્યપદ્ધતિનો અમલ કરવા ઠરાવવામાં આવે છે.

૧. હાલમાં બાંધકામમાં વપરાતા નીચેના ખનિજો માટે આ કાર્યપદ્ધતિનો અમલ કરવાનો રહેશે.

- સાદી રેતી/ માટી/ કંકર/ ગ્રેવલ
- બ્લેકટ્રેપ (કપચી, ગ્રીટ, મેટલ, રબલ, વિગેરે)
- બિલ્ડીંગ સ્ટોન/ લાઈમસ્ટોન/ સેન્ડસ્ટોન/ક્વાર્ટઝાઈટ
- સોફ્ટ મુરમ/ હાર્ડ મુરમ
- ઈંટ માટી/ ઈંટ

૨. રોયલ્ટી વસુલાત માટેની કાર્યપદ્ધતિ:-

સરકારી બાંધકામમાં વપરાતા ગૌણ ખનિજોની રોયલ્ટી વખતો વખત ચુકવાતા રનીંગ બીલમાંથી કપાત કરવાની રહેશે અને આખરી બીલમાંથી બાકી રહેતી તમામ રોયલ્ટીની રકમની વસુલાત જે તે ઠેકેદારની સીક્યોરીટી ડિપોઝીટ છુટી કરતાં પહેલાં જે તે સંલગ્ન વિભાગે વસુલાતની રહેશે. સરકારીને બાંધકામમાં વપરાયેલ ખનિજોની પુરેપુરી રોયલ્ટી મળી રહે તે માટે પરિશિષ્ટ-૧માં જણાવેલ દર અનુસાર મુજબ કપાત કરવાની રહેશે. ઉપરોક્ત વસુલાત કરેલ રોયલ્ટીની રકમ નીચેના સદરે સમય મર્યાદામાં સંબંધિત વિભાગે જમા કરાવવાની રહેશે.

૦૮૫૩ - નોન ફેરસ માઈનીંગ એન્ડ મેટલર્જીકલ ઈન્ડસ્ટ્રીઝ

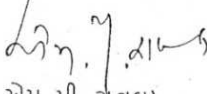
૧૦૨ - મીનરલ કન્સેશન ફી, રેન્ટ એન્ડ રોયલ્ટી

૦૧ - રીસીચ્ટ અન્ડર ગુજરાત માઈનોર મીનરલ રૂલ્સ-૧૯૬૬

૩. બાંધકામમાં વપરાતા ગૌણ ખનિજોના પ્રવર્તમાન રોયલ્ટી દર પરિશિષ્ટ-૧ માં દર્શાવેલ છે.
૪. રાજ્ય સરકાર દ્વારા ગૌણ ખનિજોના રોયલ્ટી દરોની જ્યારે જ્યારે ફેરવિચારણા થશે ત્યારે તે મુજબના દરે રોયલ્ટી વસુલ/ કપાત કરવાની રહેશે.
૫. સરકારી, અર્ધસરકારી કામોમાં વપરાયેલ ગૌણ ખનિજોની કપાત કરેલ રોયલ્ટીની વિગત પરિશિષ્ટ-૨ માં દર માસે ૧૦ તારીખ સુધીમાં જે તે સંબંધિત કચેરીએ ભુસ્તર વિજ્ઞાન અને ખનિજ ખાતાની સંલગ્ન જીલ્લા કચેરીને મોકલી આપવાની રહેશે.

ના જાહેરમુદ્દતમાં તા.૦૮/૦૮/૨૦૨૨ પછીના ડ્રાફ્ટ ટન્ડર પપ્પસમાં જાગવાઈ કરવાની રહેશે અને તે પહેલાના કામોને લાગુ પડશે નહીં અને આવા કામોમાં હાલની એડવાન્સ રોયલ્ટી પ્રથા મુજબ નિયમોનુસાર ખનિજો મેળવી ઉપયોગ કરવાનો રહેશે.

ગુજરાત રાજ્ય સરકારના રાજ્યપાલશ્રીના હુકમથી અને તેમના નામે,


(એમ. પી. રાવલ)

ખાસ ફરજ પરના અધિકારી (સિં.ચો.)

નર્મદા, જળસંપત્તિ, પાણી પુરવઠા અને કલ્પસર વિભાગ,
ગાંધીનગર.

પ્રતિ,

- માન. મંત્રીશ્રી (જસં.)ના અંગત સચિવશ્રી, ન.જ.સં.પા. પુ. અને ક. વિ. સચિવાલય, ગાંધીનગર.
- માન. રાજ્યકક્ષા મંત્રીશ્રી(જસં.)ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર.
- માન. સંસદીય સચિવશ્રી(જસં.) ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- સચિવશ્રી (જસં.) ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર.
- ખાસ સચિવશ્રી (જસં.) ના અંગત સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- સર્વે મુખ્ય ઈજનેરશ્રી અને અધિક સચિવશ્રી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- વહીવટી સંચાલકશ્રી, જળસંપત્તિ વિકાસ નિગમ લી. ગાંધીનગર.
- મુખ્ય ઈજનેર અને નિયામકશ્રી, જળ અને જમીન વ્યવસ્થાપન સંસ્થા, આણંદ.
- મુખ્ય ઈજનેર અને નિયામકશ્રી, ગુજરાત ઈજનેરી સંશોધન સંસ્થા, વડોદરા.
- સર્વે તાંત્રિક અધિકારી, ન.જ.સં.પા.પુ.અને ક.વિ. સચિવાલય,ગાંધીનગર
- સર્વે અધિક્ષક ઈજનેરશ્રીઓ, ન.જ.સં.પા.પુ.અને ક.વિભાગ.
- સર્વે શાખાઓ ન.જ.સં.પા.પુ.અને ક.વિભાગ, સચિવાલય, ગાંધીનગર.
- સિલેક્ટ ડ્રાઇલ

પરિશિષ્ટ - ૧

બાંધકામમાં વપરાતા ગૌ ખનીજોના રોયલ્ટીના દર:-(તા.૧૫-૧-૨૦૧૦ ની અસરથી)

અં.નં.	ખનિજનું નામ	રોયલ્ટી દર પ્રતિ મે. ટન
૧	ગૌણ ખનિજ લાઈમસ્ટોન (અ) ડ્રેસ બ્લોક (બ) રબલ (ક) મેટલ	૩૦
૨	બ્લોક ટ્રેપ (અ) રબલ (બ) કપચી (ક) મેટલ (ડ) ગ્રીટ	૨૫
૩	સેન્ડ સ્ટોન (અ) ડ્રેસ બ્લોક (બ) રબલ (ક) મેટલ	૩૦
૪	કવાર્ટાઈઝ	૨૦
૫	સામાન્ય રેતી	૧૨
૬	કંકર	૧૨
૭	સામાન્ય માટી	૧૨
૮	સોફ્ટ મુરમ	૧૨
૯	હાર્ડ મુરમ	૨૦
૧૦	ગ્રેવલ	૧૫
૧૧	બિલ્ડીંગ સ્ટોન (અ) રાજુલા બિલ્ડીંગ સ્ટોન (બ) ધાંગધા સેન્ડ સ્ટોન(બિલ્ડીંગ સ્ટોન તરીકે ઉપયોગ) (ક) રાયોલાઈટ (બાંધકામ માટે ઉપયોગી)	૩૦
૧૨	અન્ય બાંધકામના ખનિજો	૩૦

સરકારી/ અર્ધસરકારી બાંધકામમાં વપરાયેલ ગૌણ બનિજોની દર માસે રોયલ્ટીની વિગત દર્શાવતું પત્રક:-

૧. કચેરીનું નામ:-.....

૨. માસ/ વર્ષ.....

અં.નં.	કોન્ટ્રાક્ટરનું નામ અને સરનામું	કામનું નામ	વર્ક ઓર્ડર નંબર તારીખ અને કામની વિગત	વપરાયેલ બનિજ જથ્થાની રોયલ્ટી/ બનિજ કિંમતની વિગત						નોંધ
				બનિજનું નામ	જથ્થો મે. ટન	રોયલ્ટી નો દર	રોયલ્ટી/ બનિજ કિંમતની રકમ રૂ. માં	ચલણ નંબર	તારીખ	
૧	૨	૩	૪	૫	૬	૭	૮	૯	૧૦	૧૧

કુલ રૂ.....

ઓડિટ અધિકારીની સહી અને હોદ્દો

નંબર

તારીખ

સંબંધિત અધિકારીની સહી/ હોદ્દો

પ્રતિ,

મદદનીશ ભુસ્તરશાસ્ત્રીશ્રી/ ભુસ્તરશાસ્ત્રીશ્રી,

ભુસ્તર વિજ્ઞાન અને બનિજ ખાતુ,

જીલ્લા કચેરી.....ની જાણ તથા સંબંધિત ચલણની નકલ સામેલ છે.

બાંધકામ માટે વપરાતા ગૌણ ખનીજોની
રોયલ્ટી તથા બાંધકામ શ્રમયોગીઓના
કલ્યાણ અંગે સેસની રકમ એકઠી કરવા
બાબત.

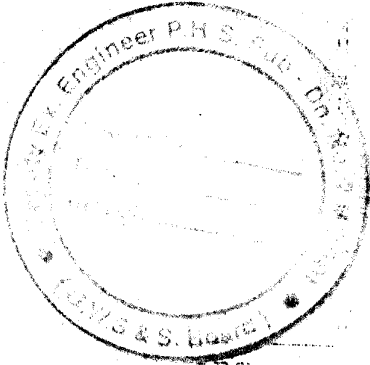
ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ,

" જલસેવા ભવન " સેક્ટર-૧૦-એ ગાંધીનગર

પરિપત્ર નં. એબી/સીમે-૧-૨/૨૦૧૦-૧૧/ફા.નં.૨૫/૩૦૬૫ સને ૨૦૧૧

તા.૧૨/૫/૨૦૧૧.

વંચાણે લીધા :-



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- ૧) ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ, કોન્ટ્રાક્ટર એસોશીએશન, ગુજરાત રાજ્ય, અમદાવાદનો તા. ૨૧-૮-૦૯ નો પત્ર
- ૨) ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ કોન્ટ્રાક્ટર એસોશીએશન, ગુજરાત રાજ્ય સાથેની તા. ૨૨-૬-૨૦૧૦ ની મીટીંગની કાર્યવાહી નોંધ જે સીનીયર મેનેજર (ના/હિ), ગુ.પા.પુ. અને ગ.વ્ય.બોર્ડ, ગાંધીનગરના પત્ર નં. એબી/સીમે-૧-૨//૨૦૧૦-૧૧/ફા.નં.૨૫/૫૬૪૩, તા. ૧૧-૮-૨૦૧૦ હેઠળ બહાર પડાયેલ છે.
- ૩) નાણાં નિયંત્રકશ્રી, ગુ.પા.પુ. અને ગ.વ્ય.બોર્ડ, ગાંધીનગરના પત્ર નં. એબી/સીમે-૧-૨/૨૦૧૦-૧૧/ફા.નં.૨૫/૬૧૯૪, તા. ૩-૯-૨૦૧૦ હેઠળ નિયુક્ત થયેલ કમિટિનો તા. ૧-૧૧-૨૦૧૦ નો અહેવાલ જે મુખ્ય ઇજનેરશ્રી ઝોન-૨ અમદાવાદના પત્ર નં. એબી-૨/૨૦૧૦-૧૧/કોન્ટ્રાક્ટર એસો./ફા.નં.૫૦/૩૨/૬ તા. ૧-૧૧-૨૦૧૧

૬૨૬
૨૨/૫/૧૧
આમુખ
PB
૨૧/૫/૧૧
૨૨/૫/૧૧
૨૦૧૧

ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ, અમદાવાદ દ્વારા વિવિધ મુદ્દે
સેક્શન-૧) હેઠળના પત્રથી રજુઆત કરવામાં આવેલ. જે સંદર્ભે સભ્ય સચિવશ્રી, ગુ.પા.પુ.
અને ગ.વ્ય.બોર્ડની અધ્યક્ષતામાં કોન્ટ્રાક્ટર એસોશીએશનના પ્રતિનિધિઓ સાથે તા. ૨૨-૬-
૨૦૧૦ ના રોજ મીટીંગ યોજવામાં આવેલ. જે દરમ્યાન એસોશીએશનની રજુઆતના મુદ્દે
વિગતેથી ચર્ચા કરવામાં આવેલ. તે પૈકી બાંધકામ માટે વપરાતા ગૌણ ખનીજોની રોયલ્ટી
તથા બાંધકામ શ્રમયોગીઓના કલ્યાણ અંગે સેસની રકમ એકઠી કરવા બાબતે પ્રવર્તમાન

નિયમો અંગેનો અભ્યાસક રીતે અન્વયેની ભલામણ આપવા મુખ્ય ઇજનેર, ઝોન-૨, અમદાવાદની અધ્યક્ષતામાં એક કમીટીનું ગઠન કરવામાં આવેલ. સદર કમીટીના અધ્યક્ષ દ્વારા સંદર્ભ-(૩) હેઠળના ઉલ્લેખિત તા. ૧-૧૧-૨૦૧૧ ના પત્રથી તેમનો અહેવાલ મળેલ છે. સદર અહેવાલ તથા અહેવાલમાં ઉલ્લેખિત બાબતોના પ્રવર્તમાન નિયમો ઉપર કાળજીપૂર્વક વિચારણા કરી નીચે મુજબ કાર્યવાહી કરવા ઠરાવવામાં આવે છે.

પરિપત્ર :-

(૧) બાંધકામ માટે વપરાતા ગૌણ ખનીજોની રોયલ્ટી ભરવા બાબતે માર્ગ અને મકાન વિભાગના પરિપત્ર નં. ટીએનસી/૨૨૮૬/યુઓ-૩૯/(૧૯)/સ તા. ૨૩-૧૦-૧૦૮૯ ની જોગવાઈઓ મુજબ નીચે પ્રમાણેની કાર્યવાહી કરવી.

ક) રૂપિયા ૨.૦૦ લાખ સુધીની અંદાજીત રકમના કામો હોય તેવા કામો માટે કાર્યપાલક ઇજનેરશ્રી કામનો વર્કઓર્ડર આપે કે તુર્ત જ તે કામના શીડ્યુલ-બી ની નકલ જે તે વિસ્તારનાં ભુસ્તર અને ખનીજ શાખાના સંબંધિત અધિકારીને મોકલી આપવાની રહેશે.

ખ) રૂપિયા ૨.૦૦ લાખ થી ઉપરના કામના કોન્ટ્રાક્ટરોએ તેઓએ ખરીદેલ ખનીજનો જથ્થો અને તે ક્યાંથી ખરીદેલ છે અને તે વેચનારની વિગતો દર્શાવતા બીલોની નકલ તથા પત્રકનાં રૂપમાં માહિતી દર ત્રણ માસે જે તે વિસ્તારનાં ભુસ્તર અને ખનીજ શાખાનાં સંબંધિત અધિકારીને મોકલી આપવાની રહેશે. આ બીલોમાં માલ વેચનારનું નામ, સ્થળ, તારીખ અને માલ લેનારનું નામ, માલનું નામ અને જથ્થો વિગતે દર્શાવેલ હોવા જોઈએ.

ગ) જરૂર પડે જરૂરી કિસ્સામાં જે તે વિસ્તારનાં ભુસ્તર અને ખનીજ શાખાના સંબંધિત અધિકારી તરફથી વધુ માહિતી/વિગત માલ કે બીલના સંબંધમાં માંગવામાં આવે તો જે તે કાર્યપાલક ઇજનેરશ્રી ખનીજ ખાતાના અધિકારીને તે વિગતો કોન્ટ્રાક્ટર પાસેથી મેળવવામાં મદદ કરશે.

આ સંજોગોમાં માર્ગ અને મકાન વિભાગના ઉપર ઉલ્લેખિત તા. ૨૩-૧૦-૧૦૮૯ ના પરિપત્રની તારીખથી સીક્યોરીટી ડીપોઝીટ પરત કરવા માટે રોયલ્ટી ભરાયા અંગેના પ્રમાણપત્ર અંગેનો આગ્રહ રાખવાનો રહેશે નહીં. પરંતુ આ પરિપત્રની તારીખથી આ પ્રથા અમલી બનાવવામાં આવેલ છે તે પહેલાં કોન્ટ્રાક્ટરે જે માલ વાપર્યો હોય તેના સંબંધમાં નો-ડયુ સર્ટીફિકેટ તે વખતની પ્રથા મુજબ મેળવવાનું રહેશે.

(૨) બાંધકામ શ્રમયોગીઓના કલ્યા અંગેની સેસની રકમ એકઠી કરવા બાબતે ગુજરાત સરકાર શ્રમ અને રોજગાર વિભાગ, ગાંધીનગરના ઠરાવ નં. સીડબલ્યુએ/૨૦૦૪/

૮૪૧/ એમ-૩/તા.૩૦-૧-૨૦૦૬(નકલ સામેલ છે) મુજબ નવા કામોના અંદાજોમાં ૧ ટકા મુજબ સેસની જોગવાઈ રાખવા જણાવવામાં આવે છે. વધુમાં આ સેસની વસુલાત એજન્સીના બીલમાંથી કરવાની જોગવાઈ બાંધકામના ટેન્ડરમાં કરવાની રહેશે. ક્ષેત્રિય અધિકારીઓ દ્વારા કરારની શરત મુજબ લેબર સેસની રકમ બીલમાંથી કપાત કરી સરકારશ્રીમાં જમા કરાવવાની રહેશે.

પરંતુ જે કામોના કરારમાં આ બાબતની જોગવાઈ ન હોય તથા ભવિષ્યમાં લાગુ થનાર કોઈ સેસ બાબતે જવાબદારી એજન્સીની જવાબદારી ન રાખવામાં આવેલ હોય, તેવા કિસ્સામાં સેસ ભરવાની જવાબદારી એજન્સીના પક્ષે રહે નહીં જો કે ટીપીસી જે ટેન્ડરમાં લેબર સેસ સહિત ભાવો મંજૂર કરેલા હોય તેવા કિસ્સામાં લેબર સેસ એજન્સીના બિલમાંથી કાપવાનું રહેશે. તેથી આ સંજોગોમાં લેબર સેસની રકમ ભરવાની થતી હોય તો તે બોર્ડ દ્વારા ભોગવવાની રહે. આમ છતાં આવા કિસ્સામાં એજન્સીઓ પાસેથી સેસ વસુલ કરવામાં આવેલ હોય તો તે એજન્સીને રીએમ્બર્સ કરી આપવાની રહેશે.

વધુમાં કાપેલ લેબરસેસ તાકીદે સરકારી તિજોરીમાં ચલણથી નિયત કરેલા હેડમાં ભરી દેવાની પણ તકેદારી રાખવાની રહેશે.

બિડાણ : ઉપર મુજબ

Jan
(ડૉ. જયપાલસિંહ)

સભ્ય સચિવ

પ્રતિ,

- મુખ્ય ઇજનેરશ્રી ઝોન-૧/૨/૩/૪
- મુખ્ય ઇજનેરશ્રી મટીરીયલ સેલ(સિવિલ)/યાંત્રિક
- પ્રોજેક્ટ ડાયરેક્ટરશ્રી. એડીબી/અર્બન સેલ, ગાંધીનગર.
- નિયામકશ્રી, જલસેવા તાલીમ સંસ્થા, સે.૧૫, ગાંધીનગર.
- અધિક્ષક ઇજનેરશ્રી (સર્વે)/ કાર્યપાલક ઇજનેરશ્રી (સર્વે)
- સીનીયર મેનેજરશ્રી (ના/હિ) સર્વે/ નાયબ મેનેજરશ્રી (ના/હિ) સર્વે
- સીસ્ટમ મેનેજરશ્રી, કોમ્પ્યુટર સેલ, વડી કચેરી, ગાંધીનગર.

નકલ રવાના

- માન. અધ્યક્ષશ્રીના કાર્યકારી, સચિવશ્રી, ગુ.પા.પુ. અને ગ.બોર્ડ, ગાંધીનગર
- સભ્ય સચિવશ્રીના અંગત મદદનીશશ્રી, ગુ.પા.પુ. અને ગ.વ્ય.બોર્ડ, ગાંધીનગર
- નાણાં નિયંત્રકશ્રી, ગુ.પા.પુ. અને ગ.વ્ય.બોર્ડ, ગાંધીનગર
- મુખ્ય વહીવટી અધિકારીશ્રી, ગુ.પા.પુ. અને ગ.વ્ય.બોર્ડ, ગાંધીનગર.

નો. એન/ ઝોન/ ૧૨૧૧
૨૦૧૧

જાન. બા. સ. ઇ. ડી. બ. ડા. ડા. બ. બા. ૧(૨)૩ મેન/ કોન્ટ્રી

૧૬/૦૫/૨૦૧૨ જે. સ. સ. ૨૦૧૨
૨૦/૦૫/૨૦૧૨

[Signature]
Executive Engineer
Public Health Works Div.
Guj. W.S. & S. Board,
MORBI.

Instructions on implementation of
the Building and other Construction
Workers (ROE & COS) Act, 1996
and Building and other Construction
Workers Welfare Cess Act, 1996

Government of Gujarat
Labour & Employment Department
G.R. No. CWA-2004-841-M3
Sachivalaya, Gandhinagar
Dated: January 2006

30 JAN 2006

Read: Labour & Employment Department, Gandhinagar GR No. CWA-2004-1831-M(3)
dated 9-12-2005

RESOLUTION

Building and other constructions workers are one of the largest and most vulnerable segments of the unorganised labour. Their work is characterised by inherent risk to life and limb of the workers and also by the casual nature, temporary relationship between employer and employee, uncertain working hours, lack of basic amenities and inadequate welfare facilities.

Government of India has decided to constitute Welfare Boards for such workers in every State and accordingly, the Building and other Construction Workers (Regulation of Employment & conditions of Service) Act, 1996 was enacted by Parliament and brought into force from 19th August, 1996. Implementation of the Act including cess collection has already commenced in Kerala, Karnataka, Tamil Nadu and Delhi. Under the said Act, Government of Gujarat has constituted a Board under section 18. The State Government has been given powers to make rules for carrying out the provisions of this Act.

Accordingly, Government of Gujarat made Gujarat Building and other Construction Workers (Regulation of Employment and Condition of Service) Rules, 2003

LL
11/12/05
11/12/06

શ્રી ૨૦૦૪-૮૪૧-મ૩
સચિવાલય ગાંધીનગર
ગુજરાત
૧૫મ
૨૭/૧૩/૦૬

published these Rules vide Notification No. GHR-2003-111-CWA-2003 dated 18th August, 2003. Government of Gujarat has also constituted Building and other Construction Workers Welfare Board vide Notification GHR/2004/163/CWA/2004/3743-M3, dated 18th December, 2004. Secretary has been appointed as Chairman.

Government of India has also enacted the Building and Other Construction Workers' Welfare Cess Act (hereinafter called as Cess Act) and brought it in force dated 19th August, 1996. The Cess Act provides for the levy and collection of cess on the cost of construction incurred by the employers, for increasing the resources of the Welfare Board. Section 3 of the Cess Act provides that cess shall be levied and collected not less than 1% of the cost of construction incurred by an employer. Rule 5 of Building and other Construction Workers Welfare Cess Rules, 1998 reads as follows :-

- (1) The proceeds of the cess collected under Rule 4 shall be transferred by such Government office, Public Sector Undertakings, local authority or cess collector, to the Board along with the form of challan prescribed (and in the head of account of the Board) under the accounting procedures of the State, by whatever name they are known.
- (2) Such Government Office or Public Sector Undertaking may deduct from the cess collected, or claim from the Board, as the case may be, actual collection expenses not exceeding one per cent of the total amount collected.
- (3) The amount collected shall be transferred to the Board within thirty days of its collection.

Moreover, under Rule 6, every employer, within thirty days of commencement of his work or payment of cess, as the case may be, has to furnish information in Form 1 to the Assessing Officer. Under Rule 12, the Assessing Officer, in cases where the employer has not pay the cess or has paid less cess, can impose a penalty upto the amount of cess payable.

By Government of Gujarat Notification No. GHR/2005/04/CWA/2004/841/M3, dated 3rd January 2005, all Heads of the Departments of the Government of Gujarat, all Executive Heads of Public Sector Undertakings and all Executive Heads of Local

Authorities (except Gram Panchayat and Nagar Panchayats) are declared as Cess Collectors and Assessing Officers.

The Building and other Construction Workers Welfare Board has passed the necessary resolution to collect the cess with effect from 18th December 2004.

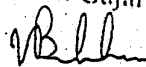
Accordingly, the cess is payable by Government Offices, Public Sector Undertaking, Local Authority or Cess Collector to the Board in Challan prescribed, in the following Head/Sub Head :

Major Head - 0230-Labour and Employment
Minor Head - 106-Fees under Contract Labour (Regulation and Abolition) Rules
Sub Head - (04)-Income from Cess levied under Gujarat Building & Other Construction Workers' Welfare Cess Act, 1996

Approval of the Finance Department, Government of Gujarat has been taken for meeting the expenditure to be incurred for the various welfare activities by the Gujarat Building & other Construction Workers Welfare Board and the opening of the Accounting Head/Sub-head in file No. CWA-2004-1831-M3, on 1st December, 2005 (copy of Resolution dated 9/12/2005 is enclosed).

All Government Departments, Public Sector Undertakings and local authorities are instructed to pay the above cess as per the Act. All Departments, Public Sector Undertakings and local authorities are also advised to incorporate the 1% cess in their estimates for all new works.

By order and in the name of Governor of Gujarat.



(Vinod Babbar)

Principal Secretary to Government
Labour & Employment Department.

જામીનગીરી અનામત(એસડી) અને અર્નેસ્ટ
મની ડીપોઝીટ(ઇએમડી) રૂપે બેન્ક ગેરંટી
સ્વીકારવા બાબત

ગુજરાત પાણી પુરવઠા અને ગટર વ્યવસ્થા બોર્ડ

જલસેવા ભવન, સેક્ટર-૧૦/એ, ગાંધીનગર

પરિપત્ર ક્રમાંક: એબી/સી.મે.૧-૨/૨૦૦૭-૦૮/કા.નં.૩૫/૩૫૮

તારીખ : ૦૧/૦૮/૨૦૧૮

પરિપત્ર:

વંચાણે લીધો:

ગુજરાત સરકારના નાણાં વિભાગનો ઠરાવ ક્રમાંક: ઇએમડી/૧૦/૨૦૧૮/૧૮/ડીએમઓ તા.૧૬/૦૪/૨૦૧૮

ઉપરોક્ત વિષય અને સંદર્ભ અન્વયે જણાવવાનું કે, બોર્ડ હસ્તક ચાલતા કામો માટે જામીનગીરી અનામત (એસ.ડી.) અને અર્નેસ્ટ મની ડીપોઝીટ(ઇએમડી) તરીકે નાણાંકીય વર્ષ ૨૦૧૮-૧૯ માટે કઇ કઇ બેન્કની ગેરંટી સ્વીકારી શકાય, તેનો ગુજરાત સરકારના નાણાં વિભાગનો તા.૧૬/૦૪/૨૦૧૮ નો ઠરાવ આ સાથે સામેલ છે, જે વંચાણે લઇ તે મુજબની સુચનાઓનું પાલન કરવા જણાવવામાં આવે છે.

બિડાણ : ઠરાવની નકલ અને એનેક્સર-૧

(એસ.જી.પટેલ)
નાણાં નિયંત્રક

પ્રતિ:

મુખ્ય ઇજનેરશ્રી, ઝોન-૧/૨/૩/૪/૫, વડોદરા/અમદાવાદ/રાજકોટ/ભૂજ/જુનાગઢ
મુખ્ય ઇજનેરશ્રી, મટીરીયલ સેલ(સિવિલ)/યાંત્રિક, બોર્ડ કચેરી, ગાંધીનગર
મુખ્ય ઇજનેરશ્રી, મોનીટરીંગ સેલ, બોર્ડ કચેરી, ગાંધીનગર
પ્રોજેક્ટ ડાયરેક્ટરશ્રી, અર્બન સેલ, બોર્ડ કચેરી, ગાંધીનગર
નિયામકશ્રી, જલસેવા તાલીમ સંસ્થા, સેક્ટર-૧૫, ગાંધીનગર
મુખ્ય વહીવટી અધિકારીશ્રી, બોર્ડ કચેરી, ગાંધીનગર
અધિક્ષક ઇજનેરશ્રી (તમામ)/ કાર્યપાલક ઇજનેરશ્રી(તમામ)
સીનીયર મેનેજરશ્રી(ના/હિ) સર્વે
નાયબ મેનેજરશ્રી(ના/હિ) સર્વે
સીસ્ટમ મેનેજરશ્રી, કોમ્પ્યુટર સેલ, બોર્ડ કચેરી, ગાંધીનગર - બોર્ડની વેબસાઇટ ઉપર મુકવા સારું.

નકલ સવિનય રવાના:

માન.અધ્યક્ષશ્રીના કાર્યકારી સચિવશ્રી, બોર્ડ કચેરી, ગાંધીનગર
સહ્ય સચિવશ્રીના અંગત મદદનીશશ્રી, બોર્ડ કચેરી, ગાંધીનગર

C-453

**Acceptance of Bank
Guarantee as Security Deposit
and Earnest Money Deposit.**

Government of Gujarat

Finance Department

GR. No.: EMD/10/2018/18/DMO

Date: 16/04/2018

Read: FD GR. No.: EMD/10/2016/328/DMO Dt. 01/05/2017

Preamble:

Tendering authorities of the State Government and its Boards/Corporations/Societies/PSUs frequently take Bank Guarantee from the bidders towards Security Deposit (SD) and Earnest Money Deposit (EMD). State Government had issued the list of eligible banks for the financial year 2017-18 vide above mentioned resolution of this department Dt. 01-05-2017.


After careful consideration, the Government has decided to approve the list of Banks whose Bank Guarantees would be accepted in the Financial Year 2018-19 and it has now been decided to resolve as follows:

Resolution:

Government Departments and its Boards/Corporations/Societies/PSUs would accept Bank Guarantee [towards Security Deposit (SD) and Earnest Money Deposit (EMD)] issued by any of the bank included in the **Annexure I**, attached to this Resolution.

The tendering authority will be required to ascertain the authenticity of the Bank Guarantee and set up necessary internal control procedures.

By order and in the name of the Governor of Gujarat


(J G Shelat)
Section Officer
Finance Department

To,

- The Secretary to the Governor of Gujarat, Raj Bhavan, Gandhinagar.
- The Principal Secretary to Hon. Chief Minister.
- PS to Hon. Deputy Chief Minister.
- PS to all Hon. Ministers, State Ministers and Deputy Ministers.
- PS to Leader of Opposition Party.
- Secretary, Legislative Assembly Secretariat, Gandhinagar.
- PS to Chief Secretary.
- PS to Additional Chief Secretary Finance Department.
- PS to Secretary (Economic Affairs), Finance Department
- PS to Secretary (Expenditure), Finance Department.
- PS to Deputy Secretary (Budget).
- All Administrative Departments, Sachivalaya, Gandhinagar.
- All Heads of Department.
- All Public Sector Enterprises of the State.
- All State's Boards/Corporations/Societies.
- Accountant General-I (Audit) Gujarat, Ahmedabad.
- Accountant General (A&E) Gujarat, Ahmedabad.
- Accountant General-II (Audit) Gujarat, Rajkot.
- Accountant General (A&E) Gujarat, Rajkot.
- Pay & Accounts Office, Gandhinagar / Ahmedabad.
- Chief Information Officer, Finance Department.
- All Joint Secretary / Deputy Secretary / Under Secretary of Finance Department.
- All Branches, Finance Department (Including Finance Branches).
- System Manager, Finance Department for put up on GSWAN website.
- Select File DMO-Finance Department.

Annexure I.

Finance Department, GR. No.: EMD/10/2018/18/DMO

Date: 16/04/2018

(A) Guarantees issued by following banks will be accepted as SD/EMD on permanent basis.

- ❖ All Nationalized Banks including the Public Sector Bank- IDBI Ltd.

(B) Guarantees issued by following Banks will be accepted as SD/EMD for period up to March 31, 2019. The validity cut-off date in GR is with respect to date of issue of Bank Guarantee irrespective of date of termination of Bank Guarantee.

- ❖ Rajkot Nagarik Sahakari Bank Ltd.
- ❖ The Mehsana Urban Co-Operative Bank Ltd.
- ❖ The Surat District Co-Op. Bank Ltd.
- ❖ The Ahmedabad Mercantile Co-Op. Bank Ltd.
- ❖ Nutan Nagarik Sahakari Bank Ltd.
- ❖ The Kalupur Commercial Co-operative Bank Ltd.
- ❖ Saurashtra Gramin Bank
- ❖ Baroda Gujarat Gramin Bank
- ❖ RBL Bank
- ❖ Karur Vysya Bank
- ❖ AXIS Bank
- ❖ ICICI Bank
- ❖ HDFC Bank
- ❖ Kotak Mahindra Bank
- ❖ IndusInd Bank
- ❖ DCB Bank
- ❖ FEDERAL Bank
- ❖ YES Bank

All the eligible banks are instructed to collect the original documents/papers of guarantee from the concerned tendering authority.



(J G Shelat)
Section Officer
Finance Department

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ઉદ્યોગ અને ખાણ વિભાગના ઠરાવ ક્રમાંક:એસપીઓ/૧૦૨૦૧૫/૧૯૧૦૯૩/ચ. તા.૦૩/૦૬/૨૦૧૬નું

પરિશિષ્ટ-૨

Supply of material to be purchased
By Government Departments/Offices-
Consideration of Quotation for-

GOVERNMENT OF GUJARAT
FINANCE DEPARTMENT
Circular No.GST 1070/6246-TH,
Sachivalaya, Gandhinagar
Dated the 30th January, 1971

Read: Government Circular, Finance Department No.STA-2752/1173-K,
Dated the 2nd May, 1962 (Reproduced Below)

CIRCULAR

Read: Government Circular, Finance Department No. Circular No.STA-2752/1173-K, Dated the 2nd May, 1962, Government has directed that While considering the quotations from suppliers who are liable to sales Tax/General Sales Tax, the amount of tax so payable should be left out of account; whereas in the case of suppliers who have to pay Sales Tax under the local Sales Tax law or the Central Sales Tax Act,1956 to the Government of any other State, the amount of Such taxes should be added to the gross price inclusive of tax considered. The comparative quotations computed on the above basis should then be considered on merits. It has come to the notice of Government that in spite of these instructions, some of the Government Departments/Offices do not follow the said instructions. It is therefore directed that the instructions and the procedures prescribed in the aforesaid circular in regard to consideration of quotations for supply of materials to be purchased by Government Departments/Offices should be observed scrupulously.

By order and in the name of the Government of Gujarat,

Sd/-

T.K.JAYARAMAN

Deputy Secretary to the Govt. of Gujarat.
Finance Department.

To,

1. All Secretariat Departments.
2. All Heads of Departments and Heads Office Under the Secretariat Departments/Offices.
3. All Finance Advisers
4. The Accountant General, Gujarat, Ahmedabad.
5. The Pay and Accountant Officer, Ahmedabad/Gandhinagar
6. All Branches in Finance Department
7. The Commissioner of Sales Tax, Ahmedabad (With 100 copies) (Distribution "A" Class)


MR SONI-US-IMD

CONTRACT NO.

**Bhavnagar Municipal Corporation
BHAVNAGAR**



(A WHOLLY OWNED BHAVNAGAR MUNICIPAL CORPORATION UNDERTAKING)

ESTIMATED COST

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

ESTIMATED COST: RS. 14,70,03,332.00/-

VOLUME – IIIA: GENERAL TECHNICAL SPECIFICATION

Employer

EXECUTIVE ENGINEER

(Drainage Dept.)

BHAVNAGAR Municipal Corporation

Sir Mangal Sinhji Road, Near Kalanala,

Bhavnagar,

Bhavnagar,-364001.

Contact Number: 0278 2424801-10

VOLUME- III B:
TECHNICAL SPECIFICATION - CIVIL WORKS

SECTION	PARTICULARS
Section - 1	GENERAL AND MATERIAL
Section - 2	SURVEY & GEOTECHNICAL INVESTIGATION FOR DESIGN
Section - 3	CONCRETE
Section - 4	BUILDING DETAILS
Section - 5	STRUCTURE STEEL WORKS
Section - 6	WATER SUPPLY AND SANITARY WORKS
Section - 7	EARTHWORK
Section - 8	ITEMWISE SPECIFICATIONS

SPECIFICATIONS

SECTION: 1

GENERAL AND MATERIAL

SECTION: 1

GENERAL AND MATERIAL

GENERAL

1.0 Employer's Drawings:

- 1.1. The drawings listed in the Tender document are the Employer's conceptual drawings and are to be got approved prior to start of the works with actual site conditions & level in consultation with EIC.

2.0 Drawing Sheet Format:

- 2.1. All drawings provided by the Contractor shall be on standard size sheets, prepared on computer with AutoCAD and shall show the following particulars in a title block located in the lower right-hand corner, in addition to the name of Contractor and equipment manufacturer, date, scale, drawing number, revision number (R0 for drawings submitted initially, R1, R2, etc. for drawings submitted subsequently) and title.

Project Title: - BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

A blank space of 90 mm x 100 mm shall be provided for the Engineer's approval stamp and provision shall be made for details of revisions to be recorded.

- 2.2. All drawings submitted by the Tenderer/Contractor shall use the English language and SI units. All drawings shall be clearly and fully cross-referenced to the other drawings as relevant.

3.0 Tender / Contract Drawings:

3.1. Drawings submitted by the Tenderer shall show all the essential items of the Plant offered together with sufficient details to enable the general arrangement of the Plant to be determined.

3.2. The drawings and documents to be provided by the Tenderer / Contractor shall be as per the schedules of price but shall not be limited to those listed:

4.0 Submissions and Approval of Drawings:

4.1. The following shall be the procedure for submission and approval of drawings:

4.1.1. The Contractor shall submit 4 copies of the drawings to the Employer. All the drawings are to be signed by the Contractor or his authorized representatives

4.1.2. The Engineer's Representative will review the drawings and, if found fit for approval, the Employer will return 2 copies to the Contractor duly approved.

4.1.3. In case the drawings/documents are not fit for approval but worth for review, the Engineer's Representative will mark the comments on the drawings and return 2 copies to the Contractor. In such case, the Contractor shall resubmit the revised drawings within two weeks as per sub-clause 4.1.1 above and the same shall be repeated till the drawings are finally approved as per sub-clause 4.1.2 above.

4.1.4. If the submitted drawings/documents are not worth for review, the Contractor will be informed accordingly.

4.1.5. On receipt of the approved drawings as per sub-clause 4.1.2 above, the Contractor shall submit CD or Pen drive and documents to the employer.

4.1.6. After tests on completion, the Contractor shall submit, within 15 days of the conclusion of the tests, floppies of the "As Built Drawings" to the Employer.

4.1.7. When the drawings are received by the Engineer's Representative after revision by the Contractor, he will only review the revision made and hence the Contractor shall carefully identify all the revised details / dimensions and also describe the revisions

in the revision block.

4.1.8 No drawings, with corrections made after taking the prints, will be accepted.

4.1.9 Approval of drawings by the Engineer shall not relieve the Contractor of his responsibility in terms of the Contract.

5.0 Delivery, Unloading and Storing at Site:

5.1. The Contractor shall be responsible for checking all materials delivered to Site and shall keep the Engineer's Representative fully informed of the state of deliveries. The Contractor shall carry out, at his cost, all instructions of Engineer or his Representative for proper unloading, preservation, maintenance, storage and security of materials delivered to Site until he fulfills all his obligations under the Contract.

5.2. The Contractor shall erect and maintain on the Site any temporary storage facility as required and approved by the Engineer.

5.3. Multiple handling and movement of materials during storage and retrieval shall be avoided.

6.0 Spare Parts:

6.1. Spare Parts required after the taking over the Plant shall be filled up by the bidder in the price schedule.

6.2. Spares during pre-commissioning trials, commissioning tests/maintenance, guarantee etc. shall be provided by the Contractor. The necessary spares shall be brought by the Contractor prior to the pre-commissioning test so as to avoid the downtime of equipment due to non-availability of them. All these spares have to be provided as required, by Contractor free of cost.

6.3. All spare parts shall be new, unused and strictly interchangeable with the parts for which they are intended to be replacements and shall be treated and packed for long storage under the climatic conditions prevailing at the Site. Each spare part shall be clearly marked or labeled on the outside of its packing with its description, number

and purpose. When more than one spare is packed in a single case or other container, a general description of its contents shall be shown on the outside of such case or container and a detailed list enclosed. All cases, containers and other packages shall be marked and numbered in an approved manner for the purpose of identification. Spares shall be delivered to Site after the completion of erection but before start of commissioning of Plant along with technical leaflets and details. Spare parts shall be indicated in the assembly drawing showing clearly the part numbers.

- 6.4. All cases, containers or other packages are liable to be opened for such examination as the Engineer's Representative may require and packing shall be designed to facilitate opening and thereafter re-packing. In the event of some specific spares offered in the Contract being withdrawn from manufacture owing to changes in design of equipment or similar reasons viz., model being obsolete etc., the Contractor shall inform the Employer before such withdrawal so that the Employer can take timely alternative steps.

7.0 Tools:

- 7.1. Tools shall be delivered to site just prior to Tests on Completion.

- 7.2. The specified tools shall not be used for the erection of the Plant being supplied and except that the Engineer may call upon the Contractor to demonstrate their use or effectiveness, they must be handed over to the Employer in a completely new and unused condition. Should the Contractor require any such tools at site for erection, he shall provide his own.

The test equipment shall include special purpose items essential to the testing or re-calibration of related items of Facilities.

MATERIALS AND WORKMANSHIP:

1.0 Introduction:

- 1.1 This part of the Specification sets out the general standards of materials to be supplied and the workmanship required to be ensured by the Contractor. All component parts of the Works shall, unless otherwise specified, comply with the provisions of employer's requirement or be subject to the approval of the Employer. Particular attention shall be paid to a neat, orderly and well-arranged installation

carried out in a methodical competent manner.

2.0 Reference Specifications and Standards:

2.1 Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'B.S') issued by the British Standards Institution of 2, Park street, London W.I., or to an Indian Standard Specification (I.S.) issued by the Bureau of Indian Standards, (earlier known as Indian Standard Institution), ManakBhavan, 9 Bahadur shah Zafar Marg, New Delhi 110 002, or American Society for Testing and materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American national Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or Japanese Industrial Standards (JIS) issued by Japanese Standards Association, 4-1-24, Alaska, Minato-Ku, Tokyo 107, Japan or to any other equivalent Standard it shall be to the latest revision of that Standard on the Tender opening date.

2.2 The Contractor may propose at no extra cost to the Employer, the use of any relevant authoritative internationally recognized Reference Standard.

2.3 All details, materials and utensils supplied and workmanship performed shall comply with the specified Standards. If Tenderer offers equipment to other Standards, the equipment/material should be equal or superior to those specified and full details of the difference shall be supplied.

2.4 In the event of conflict between this Specification and the Codes for equipment, provisions of this Specification shall govern. Certain specifications issued by national or other widely recognized bodies are referred to in this Specification. In referring to the Standard Specifications the following abbreviations are used:

IS	:	Indian Standard
ANSI	:	American National Standards Institute
API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
ASTM	:	American Society of Testing and Materials
AWS	:	American Welding Society
AWWA	:	American Water Works Association

ISO	:	International Organization for Standardization
DIN	:	Deutsches Institute fur Normung
BS	:	British Standard
IEC	:	International Electro technical Commission
IEE	:	Institution of Electrical Engineers
IEEE	:	Institute of Electrical and Electronic Engineers
NEMA	:	National Electrical Manufacturers Association
AGMA	:	American Gear Manufacturer's Association

3.0 Materials – General:

3.1 All materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of reputed make/approved quality, free from imperfections and selected for long life and minimum maintenance. Non-destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the Plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause.

4.0 Workmanship – General:

4.1 Workmanship and general finish shall be of first-class quality and in accordance with best workshop practice.

4.2 All similar items of the Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items.

4.3 All parts, which can be worn or damaged by dust, shall be totally enclosed in dust proof housings. All materials incorporated in the Works shall be the most suitable for the duty concerned, free from imperfections and selected for long life and minimum maintenance. All necessary accessories required for satisfactory and safe operation of the Plant shall be supplied by the Contractor unless it is specifically excluded from his scope. Suitable provision by means of eyebolts or other means are

to be provided to facilitate handling of all items that are too heavy or bulky for lifting and carrying by two men.

5.0 Welding:

5.1 Welding shall comply with the latest revision of the BS 5135 Code.

5.2 Welders shall be qualified in accordance with the requirement of the appropriate section of BS 4871. The Engineer shall have the right to call for further qualification from time to time from any welder who in the opinion of the Engineer does not produce weld in accordance with the qualification. Each welder shall be assigned a number and letter. Each welding elements shall clearly be identified as to its welder marking the welder's Code adjacent to the welds. A record chart shall be maintained for each welder showing the procedures, for which he has qualified, the date of such qualification, the type of defects produced and their frequency. The Engineer shall disqualify the welder whose Work requires a disproportionate amount of repairs. All procedures where required shall be qualified as per BS EN 283-3.

5.3 Inspection and quality of surveillance shall not be limited to the examination of finished welds. The techniques employed shall be based on methods which are known to produce good results and which have been verified at Site by actual demonstration.

5.4 Haphazard striking of the electrodes for establishing an arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. In case of any inadvertent strike on place other than the welding, the area affected shall be ground flushed and examined by liquid penetration method.

5.5 Generally, a stringer bead technique shall be used with a slight oscillation of necessary to avoid slag and to minimize the number of beads needed to fill exceed 3 times the wire diameter. Vertical welds shall be made in upward direction. For all pipes above 300 mm dia., welding shall be done whenever possible, by 2 welders working simultaneously along both sides of the pipe.

5.6 The root pass shall have less than 1.5 mm internal reinforcement. Defects like icicles, burn through and excessive "such back", etc. shall be cause for rejection of

welds.

- 5.7 Final welds shall be suitable for appropriate fabrication of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without gouging or thinning of the parent metal in any way. Uneven and excessive grinding may be a cause for rejection. Fillet weld shall preferably be convex and free from undercutting and overlap at the toe of weld. Convexity and concavity shall not exceed 1.5 mm. The leg lengths shall not exceed the specified size by more than 1.5 mm.
- 5.8 All attachments such as lugs, brackets and other non-pressure parts shall also be done by qualified welders in accordance with the design details and materials specifications. Temporary attachments shall be removed in a manner that will not damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by ultrasonic or liquid penetration methods.
- 5.9 All tack welds shall be made using qualified procedure and welders, the number of sizes of tack welds shall be kept as small as to consist of adequate strength and joint alignments. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their starting ends so that they may be satisfactorily incorporated in the welds. Unacceptable defects shall be removed by grinding machine or chipping or gouge. Flame gouging may be permitted provided gouged surfaces are ground at least by 1.0 mm below the deepest indentation.
- 5.10 All weld repairs shall be carried out using the approved welding procedures and welders. Re-welded areas shall be re-examined by the methods specified for the original welds and the Engineer's Representative shall duly qualify repair procedures.
- 6.0 Pre-heating and Post-heating Treatment:**
- 6.1 Pre-heating and post heating treatment shall conform to the relevant application Codes. Pre-heating not exceeding 121 deg. C for all carbon steel construction above

25 mm thickness would be mandatory. Such pre-heating would be maintained during flame cutting, flame or arc gouging, welding and repairs and may be done by gas heating by gas torches/gas rings with neutral flame. The temperature shall be checked by temperature indicating crayons. However, such pre-heating will not be necessary for welds less than 6 mm size. In large diameter pipe fabricated out of plate materials, production control test plates in accordance with the BS 4870-part 1 Table 6 to represent 30% of the long seams and each welder's performance would be mandatory.

7.0 Electrodes:

7.1 All electrodes shall be stored in their original sealed containers under dry conditions. Electrodes shall remain identified until consumed. All electrodes shall be dried before use. Drying ovens shall be provided in Work areas for drying purposes. Electrodes withdrawn from oven shall be promptly used and excess unused electrodes shall be promptly returned to oven.

8.0 Examination/NDT/Radiography

8.1 The various stages of examination and types shall be as stipulated in the respective fabrication Codes. Radiographic examination shall be carried out as per provisions of BS 2600 or BS 2910; Ultrasonic tests were called for shall be carried out as per provisions of BS 3926; magnetic particle tests shall be carried out as per BS 6072. Liquid penetration tests shall be carried out as per BS 6443.

9.0 Stainless Steel Welding:

9.1 All welding consumable such as electrodes, filler weirs, argon gas for shielding and purging shall be of high quality and the proposed brand shall be furnished for approval of the Engineer. Weld deposits shall have similar or higher physical properties and similar chemical composition to the members joined.

9.2 All electrodes shall be purchased in sealed containers only and stored in their packing intact. The packets opened shall be consumed as early as possible. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by electrode manufacturer. Special care shall be taken

in avoiding mixing of electrodes in the oven. The electrodes and filling wires shall be free from rust, oil, grease, earth and other foreign matter.

- 9.3 Argon gas with purity 99.5% shall be used for shielding and purging. The purity of gas shall be certified by the gas manufacturers.
- 9.4 Non-destructive examination of the welds shall be carried out to ensure quality of weld.
- 9.5 The electric current for welding shall be direct current, straight polarity (electrode negative). The welding current shall be kept minimum possible to ensure minimum heat affected zone in the parent material. Other side of the weld joint shall be periodically flushed with argon gas.

10.0 Castings:

- 10.1 Cast iron shall be of standard grey close-grained quality. The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surfaces of castings, which are not machined, shall be smooth and shall be carefully fettled to remove all foundry irregularities.
- 10.2 Minor defects in depth not exceeding 12.5 percent of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The Engineer shall be notified of large defects and no repair welding of such defects shall be carried out without prior approval of the Engineer. If the removal of metal for repair should reduce the stress resisting cross section of the casting by more than 25 percent, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then casting shall be rejected. Test coupons cast simultaneously with the main castings shall be identified to check physical, chemical analysis of casting. Major defects on casting are not acceptable. Castings repaired by welding for minor defects shall be stress-relieved after such welding. Non-destructive tests as directed by the Engineer will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine where repair welds have been properly made.

11.0 Forging:

- 11.1 All major stress-bearing forging shall be made to a Standard Specification. Forging shall be subjected to magnetic particle testing or dye penetration test at the areas of fillets and change in section. The testing shall be conducted after rough machining (10 microns). Any defect, which will not machine out during the final machining, will be gouged out fully, inspected by dye penetration or magnetic particle inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indication, which proves to penetrate deeper than 2.5% of the finished thickness of the component, shall be reported to the Engineer giving the details like location, length, width and depth. For the magnetic particle inspection, the choice of wet or dry particles shall be at the Contractor's discretion.
- 11.2 All forging shall be demagnetized after test and shall be heat-treated for the relief of residual stresses.

12.0 Design Life:

- 12.1 The Works as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the Site, and with the minimum of maintenance. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating of engines, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operating temperatures. The Contractor shall be called upon to demonstrate this for any component part either by service records, or evidence of similar equipment already installed elsewhere or relevant type tests. Routine maintenance and repair shall as far as possible not require the services of highly skilled personnel.
- 12.2 The Plant shall be designed to provide easy access to and replacement of component parts, which are subject to wear, without the need to replace whole units. No parts in contact with water shall have a life from new to replacement or repair of less than five years.
- 12.3 Design features shall include the protection of Plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate

without undue vibration, and parts shall be designed to withstand the maximum stresses under the most severe condition of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause, which may have a detrimental effect upon the performance or life of the Works.

12.4 Plant located outside lockable areas/building shall have additional features to prevent un-authorized operation.

13.0 Name Plate:

13.1 Each item of the Plant shall have permanently attached to it in a conspicuous position, a nameplate and rating plate. Upon these shall be engraved or stamped, the manufacturer's name, type and serial number of Plant, details of the loading and duty at which the item of Plant has been designed to operate, and such diagrams as may be required by the Engineer. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their function and proper manner of use.

13.2 Nameplates, rating plates and labels shall be of a non-flame propagating material, either non-hygroscopic or transparent plastic with engraved lettering of a contrasting color. Fixing shall be by means of non-corrosive screws; drive rivets or adhesives shall not be used.

13.3 Warning labels shall be provided where necessary to warn of dangerous circumstances or substances. Inscriptions or graphic symbols shall be black on a yellow background.

13.4 Instruction labels shall be provided where safety procedures such as wearing of protective clothing are essential to protect personnel from hazardous or potentially hazardous conditions. These labels shall have inscriptions or graphic symbols in white on a blue background.

14.0 Nuts, Bolts, Studs and Washers:

14.1 Nuts, bolts, studs and washers for incorporation in the Plant shall conform to the requirements of the appropriate standard. Nuts and bolts shall be of the best quality of specified grade, machined on the shank and under the head and nut.

- 14.2 Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.
- 14.3 Washers, locking devices and anti-vibration arrangements shall be provided where necessary. Jointing hardware for the entire Plant shall be provided with sufficient spares to cater for site losses.
- 14.4 Where bolts pass through structural members taper washers shall be fitted, where necessary, to ensure that no bending stress is caused in the bolt. Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any conditions. All bolts, nuts and washers that are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel-bearing stainless steel.
- 14.5 The Contractor shall supply all holding down, alignment and leveling bolts complete with anchorages, nuts, washers and packing required to attach the Plant to its foundations, and all bed plates, frames and other structural parts necessary to spread the loads transmitted by the Plant to concrete foundations without exceeding the design stresses.
- 15.0 Allowances for Wastage:**
- 15.1 The Contractor shall supply reasonable excess quantities to cover wastage of those consumables, which will be normally subject to waste during erection, commissioning and setting to Work.
- 16.0 Painting – General:**
- 16.1 The Contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the Plant at the place of manufacture prior to packing.
- 16.2 Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After test, all surfaces shall be thoroughly cleaned and dried out,

if necessary by washing with an approved de-watering fluid prior to surface treatment. Except where the specification provides to the contrary all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.

16.3 All protective coatings shall be suitable for use in warm humid climates. All primers, under coats and finishes shall be applied by brush or airless spray, except where otherwise specified. Consecutive coats shall be in distinct but appropriate shades. All paints shall be supplied from the store to the painters, ready for application, and addition of thinners or any other material shall be prohibited.

17.0 Painting at Place of Manufacture:

17.1 Steel and cast iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp corners etc. shall be ground to a curve before sand blasting. A primer coat of a zinc rich epoxy resin based coating with at least 75 microns' dry film thickness is to be provided. In addition, the parts are to be provided with adequate number of coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns including primer coating.

18.0 Painting at Site:

18.1 Immediately on arrival at the site, all items of Plant shall be examined for damage to the paint coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

18.2 After erection, such items, which are not finish painted, shall be done so and, items that have been finish painted at the manufacturer's works shall be touched up for any damaged paintwork. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns.

18.3 The dry paint film thickness shall be measured by Electrometer or other instruments approved by the Employer. In order to obtain the dry film thickness specified the

Contractor should ensure that the coverage rate given by the paint manufacturer would enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm². Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated.

19.0 Galvanizing:

19.1 Wherever galvanizing has been specified the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

a) Fabricated steel

Thickness less than 2 mm but not less than 1.2 mm - 340 gms/sq.m

Thickness 2 mm and above - 460 gms/sq.m

b) Fasteners

Up to nominal size M10 - 270 gms/sq.m

Over M10 - 300 gms/sq.m

19.2 Galvanizing shall be carried out after all drilling; punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanizing. Any Site modification of galvanized parts should be covered well by zinc rich primer and aluminum paint.

20.0 Support for Pipe work & Valves:

20.1. All necessary supports, saddles, sling, fixing bolts & foundation bolts shall be supplied to support the pipe work. Valve and other facilities mounted in the pipe work shall be supported independent of the pipes to which they connect.

INSPECTION AND TESTING AT MANUFACTURER'S PREMISES

1.0 Inspection and Tests:

1.1 Valve:

1.1.1 During testing there shall be no visible evidence of structural damage to any of the valve component.

1.1.2 Motorized valves shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable of opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.

1.1.3 The following test shall be carried out for sluice valves:

- a) Seat leakage test at rated pressure
- b) Hydrostatic test at 1.5 times the rated pressure
- c) Valve operation

1.1.4 The following test shall be carried out for non-return valves:

- a) Seat leakage test at rated pressure
- b) Body hydrostatic test at 1.5 times rated pressure
- c) Operation

1.2 Pipe work:

1.2.1 Testing of pipes and fitting shall be carried out in accordance with relevant Indian Standard and internationally approved standard. Pipes, fittings and expansion bellows shall be hydrostatically tested for 1.5 times the rated pressure.

1.3. E.O.T. Crane:

1.3.1 The cranes shall be completely assembled in the Contractor's or subcontractor's Works and shall be subjected to the tests as specified in IS- 807/IS-3177 or relevant internationally approved standard. The Contractor shall provide the test weights.

1.4 Equipment for testing:

Equipment required for testing CC cubes and testing of steel bars are installed at main H/W site.

SPECIFICATIONS

SECTION:2

SURVEY & GEOTECHNICAL INVESTIGATION FOR DESIGN

Specifications for Minimum Investigations required for Project:

Survey and Soil Exploration:

To plan out and obtain pre-approval and subsequently carry out Topographic and level Survey, preparing cross sections, Longitudinal sections, Soil exploration to obtain foundation design data at various locations for all the components listed in preamble on previous page, complete all as per general pre-approved plan and as per detailed description and specifications and including submitting survey, soil exploration and analysis reports in six copies along with two soft copies and getting the same approved by the engineer in charge.

Work consists of providing all equipment, materials, labour etc. to carry out survey, to provide permanent markers of various points for later use, to create permanent bench mark of approved design and approved location on the site, to carry out soil exploration to obtain information for foundation design as well as collecting data to determine various design parameters, to collect all data, prepare interim and final reports for submission and approval of the Engineer in-charge, all as per detailed description, specifications and as directed by the Engineer in-charge. This may call for revised hydraulic design, in case location of headwork/ sub headwork/ village level sump etc. changes. However, minimum pipe size (as given in Schedules and drawings) shall be adhered to. In certain cases, due to revised location of tail end point sump, level may be higher or frictional losses may increase. This will demand pipe size of higher diameter and contractor shall carry out hydraulic design to suit specific section subject. In case level of such sump reduces or location reduces the length ultimately resulting into permission of lower size, size given in schedule & drawing shall be provided and on no account, it shall be reduced.

It must be clearly understood that the data furnished with the tender and suggested procedure for survey and soil exploration are purely for general guidance of the bidders for selecting the best design criteria. The contractor is expected to carry out additional work if it becomes necessary in the process of selecting appropriate criteria. In any case responsibility of assuring the guaranteed water supply will fully rests with him.

Work Description:

Work under this item involves survey, soil exploration and investigation as described below. Survey maps and all interim as well as final reports of soil investigation, other tests as well as the reporting of final test shall be submitted in six paper copies as

well as two soft copies and these will form part of a permanent record of the project for use during construction, operation, and maintenance stages as well as for future use. All below mentioned work shall be all inclusive and will be carried out as per detailed specifications and as directed by the Engineer in-charge.

Survey and soil investigation shall be completed within one & half month. In case after delay of 15 calendar days the department will get completed the work from departmental agency at the risk and cost of the contractor which shall be binding to the contractor.

Survey work shall consist of the following:

- A. To carry out Block level survey based on GTS benchmark, prepare longitudinal section along alignment of all types of pipelines and prepare contour survey of the allotted plot of land and the river bed of the width of 100m – 50m on either side - of the suggested center line of the alignment, and prepare contour maps to a scale of 1:500 or larger. Survey in the river may be carried out with help of sounding technique or long metallic rod inserted in water from the boat. All the levels/ distance may be measured with help of total station or DGPS.
- B. Selecting most appropriate location (on the basis of survey) to determine various geotechnical parameters for carrying out design of various components shall be responsibility of the contractors and it shall be carried out by laboratory approved by GOG acceptable to BMC.
- C. Above survey shall be carried out in stages as and when required, using the latest equipment like TOTAL STATION or DGPS with high accuracy. In case dumpy level/ auto level is used, then fly back as well as closing error must be performed without which survey will be considered as NOT completed. All levels will be based on GTS, and the work shall include transferring level from a reliable established GTS benchmark in the vicinity of the site of work and establishing a permanent bench mark on site at a suitable location as per approved design and location. Above survey will be carried out jointly with the representative of the owner, as per his convenience during day time.
- D. Detailed Longitudinal Section for each pipe shall be prepared and HGL marked on it for approval of BMC. After marking of such data only, execution of pipeline shall be permitted.
- E. Detailed contour plan of the headwork/ sub headwork etc. prepared with interval of 0.2 m so as to determine position of various units.

- A. 150 mm bores or more diameters (Minimum one no per unit/ structure) will be made to collect information for the foundation design of the intake well, approach bridge supports, underground sump, Pump House, other structures. Minimum depth of bores from the existing level at the location of various structures shall be governed by IS stipulations or more as per requirement of specific structural design. Disturbed and undisturbed soil samples will be collected, and grain size analysis by dry sieving/Wet analysis, determination of liquid/plastic limit and other necessary tests like C value, N value, ϕ value and important parameters to carry out structural design and facilitate execution of structures shall be carried out. All levels including ground level of the bore point, levels of various strata and water levels etc. will be noted in reference to GTS.
- B. Trial pit and bore for laying of pipeline underground or saddle support/ pedestal/ bridge/ existing structure etc. shall be carried out in accordance with relevant IS stipulation to facilitate strata identification and payment towards excavation and other allied works. this shall also include collection of data necessary for structural design of thrust block and other ancillary crossing works.
- (A) **Specification for drilling, investigation, furnishing details of bore logs, laboratory testing and reporting:**
1. The investigation bores shall be made by percussion method and not by rotary method. No bentonite slurry or drilling mud shall be used. The bores shall be cased when it is to be done in sandy and silty strata.
 2. The quantity of boring mentioned in work description is approximate and likely to vary materially if investigating alternative location of Infiltration Well becomes necessary. Any change in the quantity of boring work shall not entitle the contractor for any claim or compensation. His rates shall be deemed to cover such an eventuality.
 3. The disturbed samples shall be collected at every 1.5 Mt. Depth or at the points where the strata change whichever is less.
 4. The samples so collected shall be preserved in systematic manner in core boxes, when the bore is in progress. After the bore is completed, each of the samples shall be packed in two separate poly thin bags with contents of approx. 0.5 Kg and properly numbered giving other details so as to identify the position to which the samples represent. All other details such as the bores Sr. Nos., the depth from which the samples are taken etc. should be clearly given with the samples.
 5. Out of the two sets of samples collected for every bore one set of samples with all requisite details shall be sent to the laboratory for testing and the second set of samples together with requisite details shall be supplied to the clients in their office for record. The casing pipes shall be removed after above compliance and with the

approval of the Engineer in-charge. The recovered samples shall be tested in the laboratory for grain size analysis and Atterbergs limits to identify the samples in accordance with the provision in IS.1498, 1971. The testing of samples shall have to be done at the recognized laboratory approved by the engineer-in charge.

6. The drilling shall be terminated at approx. 2.0 Mts. below the impervious (e.g. clay) strata, when bores are being made primarily to find the level of impervious strata. And if the samples collected indicate the soil being predominantly clayey further drilling shall be discontinued. In sandy strata including sand with gravels and small size boulders, Bores shall be extended at least up to 15 Mts. below bed level or low water level whichever is lower, however if required by Client /Consultants, The bores may have to be carried further.
7. Where bores are required to be done in water channel in river/ nallah bed, necessary island/islands shall be prepared in sand or sand filled gunny bags. The cost of which shall be covered within the rates quoted.
8. The rates quoted shall be inclusive for drilling in all kinds of strata including boulders, soft or hard rock.
9. For every bore water level encountered shall be recorded together with variation in water level if during the period of boring.
10. All levels shall be with reference to the GTS Bench Mark. For this purpose, a pucca GTS Bench mark shall be established in the region of proposed survey and investigation area.
11. The readings are to be recorded and observations are to be submitted with the reports in the format as per Proforma 1 and 2 shown below. The Contractor shall prepare bore charts for each and every bore in the approved manner and Proforma as required by Client.
12. The disturbed samples are to be analyzed as per relevant clause of I.S. 2720 Part I to IV.
13. The water samples of water pumped out during pump test shall be collected and analyzed covering requirements of I.S. 10500 to establish its portability and the results of the chemical and other tests submitted in the format shown in Proforma 3.
14. A Technical report covering the observations and tests is to be submitted to the client with the contractor's recommendations for selecting the most suitable site for the Radial well which could give the desired yield. The site for location of the pumping test shall be finalized in consultation with the clients before the work of pumping test including necessary boring work for the same is taken up.

(B) Specification for preparing and submitting the full technical report:

1. The survey work shall be carried out with proper accuracy and permanent Bench Mark shall be established at points which are approved by the Engineer in-charge. Also, sufficient number of permanent identification marks shall be established on the bank to enable establishment of base lines and the survey map to be included in the report shall contain sufficient details with respect to these permanent marks to enable the contractor to relocate the soil investigation bores as well as pump well and piezometric bores positions.
2. Based on the soil investigation carried out, a contour map of the area investigated showing the soil strata shall be prepared and included in the technical report.
3. The soil investigation work shall be carried out as per specifications and information will be recorded in the format given in attached Proforma 1 and 2.
4. The short chemical analysis of water samples shall be carried out as per I.S. 10500 and results reported in format given in attached Proforma 3.
5. The Proforma included in the tender are only for guidance and by no means are they to be considered as the only ones required for reporting the investigation. Additional information which is considered necessary shall be collected and recorded systematically in proper format to arrive at the relevant conclusions.
6. Using these parameters discharge shall be calculated for different water levels of the river, and the report shall make definite recommendations as regards to the number of radials, their levels, and their lengths required to obtain the desired yield.

PROFORMA 2						
Bore hole no.	Date of start	Date of comp.		Termination depth	Revision no.	
Depth of sample	Grain size analysis					
	.% Gravel	.% sand	Hydrometer		LL%	PL%
			.% Silt	.% Clay		PI%

PROFORMA 3: CHEMICAL ANALYSIS OF WATER				
Date of collection		Source		
Date of arrival at lab		Location	Village :	
Lab ref. no.				
Sr. no.	Characteristics	Permissible value as per IS 10500		
		Desirable	Relaxable in absence of alternate source	Analytical value
1	Color			
2	Odor			
3	Turbidity			
4	Dissolved solids			
5	pH			
6	Total hardness as CaCO ₃			
7	Calcium			
8	Magnesium			
9	Chloride			
10	Sulphate			
11	Nitrate			
12	Fluoride			
13	Manganese			
Signature:				
Date:				

SPECIFICATIONS

SECTION:3

CONCRETE

SECTION -3:

CONCRETE

2.0 Applicable Codes with latest revisions.

2.0.1 Materials

- 1) IS.269 Specification for 33 grade ordinary Portland cement.
- 2) IS.455 Specification for Portland slag cement.
- 3) IS.1489 Specification for Portland- Pozzolana cement (Part 1&2).
- 4) IS:8112 Specification for 43 grade ordinary Portland cement.
- 5) IS:12269 Specification for 53 grade ordinary Portland cement.
- 6) IS:12330 Specification for sulphate resisting Portland cement.
- 7) IS:383 Specification for coarse and fine aggregates from natural sources
For concrete.
- 8) IS:432 Specification for mild steel and medium (tensile steel bars and hard-drawn steel) wires for concrete reinforcement. (Part 1 and 2)
- 9) IS:1786 Specification for high strength deformed steel bars and wires for Concrete reinforcement.
- 10) IS:1566 Specification for hard-drawn steel wire fabric for concrete Reinforcement.
- 11) IS:9103 Specification for admixtures for concrete.
- 12) IS:2645 Specification for integral cement water- proofing compounds.
- 13) IS:4990 Specification for plywood for concrete shuttering work.

2.0.2 Material Testing:

- 1) IS.4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)
- 2) IS:4032 Method chemical analysis of hydraulic cement.
- 3) IS:650 Specification for standard sand for testing of cement.
- 4) IS:2430 Methods for sampling of aggregates for concrete.
- 5) IS: 2386 Methods of test for aggregates for concrete (Parts 1 to 8)
- 6) IS:3025 Methods of sampling and test (physical and chemical) for water used in industry.
- 7) IS:6925 Methods of test for determination of water soluble chlorides in Concrete admixtures.

2.0.3 Material Storage:

- 1) IS:4082 Recommendations on stacking and storing of construction Materials at site.

2.1.4 Concrete Mix Design:

- 1) IS:10262 recommended guidelines for concrete mix design.
- 2) SP:23 (S&T) Handbook on Concrete Mixes

2.1.5 Concrete Testing:

- 1) IS.1199 Method of sampling and analysis of concrete.
- 2) IS:516 Method of test for strength of concrete.
- 3) IS:9013 Method of making, curing and determining compressive strength Of accelerated cured concrete test specimens.
- 4) IS:8142 Method of test for determining setting time of concrete by Penetration resistance.
- 5) IS:9284 Method of test for abrasion resistance of concrete.
- 6) IS:2770 Methods of testing bond in reinforced concrete.

2.1.6 Equipment:

- 1) IS:1791 Specification for batch type concrete mixers.
- 2) IS:2438 Specification for roller pan mixer.
- 3) IS:4925 Specification for concrete batching and mixing plant.
- 4) IS:5892 Specification for concrete transit mixer and agitator.
- 5) IS:7242 Specification for concrete spreaders.
- 6) IS:2505 General Requirements for concrete vibrators: Immersion type.
- 7) IS:2506 General Requirements for screed board concrete vibrators.
- 8) IS:2514 Specification for concrete vibrating tables.
- 9) IS:3366 Specification for pan vibrators.
- 10) IS:4656 Specification for form vibrators for concrete.
- 11) IS:11993 Code of practice for use of screed board concrete vibrators.
- 12) IS:7251 Specification for concrete finishers.
- 13) IS:2722 Specification for portable swing weigh batchers for concrete (Single and double bucket type).
- 14) IS:2750 Specification for steel scaffoldings.

2.1.7 Codes of Practice:

- 1) IS:456 Code of practice for plain and reinforced concrete.
- 2) IS:457 Code of practice for general construction of plain and reinforced Concrete for dams and other massive structures.
- 3) IS:3370 Code of practice for concrete structure for storage of liquids (Part1to4)
- 4) IS:3935 Code of practice for composite construction.
- 5) IS:2204 Code of practice for construction of reinforced concrete shell roof
- 6) IS:2210 Criteria for the design of reinforced concrete shell structures and Folded Plates.
- 7) IS:2502 Code of practice for bending and fixing of bars for concrete Reinforcement.

- 8) IS:5525 Recommendation for detailing of reinforcement in reinforced Concrete works.
- 9) IS:2751 Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
- 10) IS:9417 Specification for welding cold worked bars for reinforced concrete construction.
- 11) IS:3558 Code of practice for use of immersion vibrators for consolidating concrete.
- 12) IS:3414 Code of practice for design and installation of joints in buildings.
- 13) IS:4326 Code of practice for earthquake resistant design and construction Of building.
- 14) IS:4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)
- 15) IS:2571 Code of practice for laying in situ cement concrete flooring.
- 16) IS:7861 Code of practice for extreme weather concreting: Part 1 Recommended practice for hot weather concreting.

2.1.8 Construction Safety:

- 1) IS: 3696 Safety code for scaffolds and ladders. (Parts 1 &
- 2) IS:7969 Safety code for handling and storage of building materials.
- 3) IS:8989 Safety code for erection of concrete framed structures.

2.2 General:

The Engineer in charge shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment and the quality control system. Such an inspection shall be arranged and the Engineer in charge's approval obtained, prior to starting of concrete work. This shall however, not relieve the Contractor from any of his responsibilities. All materials which do not conform to the Specifications shall be rejected.

Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall generally be used.

Other materials may be used after approval of the Engineer in charge and after establishing their performance suitability based on previous data, experience or tests.

2.3 Materials:

2.3.1 Cement:

Unless otherwise called for by the Engineer in charge, cement shall be ordinary Portland cement conforming to IS: 269, IS: 8112 or IS: 12269. However, in any case, cement grade shall not be lower than 43 grades.

Where Portland Pozzolana or slag cements are used, it shall be ensured that consistency of quality is maintained, there will be no adverse interactions between the materials and the finish specified is not marred.

Only one type of cement shall be used in a particular unit. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without approval from the Engineer in charge.

Cement which is not used within 90 days from its date of manufacture shall be tested at a laboratory approved by the Engineer in charge and until the results of such tests are found satisfactory, it shall not be used in any work.

2.3.2 Aggregates (General):

Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/ organic impurities/deleterious materials and conform to IS:383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

Aggregates shall be washed and screened before use where necessary or if directed by the Engineer in charge.

Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long term effects, on the concrete.

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.

The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

Plums 160 mm and above of a reasonable size may be used in mass concrete where directed. Plums shall not constitute more than 20% by volume of the concrete.

2.3.3 Water:

Water to be used for both mixing and curing shall conform to IS: 456. Potable water is generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

2.3.4 Reinforcement:

All reinforcement steel shall be TMT tor steel conforming to relevant I.S. for all RCC structure with CRS - Fe-415 conforming to IS-1786.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

2.3.5 Admixtures:

Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS: 9103 and integral water proofing admixtures to IS: 2645.

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the Engineer in charge. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedment.

Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts.

Wastage:

Wastage allowance for cement and steel shall be considered in the item rate and no extra payment shall be paid to the Contractor on any account.

2.4 Samples and Tests:

All materials used for the works shall be tested before use.

Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the Engineer in charge samples shall also be got tested by the Contractor in a laboratory approved by the Engineer in charge at no extra cost. Engineer in charge may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

Sampling and testing shall be as per IS: 2386 under the supervision of the Engineer in charge.

Water to be used shall be tested to comply with requirements of IS: 456.

The Contractor shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed, the admixture shall be got tested at an approved laboratory at no extra cost.

2.5 Storing of Materials:

All materials shall be stored in a manner so as to prevent its deterioration and contamination which would preclude its use in the works. Requirements of IS: 4082 shall be complied with.

The Contractor will have to make his own arrangements for the storage of adequate quantity of cement. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by the Engineer in charge. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt.

Each size of coarse and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

The Contractor shall make his own arrangements for storing water at site in tanks to prevent contamination.

The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/water. Each type and size shall be stacked separately.

2.6 Concrete:

2.6.1 General:

Concrete grade shall be as designated on drawings. In concrete grade M15, M20 etc. the number represents the specified characteristic compressive strength of 150X150X150 mm cube at 28 days, expressed in N/mm² as per IS:456. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete works of grade M5, M7.5 and M10 shall be NOMINAL MIX CONCRETE whereas all other grades, M15 and above, shall be DESIGN MIX CONCRETE. Concrete grade shall not be lower than M-20 for building and M-25 for water retaining structures (all units of STP including distribution chambers, sludge chambers, inlet/ outlet chambers adjacent to PST/ AT/ SST).

2.6.2 Design Mix Concrete:

(a) Mix Design & Testing:

For Design Mix Concrete, the mix shall be designed according to IS: 10262 and SP:23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS:456. The design mix shall be cohesive and does not segregate and should result in a dense and durable concrete and also capable of giving the finish as specified. For liquid retaining structures, the mix shall also result in water tight concrete. The Contractor shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

The minimum cement content for Design Mix Concrete shall be as per Appendix-A of IS:456 or as given below, whichever is higher.

Grade of Concrete	Minimum Cement Content in Kg/m ³ of Concrete
M15	260
M20	315
M25	360
M30	380
M 35	400

The minimum cement content stipulated above shall be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The CONTRACTOR's quoted rates for concrete shall provide for the above eventuality and nothing extra shall be paid to the CONTRACTOR on this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the CONTRACTOR.

It shall be the Contractor's sole responsibility to carry out the mix designs at his own cost. He shall furnish to the EMPLOYER at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS: 516 shall comply with the requirements of IS:456.

Grade of Concrete	Minimum Compressive Strength N/sq.mm at 7 days	Specified Characteristic Compressive Strength N/sq.mm at 28 days
M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer in charge is given below:

Structure/Member	<i>Slump in millimeters</i>	
	Maximum	Minimum
Reinforced foundation walls and footings	75	25
Plain footings, caissons and substructure walls	100	25
Slabs, Beams and reinforced walls	75	25
Pump & miscellaneous Equipment Foundations	100	25
Building columns	50	25
Pavements	50	25
Heavy mass construction	50	25

(b) Batching & Mixing of Concrete:

Proportions of aggregates and cement, as decided by the concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by the Engineer in charge shall be maintained. Each time when the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

Arrangement should be made by the Contractor to have the cubes tested in an approved laboratory or in field with prior consent of the Engineer in charge. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456, IS 3370.

2.6.3 Nominal Mix Concrete;

(a) Mix Design & Testing:

Mix design and preliminary tests are not necessary for Nominal Mix Concrete.

However, works tests shall be carried out as per IS: 456. Proportions for Nominal Mix Concrete and Water Cement Ratio may be adopted as per Table-3 of IS: 456. However, it will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

(b) **Batching & Mixing of Concrete:**

Based on the adopted nominal mixes, aggregates shall be measured by volume. However, cement shall be by weight only.

2.7 Formwork:

Formwork shall be all inclusive and shall consist of shoring, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, false work, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the Engineer in charge, the drawings and calculations for the design of the formwork shall be submitted to the Engineer in charge for approval.

Formwork shall be designed to fulfill the following requirements:

- (a) Sufficiently rigid and tight to prevent loss of grout/ slurry or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.
- (b) Made of suitable materials.
- (c) Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.
- (d) Capable of withstanding without deflection the worst combination of self-weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, earthquake, wind and weather forces.
- (e) Capable of easy striking out without shock, disturbance or damage to the concrete.
- (f) Soffit forms capable of imparting a camber if required.
- (g) Soffit forms and supports capable of being left in position if required.

- (h) Capable of being cleaned and/or coated, if necessary, immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of the Engineer in charge. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mold oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of the Engineer in charge. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left in situ shall not impair the desired appearance or durability of the structure by causing spilling, rust staining or allowing the passage of moisture.

For liquid retaining structures, sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

Where specified all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

Forms for substructure may be omitted when, in the opinion of the Engineer in charge, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the Engineer in charge, than that required as per drawing to compensate for irregularities in excavation.

The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as approved by the Engineer in charge. The Contractor shall temporarily and securely fix items to be casted (embedment / inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at Contractor's cost.

The striking time for formwork shall be determined based on the following requirements:

- (a) Development of adequate concrete strength;
- (b) Permissible deflection at time of striking form work;
- (c) Curing procedure employed - its efficiency and effectiveness;
- (d) Subsequent surface treatment to be done;
- (e) Prevention of thermal cracking at re-entrant angles;
- (f) Ambient temperatures; and
- (g) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Under normal circumstances (generally where temperatures are above 20°C) forms may be struck after expiry of the time period given in IS: 456 unless approved otherwise by the Engineer in charge. For Portland Pozzolana/slag cement the stripping time shall be suitably modified as approved by the Engineer in charge. It is the Contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

2.8 Reinforcement Workmanship;

Reinforcing bars supplied bent or in coils shall be straightened cold without damage.

No bending shall be done when ambient temperature is below 5°C. Local warming may be permitted if steel is kept below 10° C.

All bars shall be accurately cut and bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by Engineer in charge. Re-bending or straightening incorrectly bent bars shall not be done without the approval of the Engineer in charge.

Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by the Engineer in charge prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spilling of the concrete cover.

Binding wire shall be 16-gauge soft annealed wires. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

Substitution of reinforcement, laps/splices not shown on drawing shall be subject to Engineer in charge's approval.

2.9 Tolerances:

Tolerance for formwork and concrete dimensions shall be as per IS:456 unless specified otherwise.

Tolerances specified for horizontal or vertical building lines or footings shall not be construed to permit encroachment beyond the legal boundaries.

The formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings within the tolerances given below:

(a)	Deviation from specified dimensions of cross section of columns and beams	- 6 mm+ 12 mm
(b)	Deviations from dimensions of footings (Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels)	
	1) Dimension in plan	- 12 mm+ 50 mm
	2) Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm.
	3) Thickness	± 0.05 times the specified thickness

2.10 Preparation Prior to Concrete Placement:

Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mold oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

All arrangements-formwork, equipment and proposed procedure, shall be approved by the Engineer in charge. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

2.11 Transporting, Placing and Compacting Concrete:

Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms the Contractor shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.0m.

Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremie or by pipeline from the mixer and shall never be allowed to fall freely through the water.

While placing concrete the Contractor shall proceed as specified below and also ensure the following:

- (a) Continuously between construction joints and pre-determined abutments.
- (b) Without disturbance to forms or reinforcement.
- (c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.
- (d) Without dropping in a manner that could cause segregation or shock.
- (e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.
- (f) Do not place if the workability is such that full compaction cannot be achieved.
- (g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.
- (h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.
- (i) Ensure that there is no damage or displacement to sheet membranes.

- (j) Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration shall be avoided.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by the Engineer in charge. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

Except when placing with slip forms, each placement of concrete in multiple lift work shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as approved by the Engineer in charge. Concrete shall be protected against damage until final acceptance.

2.12 Mass Concrete Works:

Sequence of pouring for mass concrete works shall be as approved by the Engineer in charge. The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

2.13 Curing:

Curing and protection shall start immediately after the compaction of the concrete to protect it from:

- (a) Premature drying out, particularly by solar radiation and wind;

- (b) Leaching out by rain and flowing water;
- (c) Rapid cooling during the first few days after placing;
- (d) High internal thermal gradients;
- (e) Low temperature or frost;
- (f) Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

All concrete, unless approved otherwise by the Engineer in charge, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

Where a curing membrane is approved to be used by the Engineer in charge, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be approved by the EMPLOYER before use and shall be applied with spraying equipment capable of a smooth, even textured coat.

Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

2.14 Construction Joints and Keys:

Construction joints will be as shown in the drawing or as approved by the EMPLOYER. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of the Engineer in charge.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as approved by the Engineer in charge.

Before resuming concreting on a surface which has hardened all laitance and loose stone shall be thoroughly removed by wire brushing/hacking and surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and horizontal layers.

When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this, a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. **Thereafter work shall proceed in the normal way.**

2.15 Foundation Bedding:

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy areas shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as approved by the Engineer in charge. The surfaces of absorptive soils shall be moistened.

Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

2.16 Finishes:

2.16.1 General:

The formwork for concrete works shall be such as to give the finish as specified. The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish as specified. Defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

Surface Finish Type F1:

The main requirement is that of dense, well-compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade, which will receive waterproofing treatment, the concrete shall be free of surface irregularities, which would interfere with proper and effective application of waterproofing material specified for use.

Surface Finish Type F2:

The appearance shall be that of a smooth dense, well-compacted concrete showing

the slight marks of well fitted shuttering joints. The Contractor shall make good any blemishes.

Surface Finish Type F3:

This finish shall give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discoloration, blemishes, arises, air holes etc. Only lined or coated plywood with very tight joints shall be used to achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by the Contractor.

Integral Cement Finish on Concrete Floor:

In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screened off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the Engineer-In-Charge shall be supplied and used as recommended by the manufacturer.

The formwork for concrete works shall be such as to give the finish as specified. The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

2.17 Repair and Replacement of Unsatisfactory Concrete:

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be inspected by the Engineer in charge who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Employer.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the Engineer in charge.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the Engineer in charge as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the Engineer in charge.

2.18 Vacuum Dewatering of Slabs:

Where specified floor slabs, either grade or suspended, shall be finished by vacuum dewatering including all operations such as poker vibration, surface vibration, vacuum processing, floating and toweling as per equipment manufacturers recommendation. The equipment to be used shall be subject to the Engineer in charge's approval.

2.19 Hot Weather Requirements:

Concreting during hot weather shall be carried out as per IS: 7861 (Part I).

Adequate provisions shall be made to lower concrete temperatures which shall not exceed 40° C at the time of placement of fresh concrete.

Where directed by the Engineer in charge, the Contractor shall spray non-wax based curing compound on unformed concrete surfaces at no extra costs.

Cold Weather Requirements.

Concreting during cold weather shall be carried out as per IS: 7861 (Part II).

The ambient temperature during placement and up to final set shall not fall below 5° C. Approved antifreeze/accelerating additives shall be used where directed.

For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

2.20 Liquid Retaining Structures:

The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.

The minimum level of surface finish for liquid retaining structures shall be as defined elsewhere. All such structures shall be hydro-tested.

The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

The Contractor shall also make all temporary arrangements that may have to be made to ensure stability of the structures during construction.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the Engineer in charge. All such rectification shall be done by the Contractor to the entire satisfaction of the Engineer in charge at no extra cost.

2.21 Testing Concrete Structures for Leakage:

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the Engineer in charge, as described below:

In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven-day period for absorption after filling with water.

In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling; the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. Over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the watertightness of the structure. The Engineer in charge shall

decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

Each compartment/segment of the structure shall be tested individually and then all together.

For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

2.22 Optional Tests:

If the Employer feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the Specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the Engineer in charge, as per relevant IS Codes. Contractor shall have to pay for these tests.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the Engineer in charge reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. The Engineer in charge also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the Engineer in charge. Alternately Engineer in charge also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

2.23 Grouting:

2.23.1 Standard Grout:

Grout shall be provided as specified on the drawings.

The proportion of Standard Grout shall be such as to produce a flow able mixture consistent with minimum water content and shrinkage. Surfaces to be grouted shall be thoroughly roughened and cleaned. All structural steel elements to be grouted

shall be cleaned of oil, grease, dirt etc. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete shall be saturated with water and just before grouting, water in all pockets shall be removed. Grouting once started shall be done quickly and continuously. Variation in grout mixes and procedures shall be permitted if approved by the Engineer in charge. The grout proportions shall be limited as follows:

Use	Grout Thickness	Mix Proportions	Water Cement Ratio (max)
a) Fluid mix	Under 25mm	One part Portland Cement to one part sand	0.44
b) General mix	25mm and over but less than 50mm	One part Portland Cement to 2 parts of sand	0.53
c) Stiff mix	50mm and over	One part Portland Cement to 3 parts of sand	0.53

2.23.2 Non-Shrink Grout:

Non-shrink grout where required shall be provided in strict accordance with the manufacturer's instructions / specifications on the drawing.

Inspection:

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of Engineer in charge. Materials rejected by Engineer in charge shall be expressly removed from site and shall be replaced by Contractor immediately.

Clean-Up:

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

Acceptance Criteria:

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

- a) Properties of constituent materials;

- b) Characteristic compressive strength;
- c) Specified mix proportions;
- d) Minimum cement content;
- e) Maximum free-water/cement ratio;
- f) Workability;
- g) Temperature of fresh concrete;
- h) Density of fully compacted concrete;
- i) Cover to embedded steel;
- j) Curing;
- k) Tolerances in dimensions;
- l) Tolerances in levels;
- m) Durability;
- n) Surface finishes;
- o) Special requirements such as;
 - i) Water tightness
 - ii) Resistance to aggressive chemicals
 - iii) Resistance to freezing and thawing
 - iv) Very high strength
 - v) Improved fire resistance
 - vi) Wear resistance
 - vii) Resistance to early thermal cracking

The Engineer in charge's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the Contractor.

For work not accepted, the Engineer in charge may review and decide whether remedial measures are feasible so as to render the work acceptable. The Engineer in charge shall in that case direct the Contractor to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the Contractor. Nothing extra shall become payable to the Contractor by the Employer for executing the remedial measures.

2.24 Water stops:

2.24.1 Material:

The material for the PVC water stops shall be a plastic compound with the basic resin of polyvinyl chloride and additional resins, plasticizers, inhibitors, which satisfies the performance characteristics specified below as per IS:12200. Testing shall be in accordance with IS: 8543.

- | | | | |
|------|------------------------|---|---------------------------------|
| a) | Tensile strength | : | 3.6 N/mm ² minimum |
| b) | Ultimate elongation | : | 300% minimum |
| c) | Tear resistance | : | 4.9 N/mm ² minimum |
| d) | Stiffness in flexure | : | 2.46 N/mm ² minimum |
| e) | Accelerated extraction | | |
| i) | Tensile strength | : | 10.50 N/mm ² minimum |
| ii) | Ultimate elongation | : | 250% minimum |
| (f) | Effect of Alkali | : | 7 days |
| i) | Weight increase | : | 0.10% maximum |
| ii) | Weight decrease | : | 0.10% maximum |
| iii) | Hardness change | : | ± 5 points |
| (g) | Effect of Alkali | : | 28 days |
| i) | Weight increase | : | 0.40% maximum |

- ii) Weight decrease : 0.30% maximum
- iii) Dimension change : $\pm 1\%$

PVC water stops shall be either of the bar type, serrated with center bulb and end grips for use within the concrete elements or of the surface (kicker) type for external use.

PVC water stops shall be of approved manufacture. Samples and the test certificate shall be got approved by the Engineer in charge before procurement for incorporation in the works. Alternatively, G.I. sheet of 18 gage (1.3mm) thick and 200mm wide can be used by the contractor as construction joints.

Alternatively, contractors can use G.I sheet 200mm wide and 18 gauge thick as constructions joints.

2.24.2 Workmanship:

Water stops shall be cleaned before placing them in position. Oil or grease shall be removed thoroughly using water and suitable detergents.

Water stops shall be procured in long lengths as manufactured to avoid joints as far as possible. Standard L or T type of intersection pieces shall be procured for use depending on their requirement. Any non-standard junctions shall be made by cutting the pieces to profile for jointing. Lapping of water stops shall not be permitted. All jointing shall be of fusion welded type as per manufacturer's instructions.

Water stops shall be placed at the correct location/level and suitably supported at intervals with the reinforcement to ensure that it does not deviate from its intended position during concreting and vibrating. Care shall also be taken to ensure that no honey-combing occurs because of the serrations/end grips, by placing concrete with smaller size aggregates in this region. Projecting portions of the water stops

embedded in concrete shall be thoroughly cleaned of all mortar/ concrete coating before resuming further concreting operations. The projecting water stop shall also be suitably supported at intervals with the reinforcement to maintain its intended position during concreting so as to ensure that it does not bend leading to formation of pockets. In addition, smaller size aggregates shall be used for concreting in this region also.

2.25 Preformed Fillers and Joint Sealing Compound:

2.25.1 Materials:

Preformed filler for expansion/isolation joints shall be non-extruding and resilient type of bitumen impregnated fibers conforming to IS:1838 (Part I).

Bitumen coat to concrete/masonry surfaces for fixing the preformed bitumen filler strip shall conform to IS:702. Bitumen primer shall conform to IS:3384.

Sealing compound for filling the joints above the preformed bitumen filler shall conform to Grade 'A' as per IS:1834.

2.25.2 Workmanship:

The thickness of the preformed bitumen filler shall be 25mm for expansion joints and 50mm for isolation joints around foundation supporting rotatory equipment's. Contractor shall procure the strips of the desired thickness and width in lengths as manufactured. Assembly of small pieces/thicknesses of strips to make up the specified size shall not be permitted.

The concrete/masonry surface shall be cleaned free from dust and any loose particles. When the surface is dry, one coat of industrial blown type bitumen of grade 85/25 conforming to IS: 702 shall be applied hot by brushing at the rate of 1.20 kg/m². When the bitumen is still hot the preformed bitumen filler shall be pressed and held in position till it completely adheres. The surface of the filler against which

further concreting/masonry work is to be done shall similarly be applied with one coat of hot bitumen at the rate of 1.20 kg/m².

Sealing compound shall be heated to a pouring consistency for enabling it to run molten in a uniform manner into the joint. Before pouring the sealing compound, the vertical faces of the concrete joint shall be applied hot with a coat of bitumen primer conforming to IS: 3384 in order to improve the adhesive quality of the sealing compound.

Expansion joints between beams/slabs shall be provided with 100mm wide x 4mm thick mild steel plate at the soffit of RCC beams/slabs to support and prevent the preformed joint filler from dislodging. This plate shall be welded to an edge angle of ISA 50 x 50 x 6mm provided at the bottom corner, adjacent to the expansion joint of one of the beams/slabs, by intermittent fillet welding. Steel surfaces shall be provided with 2 coats of red oxide zinc chrome primer and 3 coats of synthetic enamel paint finish.

CONCRETE POUR CARD					
POUR NO.:			DATE:		
DRG. NO.:			STRUCTURE:		
CONCRETE GRADE/QUANTITY/:			MAX. AGGREGATE SIZE /		
SLUMP:			START / COMPLETION TIME:		
SL. NO	ITEM				Remarks If Any
1.	BEFORE CONCRETING	CENTRELINES CHECKED		YES/NO	
2.		FORMWORK AND STAGING CHECKED FOR ACCURACY, STRENGTH & FINISH		YES/NO	
3		REINFORCEMENT CHECKED		YES/NO	
4		COVER TO REINFORCEMENT CHECKED		YES/NO	
5		VERIFIED TEST CERTIFICATE FOR CEMENT/STEEL		YES/NO	
6		ADEQUACY OF MATERIALS / EQUIPMENT FOR POUR		YES/NO	
7		EMBEDDED PARTS (LOCATION & PLUMB) CHECKED	CIVIL	YES/NO	
			MECH.	YES/NO	
			ELEC.	YES/NO	
8	SOFFIT(S) & POUR TOP(T) LEVELS CHECKED BEFORE (B) & AFTER (A) FORM REMOVAL			S(B) T(B) S(A) T(A)	
9	CONSTRUCTION JOINTS LOCATION & TYPE EXPANSION JOINTS – LOCATION AND TYPE				
10	CEMENT CONSUMPTION IN KGS.				
10A	REINFORCEMENT CONSUMPTION DIAWISE IN KGS				
11	NUMBER OF CUBES AND IDENTIFICATION MARKS				
12	TEST CUBE RESULTS (7 DAYS / 28 DAYS)				
13	CONCRETE CONDITION ON FORM REMOVAL			V.GOOD/ GOOD/FAIR/POOR	

Contractor's Representative
Representative

Engineer- in-charge's

NOTES:

1. EACH POUR TO HAVE SEPARATE CARDS, IN TRIPPLICATE ONE EACH FOR CLIENT, CONTRACTOR & SITE OFFICE.
- a) UNDER REMARKS, INDICATE DEVIATIONS FROM DWGS. & SPECIFICATIONS, CONGESTION IN REINFORCEMENT IF ANY, UNUSUAL OCCURRENCES SUCH AS FAILURE OF EQUIPMENTS, SINKING OF SUPPORTS / PROPS. HEAVY RAINS AFFECTING CONCRETING, POOR COMPACTION, IMPROPER CURING, OTHER DEFICIENCIES, OBSERVATIONS ETC.

SPECIFICATIONS

: SECTION -4:

: BUILDING ITEMS:

SECTION - 4: BUILDING ITEMS.

Applicable Codes and Specifications

The following codes and standards are included in this section, as part of these specifications. However, respective IS codes for the works not mentioned here shall also be applicable for those particular items of work.

- IS: 110 - Ready mixed paint, brushing, gray filler, for Enamels for use over primers
- IS: 269 - Specification for 33 grade ordinary Portland cement
- IS: 280 - Specification for mild steel wire for general Engineering purposes
- IS: 287 - Recommendations for maximum permissible Moisture content of timber used for different purposes
- IS: 383 - Specif. for coarse & fine aggregates from natural sources for concrete
- IS: 412 - Expanded metal steel sheets for general purposes
- IS: 419 - Specification for putty for use on window frames
- IS: 428 - Distemper, oil emulsion, color as required
- IS: 459 - Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets

- IS: 702 - Specification for industrial bitumen
- IS: 710 - Specification for marine plywood
- IS: 712 - Specification for building limes
- IS: 730 - Specification for hook bolts for corrugated sheet Roofing
- IS: 733 - Wrought aluminum and aluminum alloys, bars, Rods and sections for general engineering purposes
- IS: 777 - Specification for glazed earthenware tiles
- IS: 1003 - Specification for timber paneled and glazed shutters (Parts 1 & 2)
- IS: 1038 - Specification for steel doors, windows and ventilators
- IS: 1077 - Specification for common burnt clay building bricks
- IS: 1081 - Code of practice for fixing and glazing of metal (steel & aluminum) doors, windows and ventilators.

- IS: 1124 - Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
- IS: 1237 - Specification for cement concrete flooring tiles
- IS: 1322 - Bitumen felts for water proofing and damp proofing
- IS: 1346 - Code of practice for water proofing of roofs with bitumen felts

- IS:1361 - Specification for steel windows for industrial buildings
- IS: 1443 - Code of practice for laying and finishing of cement concrete flooring tiles
- IS: 1477 - Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
- IS: 1542 - Specification for sand for plaster
- IS: 1580 - Specification for bituminous compounds for water-proofing and caulking purposes
- IS: 1597 - Code of practice for construction of stone masonry: Part 1 Rubble stone masonry
- IS: 1661 - Code of practice for application of cement and cement-lime plaster finishes
- IS: 1834 - Specification for hot applied sealing compound for joint in concrete
- IS: 1838 - Specification for preformed fillers for expansion joint in concrete Pavements and structures (none extruding and resilient type): Part 1 Bitumen impregnated fiber.
- IS: 1948 - Specification for aluminum doors, windows and ventilators
- IS: 1949 - Specification for aluminum windows for industrial buildings
- IS: 2074 - Ready mixed paint, air drying, red oxide- zinc chrome, priming
- IS: 2114 - Code of practice for laying in-situ terrazzo floor finish
- IS: 2116 - Specification for sand for masonry mortars
- IS: 2185 - Specification for concrete masonry units (Parts 1,2& 3)
- IS: 2202 - Specification for wooden flush door shutters (Solid core type): Parts 1&2
- IS: 2212 - Code of practice for brickwork
- IS: 2250 - Code of practice for preparation and use of masonry mortars
- IS: 2338 - Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
- IS: 2395 - Code of practice for painting concrete, masonry and plaster surfaces (Parts 1 & 2)
- IS: 2402 - Code of practice for external rendered finishes
- IS: 2571 - Code of practice for laying in-situ cement concrete flooring
- IS: 2572 - Code of practice for construction of hollow concrete block masonry
- IS: 2645 - Specification of integral cement waterproofing compounds
- IS: 2690 - Specification for burnt clay flat terracing tiles: Part 1 Machine made
- IS: 2691 - Specification for burnt clay facing bricks
- IS: 2750 - Specification for steel scaffoldings
- IS: 2835 - Flat transparent sheet glass
- IS: 2932 - Specification for enamel, synthetic, exterior type (a) undercoating, (b) finishing

- IS: 3007 - Code of practice for laying of asbestos cement sheets - corrugated and (Part 1 & 2) semi-corrugated sheets
- IS: 3067 - Code of practice of general design details and preparatory work for Damp-proofing and water- proofing of buildings
- IS: 3068- Specification for broken brick (burnt clay) coarse aggregates for use in Lime concrete.
- IS: 3384 - Specification for bitumen primer for use in water-proofing and damp-proofing
- IS: 3462 - Specification for unbaked flexible PVC flooring
- IS: 3495 - Method of test for burnt clay building bricks: Part 1 to 4
- IS: 3536 - Specification for ready mixed paint, brushing, and wood primer, pink
- IS: 3696 - Safety code of scaffolds and ladders (Parts 1 & 2)
- IS: 4020 - Methods of test for wooden flush door: Type test
- IS: 4021 - Specification for timber door, window and ventilator frames
- IS: 4351 - Specification for steel door frames
- IS: 4443 - Code of practice for use of resin type chemical resistant mortars
- IS: 4457 - Specification for ceramic unglazed vitreous acid resisting tile
- IS: 4631 - Code of practice for laying epoxy resin floor toppings
- IS: 4832 - Specification for chemical resistant mortars (Part II)
- IS: 4860 - Specification for acid resistant bricks
- IS: 4948 - Specification for welded steel wire fabric for general use
- IS: 5318 - Code of practice for laying of flexible PVC sheet and tile flooring
- IS: 5410 - Cement paint, colour as required
- IS: 5411 - Specification for plastic emulsion paint (Parts 1 & 2)
- IS: 5437 - Wired and figured glass
- IS: 5491 - Code of practice for laying of in-situ granolithic concrete floor topping
- IS: 6042 - Code of practice for construction of light weight concrete block masonry
- IS: 6248 - Specification for metal rolling shutters and rolling grilles
- IS: 7193 - Specification for glass fiber base coal tar pitch and bitumen felts
- IS: 7452 - Specification for hot rolled steel sections for doors, windows and ventilators
- IS: 8042 - Specification for white Portland cement
- IS: 9197 - Specification for epoxy resin, hardeners and epoxy resin composites for floor topping
- IS: 9862 - Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting

IS: 12200 - Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams

Brickwork:

Materials:

Bricks used in the works shall conform to the requirements laid down in IS: 1077. The class of the bricks shall be as specifically indicated in the respective items of work.

The nominal size of the modular brick shall be 200 mm x 100 mm x 100 mm with the permissible tolerances over the actual size of 190mm x90 mm x 90 mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230 mmx115mmx75mm with tolerance upto ± 3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

Bricks shall be sound, hard, and homogenous in texture, well burnt in kiln without being vitrified, hand/machine moulded, deep red, cherry or copper colored, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand Moulded bricks shall be Moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 3N/sq.mm unless otherwise specified in the Items of work prepared by the Contractor.

The average water absorption shall not be more than 20 percent by weight up to class 12.5 and 15 percent by weight for higher classes. Bricks which do not conform to this requirement shall be rejected. Over or under burnt bricks are not acceptable for use in the works. Sample bricks shall be submitted to the BMC for approval and bricks supplied shall conform to approved samples. If demanded by BMC, brick samples shall be got tested as per IS: 3495 by Contractor. Bricks rejected by BMC shall be removed from the site of works within 24 hours.

Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:5 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work prepared by the Contractor. Sand for masonry mortar shall conform to IS:218. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by BMC. If so directed by the BMC, sand shall be screened and washed till it satisfies the limits of deleterious materials.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the BMC. The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. In case, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and shall be removed from the site. Droppings of mortar shall not be re-used under any circumstances. The Contractor shall arrange for test on mortar samples if so directed by the BMC.

Workmanship:

Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work prepared by the Contractor. Brick work 200mm/230mm thick and over shall be laid in English Bond unless otherwise specified. 100mm/115mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilized only as closers to make up required wall length or for bonding. Bricks shall be laid with frogs on top.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be leveled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, at least one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 deg. But in no case the level difference between adjoining walls shall exceed one meter. Brickwork shall not be raised more than one meter per day.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 10mm/15mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/pointing respectively to be done later. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

Brickwork shall be kept constantly moist on all the faces for at least seven days after 24 hrs of laying. The arrangement for curing shall be got approved from the E.I.C.

Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part I). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the BMC. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/pointing.

In the event of usage of traditional bricks of size 230 mm x115mm x75mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor slabs and at the top of the parapet shall be laid with bricks on edge. All brickwork shall be built tightly against columns, floor slabs or other structural members.

To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted. For resting RCC slabs, the bearing surface of masonry wall shall be finished on top with 12 mm thick cement mortar 1:3 and provided with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

RCC/ steel beams resting on masonry wall shall be provided with reinforced concrete bed blocks of 50 mm thickness, projecting 50mm on either sides of the beam, duly

finished on top with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

Steel wire fabric shall be provided at the junction of brick masonry and concrete before taking up plastering work. Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a de-shuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for the deflection of the structural element.

Reinforced cement concrete transoms and mullions of dimensions as indicated in the construction Drawings to be prepared by the Contractor are generally required to be provided in the half brick partition walls.

Where the drawings prepared by the Contractor indicate that structural steel sections are to be encased in brickwork, the brickwork masonry shall be built closely against the steel section, ensuring a minimum of 20mm thick cement-sand mortar 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.

Facing bricks of the type specified conforming to IS: 2691 shall be laid in the positions indicated on the Drawings prepared by the Contractor and all facing brickwork shall be well bonded to the backing bricks/RCC surfaces. The level of execution of the facing brickwork shall at any time be lower by at least 600 mm below the level of the backing brickwork. Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of pointing to be carried out shall be as specified in the item of works prepared by the Contractor. The pattern of laying the bricks shall be as specifically indicated in the Drawings prepared by the Contractor. For facing brickwork, double scaffolding shall be used. Faced works shall be kept clean and free from damage, discoloration etc., at all times.

Uncoursed Random Rubble Masonry, in Foundation, Plinth and Superstructure.

Materials:

Stones for the works shall be of the specified variety, which are hard, durable, fine grained and uniform in colour (for superstructure work) free from veins, flaws and other defects. Quality and work shall conform to the requirements specified in IS: 1597 (Part-I). The percentage of water absorption shall not exceed 5 percent as per

test conducted in accordance with IS: 1124. The Contractor shall supply sample stones to the BMC for approval. Stones shall be laid with its grains horizontal so that the load transmitted is always perpendicular to the natural bed.

Cement-sand mortar for stone masonry works shall be in the proportion of 1:6. Materials and preparation of mortar shall be as specified in clause 7.2.1.

Workmanship:

For All Works below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones for the hearting and selected quarry dressed stones for the facing.

For all works above ground level and in superstructure the masonry shall be random rubble uncoursed, well bonded, faced with hammer dressed stones with squared quoins at corners. The bushings on the face shall not be more than 40 mm on an exposed face and on the face to be plastered it shall not project by more than 12 mm nor shall it have depressions more than 10 mm from the average wall surface.

Face stones shall extend back sufficiently and bond well with the masonry. The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourths the thickness of wall nor less than 150 mm. The height of stone may be up to a maximum of 300 mm. Face stones or hearting stones shall not be less than 150 mm in any direction. Chips and spalls shall be used wherever necessary to avoid thick mortar joints and to ensure that no hollow spaces are left in the masonry. The use of chips and spalls in the hearting shall not exceed 20 percent of the quantity of stone masonry. Spalls and chips shall not be used on the face of the wall and below hearting stones to bring them to the level of face stones.

The maximum thickness of joints shall not exceed 20 mm. All joints shall be completely filled with mortar. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool during the progress of the work while the mortar is still green.

Through or bond stones shall be provided in walls up to 600 mm thick and in case of walls above 600 mm thickness, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous lime stone and sand stone, etc.) the bond stone shall extend about two-thirds into the wall and a set of two or more bond

stones overlapping each other by at least 150 mm shall be provided. Each bond stone or a set of bond stones shall be provided for every 0.5 sq.m of wall surface.

All stones shall be sufficiently wetted before laying to prevent absorption of water from the mortar. All connected walls in a structure shall be normally raised uniformly and regularly. However, if any part of the masonry is required to be left behind, the wall shall be raked back (and not saw toothed) at an angle not exceeding 45deg. Masonry work shall not be raised by more than one meter per day. Green work shall be protected from rain by suitable covering. Masonry work shall be kept constantly moist on all the faces for a minimum period of seven days for proper curing of the joints.

Type of scaffolding to be used shall be as specified in clause 7.2.2.

Coursed Rubble Masonry (First Sort) for Superstructure:

Materials:

The Material specification for the work shall be as per clause 7.3.1.

Workmanship:

All Courses shall be laid truly horizontal and shall be of the same height in any course. The height of course shall not be less than 150 mm and not more than 300 mm. The width of stone shall not be less than its height.

Face stones shall tail into the work for not less than their height and at least 1/3rd the number of stones shall tail into the work for a length not less than twice their height but not more than three-fourths the thickness of the wall whichever is smaller. These should be laid as headers and stretchers alternately to break joints by at least 75 mm.

The face stones shall be squared on all joints and beds; the bed joints being hammer or chisel dressed true and square for at least 80 mm back from the face and the side joints for at least 40 mm. The face of the stone shall be hammer dressed so that the bushing shall not be more than 40 mm on an exposed face and 10 mm on a face to be plastered. No portion of the dressed surface shall show a depth of gap more than 6 mm from a straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints.

No spalls or pinning shall be allowed on the face. All bed joints shall be horizontal and side joints shall be vertical and no joints shall be more than 10 mm in thickness. When plastering or pointing is not required to be done, the joints shall be struck

flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool, during the progress of the work while the mortar is still green.

Hearting shall consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity of the stone masonry. Care shall be taken so that no hollow spaces are left anywhere in the masonry.

The requirement regarding through or bond stones shall be as specified in clause 7.3.2 with the further stipulation that these shall be provided at 1.5 m to 1.8m apart clear in every course but staggered at alternate courses.

The quoins which shall be of the same height as the course, in which they occur, shall not be less than 450 mm in any direction. Quoin stones shall be laid as stretchers and headers alternately. They shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100 mm from the face. These stones shall have a minimum uniform chisel draft of 25mm width at four edges, all the edges being in the same plane.

Type of scaffolding to be used shall be as per Clause 7.2.2. Requirements of execution of the work and curing shall be as stipulated in clause 7.3.2.

Concrete Block Masonry:

Materials

Masonry units of hollow and solid concrete blocks shall conform to the requirements of IS: 2185 (Part 1).

Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of IS: 2185 (Part 3).

Masonry units of autoclaved cellular concrete blocks shall conform to the requirements of IS: 2185 (Part 3).

The height of the concrete masonry units shall not exceed either its length or six times its width.

The nominal dimensions of concrete block shall be as under.

Length 400, 500 or 600 mm

Height 100 or 200 mm

Width 100 to 300 mm in 50 mm increments

Half blocks shall be in lengths of 200, 250 or 300mm to correspond to the full-length blocks.

Actual dimensions shall be 10mm short of the nominal dimensions.

The maximum variation in the length of the units shall not be more than ± 5 mm and maximum variation in height or width of the units shall not be more than ± 3 mm.

Concrete blocks shall be either hollow blocks with open or closed cavities or solid blocks. Concrete blocks shall be sound, free of cracks, chipping or other defects which impair the strength or performance of the construction. Surface texture shall as specify. The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square.

The bedding surfaces shall be at right angles to the faces of the block.

The concrete mix for the hollow and solid concrete blocks/light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume. Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, as specified for the type of block as per relevant IS code. Contractor shall furnish the test certificates and also supply the samples for the approval of BMC.

Workmanship:

The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/or non-load bearing walls shall be as specified.

The minimum nominal thickness of non-load bearing internal walls shall be 100mm.

The minimum nominal thickness of external panel walls in framed construction shall be 200 mm.

The workmanship shall generally conform to the requirements of IS: 2572 for concrete block masonry, IS: 6042 for light weight concrete block masonry and IS:6041 for autoclaved cellular concrete block masonry works.

From considerations of durability, generally concrete block masonry shall be used in superstructure works above the damp-proof course level.

Concrete blocks shall be embedded with a mortar which is relatively weaker than the mix of the blocks in order to avoid the formation of cracks. Cement mortar of

proportion 1:6 shall be used for the works. Preparation of mortar shall be as specified in clause 7.2.1.

The thickness of both horizontal and vertical joints shall be 10mm. The first course shall be laid with greater care, ensuring that it is properly aligned, leveled and plumb since this will facilitate in laying succeeding courses to obtain a straight and truly vertical wall. For the horizontal (bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10mm. For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or on the edges of the succeeding unit when it is standing vertically and then placing it horizontally, well pressed against the previously laid unit to produce a compacted vertical joint. In case of two cell blocks with slight depression on the vertical sides these shall also be filled up with mortar to secure greater lateral rigidity. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as the mortar will stiffen and lose its plasticity. Mortar while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with a jointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10mm as each course is laid to ensure good bond for the plaster.

Dimensional stability of hollow concrete blocks is greatly affected by variations of moisture content in the units. Only well dried blocks should be used for the construction. Blocks with moisture content more than 25% of maximum water absorption permissible shall not be used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surfaces on which mortar is to be applied to obviate absorption of water from the mortar.

As per the design requirements and to effectively control cracks in the masonry, RCC bound beams/studs, joint reinforcement shall be provided at suitable locations. Joint reinforcement shall be fabricated either from mild steel wires conforming to IS: 280 or welded wire fabric/high strength deformed basis.

For jambs of doors, windows and openings, concrete blocks shall be provided. If hollow units are used, the hollows shall be filled with concrete of mix 1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.

At intersection of walls, the courses shall be laid up at the same time with a true masonry bond between at least 50% of the concrete blocks. The sequence for construction of partition walls and treatment at the top of load bearing walls for the

RCC slab shall be as detailed under clause 7.2 for the brick work. Curing of the mortar joints shall be carried out for at least 7 days. The walls should only be lightly moistened and shall not be allowed to become excessively wet. Double scaffolding as per clause 7.2.2 shall be adopted for execution of block masonry work. Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in respectively, adopting modular co-ordination for walls, opening locations for doors, windows etc.

Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

Damp - Proof Course:

Materials and Workmanship:

Where Specified, all the walls in a building shall be provided with damp-proof course cover at plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall consist of 50 mm thick cement concrete of 1:2:4 nominal mix with approved water-proofing compound admixture conforming to IS: 2645 in proportion as directed by the manufacturer. Concrete shall be with 10 mm downgraded coarse aggregates.

The surface of brick work/stone masonry work shall be leveled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster.

Damp-proof course shall be cured properly for at least seven days after which it shall be allowed to dry for taking up further work.

Miscellaneous Inserts, Bolts etc.

All the miscellaneous inserts such as bolts, pipes, plate embedment etc., shall be accurately installed in the building works at the correct location and levels, all as detailed in the construction Drawings to be prepared by the Contractor. Contractor shall prepare and use templates for this purpose, if so directed by the BMC. In the event, of any of the inserts are improperly installed, Contractor shall make necessary arrangements to remove and reinstall at the correct locations/levels, all as directed by the BMC.

Wood Work for Doors, Windows, Ventilators & Partitions

Materials

Timber to be used shall be first class Teak wood as per IS: 4021. Timber shall be of the best quality and well-seasoned by a suitable process before being planned to the required sizes. The maximum permissible moisture content shall be from 10 to 16 percent for timber 50mm and above in thickness and 8 to 14 percent of timber less than 50mm in thickness for different regions of the country as stipulated in IS:287. Timber shall be close grained, of uniform colour and free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, splits and cracks.

Flush door shutters of the solid core type with plywood face panels shall conform to IS: 2202 (Part 1) and with particle board/hard board face panels shall conform to IS: 2202 (Part 2).

Transparent sheet glass shall conform to the requirements of IS: 2835. Wired and figured glass shall be as per IS: 5437.

Builder's hardware for fittings and fixtures shall be of the best quality from approved manufacturers.

Workmanship:

The workmanship and finish of wood work in doors, windows, ventilators and partitions shall be of a very high order. Contractor shall ensure that work is executed in a professional manner by skilled carpenters for good appearance, efficient and smooth operation of the shutters.

All works shall be executed as per the detailed Drawings prepared by the Contractor and/or as directed by the BMC.

All members of the door, window, and ventilator shall be straight without any warp or bow and shall have smooth well-planned faces. The right angle shall be checked from the inside surfaces of the respective members of the frame. Frames shall have mortise and tenon joints which shall be treated with an approved adhesive and provided with metal or wood pins. The vertical members of the door frame shall project 50 mm below the finished floor level. The finished dimension of frames shall be rebated on the solid for keying with the plaster and for receiving the shutters. The depth of rebate for housing the shutter shall be 15 mm. The size of the frames shall be as specified in the respective items of work prepared by the Contractor. The workmanship shall generally conform to the requirements specified in IS:4021.

The face of the frames abutting the masonry or concrete shall be provided with a coat of coal tar.

Three hold fasts using 25 mm x 6 mm mild steel flats 225 mm long with split ends shall be fixed on each side of door and window frames, one at the center and the other two at 300 mm from the top and bottom of the frame. For window and ventilator frames less than 1 m in height, two hold fasts on each side shall be fixed at quarter points.

Timber paneled shutters for doors, windows and ventilators shall be constructed in the form of framework of stiles and rails with panel insertion. The panels shall be fixed by either providing grooves in the stiles and rails or by beading. Glazing bars shall be as detailed in the Drawings prepared by the Contractor. The stiles and rails shall be joined by mortise and tenon joints at right angles. All members of the shutter shall be straight without any warp or bow and shall have smooth, well-planned faces at right angles to each other. The right angle for the shutter shall be checked by measuring the diagonals and the difference shall not be more than ± 3 mm. Timber panels made from more than one piece shall be jointed with a continuous tongued and grooved joint, glued together and reinforced with metal dowels. The workmanship shall generally conform to the requirements specified in IS: 1003 (Parts 1 & 2). The thickness of the shutter, width/thickness of the stiles/rails/panel type shall be as specified. Marine plywood panels conforming to IS:710 shall be used for doors where specified.

Details of the wooden flush door shutters, solid core type with specific requirement of the thickness, core, face panels, viewing glazed panel, Venetian louver opening, teak wood lapping etc. shall be as specified. Panels of shutter shall be of marine plywood conforming to IS:710. Flush door shutters shall be from reputed manufacturers and Contractor shall submit test results as per IS:4020, if so desired by the BMC.

Glazing of door, window, ventilator and partitions shall be with either flat transparent sheet glass, wired or figured glass. Transparent sheet glass shall be of 'B' quality as per IS:2835. The thickness and type of glazing to be provided shall be as specified.

The material of the fittings and fixtures either of chromium plated steel, cast brass, copper oxidized or anodized aluminum shall be as specified. The number, size and type of the fittings and fixtures shall be as specified.

Woodwork shall not be provided with the finishes of painting/varnishing etc. unless it has been approved by the BMC. The type of finish and the number of coats shall be

as stipulated in the respective items of work prepared by the Contractor. Preparation of the wood surfaces and application of the finishes shall be in accordance with clause 7.32.

Wooden hand railing and architraves shall be of the size and shape with the fixing arrangement as indicated in the Drawings prepared by the Contractor.

The framework of the partitions with mullions and transoms shall be with the sections of dimensions as specified. Panels of double/single glazing/plywood shall be fixed as per details specified. Partitions shall be fixed rigidly between the floor and structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings prepared by the Contractor.

Any carpentry work which shows defects due to inadequate seasoning of the timber or bad workmanship shall be removed and replaced by Contractor with work as per Specifications.

Steel Doors, Windows and Ventilators:

Materials:

Hot rolled steel sections for the fabrication of steel doors, windows and ventilators shall conform to IS: 7452, which are suitable for, single glazing.

Pressed steel door frames for steel flush doors shall be out of 1.25mm thick mild steel sheets of profiles as per IS: 4351.

Transparent sheet glass shall conform to the requirements of IS: 2835. Wired and figured glass shall be as per IS: 5437.

Builder's hardware of fittings and fixtures shall be of the best quality from the approved manufacturers.

Workmanship:

All steel doors, windows and ventilators shall be of the type as specified in the respective items of work prepared by the Contractor and of sizes as indicated in the Drawings prepared by the Contractor prepared by the Contractor. Steel doors, windows and ventilators shall conform to the requirements as stipulated in IS: 1038. Steel windows shall conform to IS: 1361, if so specified.

Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the unit shall be with rolled section, cut to correct lengths and metered. Corners

shall be welded to form a solid fused welded joint conforming to the requirements of IS: 1038. Tolerance in overall dimensions shall be within $\pm 1.5\text{mm}$. The frames and shutters shall be free from warp or buckle and shall be square and truly plain. All welds shall be dressed flush on exposed and contact surfaces. Punching of holes, slots and other provisions to install fittings and fixtures later shall be made at the correct locations as per the requirements. Samples of the units shall be got approved by the BMC before further manufacture/purchase by the Contractor.

Type and details of shutters, hinges, glazing bar requirement, couplings, locking arrangement, fittings and fixtures shall be as described in the respective items of work and / or as shown in the Drawings prepared by the Contractor for single or composite units.

For windows with fly proof mesh as per the item of work prepared by the Contractor, rotor operator arrangement, for the operation of the glazed shutters from the inside shall be provided.

Pressed steel door frames shall be provided with fixing lugs at each jamb, hinges, lock-strike plate, mortar guards, angle threshold, shock-absorbers of rubber or similar material as per the requirements of IS: 4351. Pressed steel doorframes shall be fixed as 'built-in' as the masonry work proceeds. After placing it plumb at the specified location, masonry walls shall be built up solid on either side or each course grouted with mortar to ensure solid contact with the doorframe, without leaving any voids. Temporary struts across the width shall be fixed, during erection to prevent bow/sag of the frame. Door shutters of flush welded construction shall be 45 mm thick, fabricated with two outer skins of 1.25mm thick steel sheets, 1mm thick steel sheet stiffeners and steel channels on all four edges. Double shutters shall have meeting stile edge beveled or rebated. Provision of glazed viewing panel, louvers shall be made as per the items of works and/or Drawings prepared by the Contractor. Shutters shall be suitably reinforced for lock and other surface hardware and to prevent sagging/twisting. Single sheet steel door shutters shall be fabricated out of 1.25mm thick steel sheets, mild steel angles and stiffeners as per the Drawings prepared by the Contractor.

Doors, windows and ventilators shall be fixed into the prepared openings. They shall not be 'built-in' as the masonry work proceeds, to avoid distortion and damage of the units. The dimensions of the masonry opening shall have 10mm clearance around the overall dimensions of the frame for this purpose. Any support of scaffolding members on the frames/glazing bars is prohibited.

Glazing of the units shall be either with flat transparent glass or wired / figured glass of the thickness as specified in the items of works prepared by the Contractor. All glass panels shall have properly squared corner and straight edges. Glazing shall be provided on the outside of the frames.

Fixing of the glazing shall be either with spring glazing clips and putty conforming to IS:419 or with metal beads. Pre-formed PVC or rubber gaskets shall be provided for fixing the beads with the concealed screws. The type of fixing the glazing shall be as indicated in the items of work and/or in Drawings prepared by the Contractor.

Steel doors, windows and ventilators shall be provided with finish of either painting as specified or shall be hot dip galvanized with thickness of the zinc coating as stipulated all as described in the respective items of works prepared by the Contractor.

The material of the Builders hardware of fittings and fixtures of chromium plated steel, cast brass, brass copper oxidized or anodized aluminum shall be as specified in the items of works prepared by the Contractor. The number, size and type of fittings and fixtures shall be as in the Drawings /items of works prepared by the Contractor.

Installation of the units with fixing lugs, screws, mastic caulking compound at the specified locations shall generally conform to the requirements of IS:1081. Necessary holes etc required for fixing shall be made by the Contractor and made good after installation. Workmanship expected is of a high order for efficient and smooth operation of the units.

Aluminum Doors, Windows, Ventilators & Partitions:

Materials:

Aluminum alloy used in the manufacture of extruded sections for the fabrication of doors, windows, ventilators shall conform to designation HE9-WP of IS: 733.

Transparent sheet glass shall conform to the requirements of IS: 2835. Wired and figured glass shall be as per IS: 5437.

Builder's hardware of fittings & fixtures shall be of the best quality from approved manufacturers.

Workmanship:

All aluminum doors, windows, ventilators and partitions shall be of the type and size as specified. The doors, windows, ventilators shall conform to the requirements of IS: 1948. Aluminum windows shall conform to IS: 1949, if so specified.

All aluminum units shall be supplied with anodized finish. The minimum anodic film thickness shall be 0.015 mm. Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the units shall be with the extruded sections, cut to correct lengths, mitered and welded at the corners to a true right angle conforming to the requirements of IS: 1948. Tolerance in overall dimensions shall be within \pm 1.5mm. The frames and shutters shall be free from warp or buckle and shall be square and truly plane. Punching of holes, slots and other provisions to install fittings or fixtures later shall be made at the correct locations, as per the requirements. Aluminum swing type doors, aluminum sliding windows, partitions shall be as specified.

IS:1948 and IS:1949 referred to incorporates the sizes, shapes, thicknesses and weight per running meter of extruded sections for the various components of the units. However, new sizes, shapes, thicknesses with modifications to suit snap-fit glazing clips etc. are being continuously being added by various leading manufacturers of extruded sections, which are available in the market. As such, the sections of the various components of the unit proposed by the Contractor will be reviewed by the BMC and will be accepted only if they are equal to or marginally more than that given in the codes/as specified.

The framework of the partitions with mullions and transom shall be with anodized aluminum box sections. Anodized aluminum box sections shall be in-filled with timber of class 3 (silver oak or any other equivalent) as per IS: 4021. Panels of double/single glazing/plywood shall be fixed as per details indicated in the Drawings to be prepared by the Contractor. Partitions shall be fixed rigidly between the floor and the structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings to be prepared by the Contractor.

Specific provisions as stipulated for steel doors, windows, ventilators under clause 7.9.2 shall also be applicable for this item work. Glazing beads shall be of the snap-fit type suitable for the thickness of glazing proposed as indicated in the items of works prepared by the Contractor. A layer of clear transparent lacquer shall be applied on aluminum sections to protect them from damage during installation. This lacquer coating shall be removed after the installation is completed.

Steel Rolling Shutters:**Materials and Workmanship:**

Rolling shutters shall be of an approved manufacture, conforming to the requirements specified in IS: 6248.

The type of rolling shutter shall be self-coiling type (manual) for clear areas upto 12 m², gear operated type (mechanical) for clear areas up to 35 m² and electrically operated type for areas up to 50 sq.m. Mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear operating mechanism duly considering the size of wall/column. Electrical type of rolling shutter shall also be provided with a facility for emergency mechanical operation.

Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the Drawings prepared by the Contractor. Shutters shall be built up of interlocking laths 75 mm width between rolling centers formed from cold rolled steel strips. The thickness of the steel strip shall not be less than 0.90 mm for shutters up to 3.50m width and not less than 1.20 mm for shutters above 3.50 m width. Each lath section shall be continuous single piece without any welded joint. The guide channels out of mild steel sheets of thickness not less than 3.15 mm shall be of either rolled, pressed or built-up construction. The channel shall be of size as stipulated in IS:6248 for various clear widths of the shutters.

Hood covers shall be of mild steel sheets not less than 0.90 mm thick and of approved shape. Rolling shutters shall be provided with a central hasp and staple safety device in addition to one pair of lever locks and sliding locks at the ends.

All component parts of the steel rolling shutter (excepting springs and insides of guide channels) shall be provided with one coat of zinc chrome primer conformity to IS:2074 at the shop before supply. These surfaces shall be given an additional coat of primer after erection at the site along with the number of coats and type of finish paint as specified in the respective items of works prepared by the Contractor. Painting shall be carried out as per clause 7.33.

In case of galvanized rolling shutter, the lath sections, guides, lock plate, bracket plates, suspension shaft and the hood cover shall be hot dip galvanized with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating shall be at least 610gms/m².

Guide channels shall be installed truly plumb at the specified location. Bracket plate shall be rigidly fixed with necessary bolts and holdfasts. Workmanship of erection shall ensure strength and rigidity of rolling shutter for trouble free and smooth operation.

Rubble Sub-Base:

Materials:

Stones used for rubble packing under floors on grade, foundations etc., shall be clean, hard, durable rock free from veins, flaws, laminations, weathering and other defects. Stones shall generally conform to the requirements stipulated in IS: 1597 (Part I).

Stones shall be as regular as can be obtained from quarries. Stones shall be of height equal to the thickness of the packing proposed with a tolerance of ± 10 mm. Stones shall not have a base area less than 250 sq cm nor more than 500 sq.cm, and the smallest dimension of any stone shall not be less than half the largest dimension. The quality and size of stones shall be subject to the approval of the BMC.

Workmanship:

Stones shall be hand packed carefully and laid with their largest base downwards resting flat on the prepared sub-grade and with their height equal to the thickness of the packing. Stones shall be laid breaking joints and in close contact with each other. All interstices between the stones shall be wedged-in by small stones of suitable size, well driven in by crow bars and hammers to ensure tight packing and complete filling-in of the interstices. The wedging shall be carried out simultaneously with the placing in position of rubble packing and shall not lag behind. After this, any interstices between the smaller wedged stones shall be unfilled with clean hard sand by brooming so as to fill the joints completely.

The laid rubble packing shall be sprinkled with water and compacted by using suitable rammers.

Base Concrete:

The thickness and grade of concrete and reinforcement shall be as specified in items of works prepared by the contractor.

Before placing the blinding concrete, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between

the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

Terrazzo and Plain Cement Tiling Work:

Materials:

Terrazzo tiles and cement tiles shall generally conform in all respects to standards stipulated in IS:1237. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14N/mm².

The type, quality, size, thickness colour etc, of the tiles for flooring/dado/skirting shall be as specified.

The aggregates for terrazzo topping shall consist of marble chips which are hard, sound and dense. Cement to be used shall be either ordinary Portland cement or white cement with or without coloring pigment. The binder mix shall be with 3 parts of cement to 1 part of marble powder by weight. The proportion of cement shall be inclusive of any pigments. For every one part of cement-marble powder binder mix, the proportion of aggregates shall be 1.75 parts by volume, if the chips are between 1mm to 6mm and 1.50 parts by volume if the chips are between 6mm to 25mm.

The minimum thickness of wearing layer of terrazzo tiles shall be 5mm for tiles with chips of size varying from 1mm up to 6mm or from 1mm up to 12mm. This shall be 6mm for tiles with chips varying from 1mm up to 25mm. The minimum thickness of wearing layer of cement/colored cement tiles shall be 5mm. This shall be 6mm for heavy duty tiles. Pigment used in the wearing layer shall not exceed 10 percent of the weight of cement used in the mix.

Workmanship

Laying and finishing of tiles shall conform to the requirements of workmanship stipulated in IS: 1443.

Tiling work shall be commenced only after the door and window frames are fixed and plastering of the walls/ ceiling is completed. Wall plastering shall not be carried out upto about 50 mm above the level of proposed skirting/dado.

The base concrete shall be finished to a reasonably plane surface about 40 to 45mm below the level of finished floor. Before the tiling work is taken up, the base

concrete or structural slab shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. using steel wire brush and well wetted without allowing any water pools on the surface. A layer of 25mm average thickness of cement mortar consisting of one part of cement to 6 parts of sand shall be provided as bedding for the tiles over the base concrete. The thickness of bedding mortar shall not be less than 10mm at any place. The quantity of water to be added for the mortar shall be just adequate to obtain the workability for laying. Sand for the mortar shall conform to IS:2116 and shall have minimum fineness modulus of 1.5. The surface shall be left rough to provide a good bond for the tiles. The bedding shall be allowed to harden for a day before laying of the tiles. Neat cement slurry using 4.4 kg of cement per m² of floor area shall be spread over the hardened mortar bedding over such an area at a time as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be in straight lines and shall normally be 1.5mm wide. On completion of laying of the tiles in a room, all the joints shall be cleaned and washed fairly deep with a stiff broom/wire brush to a minimum depth of 5mm. The day after the tiles have been laid, the joints shall be filled with cement grout of the same shade as the colour of the matrix of the tile. For this purpose, white cement or grey cement with or without pigments shall be used. The flooring should be kept moist and left undisturbed for 7 days for the bedding/joints to set properly. Heavy traffic shall not be allowed on the floor for at least 14 days after fixing of the tiles.

About a week after laying the tiles, each and every tile shall be lightly tapped with a small wooden mallet to find out if it gives a hollow sound; if it does, such tiles along with any other cracked or broken tiles shall be removed and replaced with new tiles to proper line and level. The same procedure shall be followed again after grinding the tiles and all damaged tiles replaced, properly jointed and finished to match. For the purpose of ensuring that such replaced tiles match with those laid earlier, it is necessary that the Contractor shall procure sufficient quantity of extra tiles to meet this contingency.

Wherever a full tile cannot be provided, tiles shall be cut to size and fixed. Floor tiles adjoining the wall shall go about 10mm under the plaster, skirting or dado.

Tile skirting and dado work shall be executed only after laying tiles on the floor. For dado and skirting work, the vertical wall surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 10mm thick backing of 1:4 cement sand mortar. For this work the tiles as obtained from the factory shall be of the size required and practically full polished. The back of each tile to be fixed

shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. Fixing shall be done from the bottom of the wall upwards. The joints shall be in straight lines and shall normally be 1.5mm wide. Any difference in the thickness of the tiles shall be evened out in the backing mortar or cement paste so that the tile faces are in conformity & truly plumb. Tiles for use at the corners shall be suitably cut with beveled edges to obtain a neat and true joint. After the work has set, hand polishing with carborundum stones shall be done so that the surface matches with the floor finish.

Wall plastering of the strip left out above the level of skirting/dado shall be taken up after the tiles are fixed.

Chequered terrazzo tiles for flooring and for stair treads shall be delivered to site after the first machine grinding.

Machine grinding and polishing shall be commenced only after a lapse of 14 days of laying. The sequence and three numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pin holes, watering etc. shall be carried out all as specified in IS:1443.

Tiles shall be laid to the levels specified. Where large areas are to be tiled the level of the central portion shall be kept 10mm higher than that at the walls to overcome optical illusion of a depression in the central portion. Localized deviation of ± 3 mm in any 3m length is acceptable in a nominally flat floor.

In-Situ Terrazzo Work:

Materials:

The requirements of marble aggregates for terrazzo topping shall be as per clause 7.14.1.

Cement shall first be mixed with the marble powder in dry state. The mix thus obtained shall be mixed with the aggregates in the specified proportions. Care shall be taken not to get the materials into a heap which results in the coarsest chips falling to the edges and cement working to the center at the bottom. Materials shall be kept, as far as possible, in an even layer during mixing. After the materials have been thoroughly mixed in the dry state, water shall be added, just adequate to

obtain plastic consistency for the desired workability for laying. The mix shall be used in the works within 30 minutes of the addition of water to the cement.

Workmanship:

The thickness, type, quality, size and colour of chips etc. for the in-situ terrazzo finish for flooring/dado/ skirting shall be as specified in the respective items of works prepared by the Contractor. Laying and finishing of in-situ work shall conform to the requirements of workmanship stipulated in IS: 2114.

In-situ terrazzo finish shall be laid over hardened concrete base. The finish layer consists of an under layer and terrazzo topping. The under layer shall be of cement concrete of mix 1:2:4 using 10mm downgraded coarse aggregates. The combined thickness of under layer and topping shall not be less than 30 mm for flooring and 20mm for dado/skirting work.

The minimum thickness of topping shall be 6mm if chips used are between 1mm to 4mm, 9mm if chips are between 4mm to 7mm and 12mm if chips are between 7mm to 10mm. If chips larger than 10mm size are used, the minimum thickness shall be one and one third the maximum size of chips.

Both the under layer and later the topping shall be divided into panels not exceeding 2 m² for laying so as to reduce the possibility of development of cracks. The longer dimension of any panel shall not exceed 2m. Dividing strips shall be used to separate the panels. When the dividing strips are not provided, the bays shall be laid alternately, allowing an interval of at least 24 hours between laying adjacent bays.

Dividing strips shall be either of aluminum, brass or other material as indicated in the items of works prepared by the Contractor. Aluminum strips should have a protective coating of bitumen. The thickness of the strips shall not be less than 1.5mm and width not less than 25mm for flooring work.

Concrete base shall be finished to a reasonably plane surface to a level below the finished floor elevation equal to the specified thickness of terrazzo finish. Before spreading the underlayer, the base concrete surface shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. and well wetted without allowing any water pools on the surface. Dividing strips or screed strips, if dividing strips are not provided shall be fixed on the base and leveled to the correct height to suit the thickness of the finish. Just before spreading the under layer the surface shall be smeared with cement slurry at 2.75 Kg/m². Over this slurry, the under layer shall be spread and leveled with a screening board. The top surface shall be left rough to provide a good bond for the terrazzo topping.

Terrazzo topping shall be laid while the under layer is still plastic and normally between 18 to 24 hours after the under layer is laid. Cement slurry of the same colour as the topping shall be brushed on the surface immediately before laying is commenced. The terrazzo mix shall be laid to a uniform thickness and compacted thoroughly by tamping and with a minimum of toweling. Straight edge and steel floats shall be used to bring the surface true to the required level in such a manner that the maximum amount of marble chips come up and spread uniformly all over the surface.

The surface shall be left dry for air-curing for a period of 12 to 18 hours. Thereafter it shall be cured by allowing water to stand in pools for a period of not less than 4 days.

Machine grinding and polishing shall be commenced only after a lapse of 7 days from the time of completion of laying. The sequence and four numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pinholes, wet curing, watering etc shall be carried out all as specified in IS: 2114.

Shahabad / Tandur/ Kota Stone Slab work:

Materials:

The slabs shall be of approved selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws. The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS: 1124.

The slabs shall be hand or machine cut to the required thickness. Tolerance in thickness for dimensions of tile more than 100mm shall be ± 5 mm. This shall be ± 2 mm on dimensions less than 100mm. Slabs shall be supplied to the specified size with machine cut edges or fine chisel dressed to the full depth. All angles and edges of the slabs shall be true and square, free from any chipping giving a plane surface. Slabs shall have the top surface machine polished (first grinding) before being brought to site. The slabs shall be washed clean before laying.

Workmanship:

The type, size, thickness and colour/shade etc. of the slabs for flooring/ dado/ skirting shall be as specified in the respective items of works prepared by the Contractor.

Preparation of the concrete base, laying and curing shall be as per clause 7.14.2.

Dado / skirting work shall be as per clause 7.14.2. The thickness of the slabs for dado/skirting work shall not be more than 25mm. Slabs shall be so placed that the back surface is at a distance of 12mm. If necessary, slabs shall be held in position temporarily by suitable method. After checking for verticality, the gap shall be filled and packed with cement sand mortar of proportion 1:3. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed.

Grinding and polishing shall be as per clause 7.14.2 except that first grinding with coarse grade carborundum shall not be done and cement slurry with or without pigment shall not applied before polishing.

Carborundum Tile Finish:

Materials:

Carborundum tiles shall generally conform in all respects to the standards stipulated in IS: 1237 for heavy duty tiles. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14 N/mm².

The topping shall be uniform and of thickness not less than 6mm. The quantity of Carborundum grit shall be not less than 1.35 kg/sq.m used with cement with or without pigment. The Carborundum grit shall pass through 1.18mm mesh and shall be retained on 0.60 mm mesh.

Workmanship:

Requirements as detailed for terrazzo/cement tile finish under clause 7.14.2 shall be applicable for Carborundum tile flooring.

Glazed Tile Finish:

Materials:

Glazed earthenware tiles shall conform to the requirements of IS: 777. Tiles shall be of the best quality from an approved manufacturer. The tiles shall be flat, true to shape and free from flaws such as crazing, blisters, pinholes, specks or welts. Edges and underside of the tiles shall be free from glaze and shall have ribs or indentations

for a better anchorage with the bedding mortar. Dimensional tolerances shall be as specified in IS: 777.

Workmanship:

The total thickness of glazed tile finish including the bedding mortar shall be 20 mm in flooring/dado/skirting. The minimum thickness of bedding mortar shall be 12mm for flooring and 10mm for dado/skirting work.

The bedding mortar shall consist of 1 part of cement to 3 parts of sand mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modulus of 1.5.

Tiles shall be soaked in water for about 10 minutes just before laying. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.

Colored tiles with or without designs shall be uniform and shall be preferably procured from the same batch of manufacture to avoid any differences in the shade.

Tiles for the flooring shall be laid over hardened concrete base. The surface of the concrete base shall be cleaned of all loose materials, mortar droppings etc well wetted without allowing any water pools on the surface. The bedding mortar shall then be laid evenly over the surface, tamped to the desired level and allowed to harden for a day. The top surface shall be left rough to provide a good bond for the tiles. For skirting and dado work, the backing mortar shall be roughened using a wire brush.

Neat cement slurry using 3.3 kg cement per m² of floor area shall be spread over the hardened mortar bed over such an area as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. For skirting and dado work, the back of the tiles shall be smeared with cement slurry for setting on the backing mortar. Fixing of tiles shall be done from the bottom of the wall upwards. The joints shall be in perfect straight lines and as thin as possible but shall not be more than 1mm wide. The surface shall be checked frequently to ensure correct level/required slope. Floor tiles near the walls shall enter skirting/dado to a minimum depth of 10mm. Tiles shall not sound hollow when tapped. All the joints

shall be cleaned of grey cement with wire brush to a depth of at least 3mm and all dust, loose mortar etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days for the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.

Specials consisting of coves, internal and external angles, cornices, beads and their corner pieces shall be of thickness not less than the tiles with which they are used.

In-Situ Cement Concrete Floor Topping:

Materials:

The mix proportion for the in-situ concrete floor topping shall be 1:2.5:3.5 (one part cement: two and half parts sand: three and half parts coarse aggregates) by volume unless otherwise specified.

The aggregates shall conform for the requirements of IS: 383.

Coarse aggregates shall have high hardness surface texture and shall consist of crushed rock of granite, basalt, trap or quartzite. The aggregate crushing value shall not exceed 30 percent. The grading of the aggregates of size 12.5mm and below shall be as per IS: 2571.

Grading of the sand shall be within the limits indicated in IS: 2571.

Workmanship:

The thickness of the floor topping shall be as specified in the items of work prepared by the Contractor. The minimum thickness of the floor topping shall be 25mm.

Preparation of base concrete/structural slab before laying the topping shall be as per clause 7.13. The surface shall be rough to provide adequate bond for the topping.

Mixing of concrete shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the BMC. The concrete shall be as stiff as possible and the amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and compacting. The mix shall be used in the work within 30 minutes of the addition of water for its preparation.

Floor finish shall be laid in suitable panels to reduce the risk of cracking. No dimension of a panel shall exceed 2 meters and the length of a panel shall not

exceed one and a half times its breadth. Topping shall be laid in alternate panels; the intermediate panels being cast after a gap of at least one day. Construction joints shall be plain vertical butt joints.

Screed strips shall be fixed dividing the area into suitable panels. Immediately before depositing the concrete topping, neat cement slurry at 2.75 kg/m² of area shall be thoroughly brushed into the prepared surface. Topping shall then be laid, very thoroughly tamped, struck off level and floated with wooden float. The surface shall then be tested with a straight edge and mason's spirit level to detect any inequalities and these shall be made good immediately.

Finishing of the surface by Trowelling shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled 3 times at intervals so as to produce a smooth uniform and hard surface. Immediately after laying, the first Trowelling just sufficient to give a level surface shall be carried out avoiding excessive Trowelling at this stage. The surface shall be re-trowelled after sometime to close any pores and to scrap off excess water or laitance, which shall not be trowelled back into the topping. Final Trowelling shall be done well before the concrete has become too hard but at a time when considerable pressure is required to make any impression on the surface. Sprinkling of dry cement or cement-sand mixture for absorbing moisture shall not be permitted.

Immediately after the surface is finished, it shall be protected suitably from rapid drying due to wind/ sunlight. After the surface has hardened sufficiently to prevent any damage to it, the topping shall be kept continuously moist for a minimum period of 10 days.

It is preferable to lay the topping on hardened base concrete, as against being laid monolithically with a lesser thickness, since proper levels and slopes with close surface tolerances is achievable in practice, owing to its greater thickness. Further, as this would be laid after all other building operations are over, there will be no risk of any damages or discolorations to the floor finish which are difficult to repair satisfactorily.

In-Situ Granolithic Concrete Floor Topping:

Materials and Workmanship:

The Requirements of materials and workmanship shall be all as per clause 7.19 for in-situ cement concrete floor topping except that the mix proportion of the concrete shall be 1:1:2 (cement: sand: coarse aggregates) by volume.

The minimum thickness of granolithic floor topping on hardened concrete base shall be 40mm.

Floor Hardener Topping:

Materials & Workmanship:

Floor Hardener topping shall be provided either as integrally finished over the structural slab/grade slab or lay monolithically with the concrete/granolithic floor finish on top of hardened concrete base.

Floor hardener of the metallic or non-metallic type suitable for the performance of normal / medium/ heavy duty function of the floor, the quantum of ingredients and the thickness of topping shall be as specified in the respective items of work prepared by the Contractor. For monolithic application with the floor finish/slab the thickness of the layer shall be 15mm. The topping shall be laid within 2 to 3 hours after concrete is laid when it is still plastic but stiffened enough for the workmen to tread over it by placing planks. The surface of the concrete layer shall be kept rough for providing adequate bond for the topping. Laitance shall be removed before placing the topping. The topping shall be screened and thoroughly compacted to the finished level. Trowelling to a smooth finish shall be carried out as per clause 7.19.2. After the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days. The procedure for mixing the floor hardener topping shall be as per manufacturer's instructions.

Surface shall be prevented from any damages due to subsequent building operations by covering with 75 mm thick layer of sand.

PVC Sheet/Tile Flooring:

Materials:

PVC floor covering shall be of either unbaked homogeneous flexible type in the form of sheets/tiles conforming to IS: 3462 or homogeneous PVC asbestos tiles conforming to IS: 3461. Surface of the sheets/tiles shall be free from any physical defects such as pores, blisters, cracks etc. which affects the appearance and serviceability. Tiles/sheets shall meet with the tolerance limits in dimensions specified in the IS. Contractor shall submit the test certificates, if so desired by the BMC.

Each tile/sheet shall be legibly and indelibly marked with the name of the manufacturer or his trade mark, IS certificate mark, and batch number.

The adhesive to be used for laying the PVC flooring shall be rubber based and of the make as recommended and approved by the manufacturer of PVC sheets/tiles.

The type, size, colour, plain or mottled and the pattern shall be as specified in the respective items of work prepared by the Contractor.

Workmanship:

PVC Floor covering shall be provided over an under bed of cement concrete floor finish over the base concrete or structural slab. It is essential that the sub-floor and the under bed are perfectly dry before laying the PVC flooring. This shall be ensured by methods of testing as stipulated in Appendix-A of IS: 5318.

The surface of the under bed shall have trowelled finish without any irregularities, which creates poor adhesion. Surface shall be free of oil or grease and thoroughly cleaned of all dust, dirt and wiped with a dry cloth.

PVC sheets/tiles shall be brought to the temperature of the area in which they are to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours. Where air-conditioning is installed, the flooring shall not be laid on the under bed until the A/C units have been in operation for at least 7 days. During this period, the temperature range shall be between 20deg.C and 30deg.C and this shall be maintained during the laying operations and also for 48 hours thereafter.

Layout of the PVC flooring shall be marked with guidelines on the under bed and PVC tiles/sheets shall be first laid for trial, without using the adhesive, according to the layout.

The adhesive shall be applied by using a notched trowel to the surface of the under bed and to the backside of PVC sheets/tiles. When the adhesive has set sufficiently for laying, it will be tacky to the touch, which generally takes about 30 minutes. The time period need be carefully monitored since a longer interval will affect the adhesive properties. Adhesive shall be uniformly spread over only as much surface area at one time which can be covered with PVC flooring within the stipulated time.

PVC sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface and no air pockets are formed. It shall then be pressed with a suitable roller to develop proper contact. The next sheet shall be laid edge to edge with the sheet already laid, so that there is minimum gap between joints. The alignment shall be checked after each row of sheet is completed and trimmed if considered necessary.

Tiles shall be laid in the same manner as sheets and preferably, commencing from the center of the area. Tiles should be lowered in position and pressed firmly on to the adhesive with minimum gap between the joints. Tiles shall not be slide on the

surface. Tiles shall be rolled with a light wooden roller of about 5kg to ensure full contact with the underlay. Work should be constantly checked to ensure that all four edges of adjacent tiles meet accurately.

Any excess adhesive which may squeeze up between sheets/tiles shall be wiped off immediately with a wet cloth. Suitable solvents shall be used to remove hardened adhesive.

A minimum period of 24 hours shall be given after laying for the development of proper bond of the adhesive. When the flooring is thus completed, it shall be cleaned with a wet cloth soaked in warm soap solution.

Metallic edge strips shall be used to protect the edges of PVC sheets/tiles which are exposed as in doorways/ stair treads.

Hot sealing of joints between adjacent PVC sheet flooring to prevent creeping of water through the joints shall be carried out, using special equipment as per manufacturer's instructions.

Acid Resisting Brick/Tiling Work:

Materials:

The ceramic unglazed vitreous acid resisting tiles shall conform to the requirements of IS: 4457. Acid resistant bricks shall conform to the requirements of IS: 4860.

The finished tile/brick when fractured shall appear fine grained in texture, dense and homogeneous. Tile/brick shall be sound, true to shape, flat, free from flaws and any manufacturing defects affecting their utility. Tolerance in dimensions shall be within the limits specified in the respective IS.

The tiles/bricks shall be bedded and jointed using chemical resistant mortar of the resin type conforming to IS: 4832 (Part II). Method of usage shall generally be as per the requirements of IS: 4443.

Workmanship:

The resin shall have viscosity for readily mixing with the filler by manual methods. The filler shall have graded particles which permit joint thickness of 1.5 mm.

The base concrete surface shall be free from dirt and thoroughly dried. The surface shall be applied with a coat of bitumen primer conforming to IS: 3384. The primed

surface shall then be applied with a uniform coat of bitumen conforming to IS: 1580. Tiles or bricks shall be laid directly without the application of bitumen, if epoxy or polyester resin is used for the mortar. Just adequate quantity of mortar which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for bedding and jointing. Rigid PVC/Stainless steel/chromium plated tools shall be used for mixing and laying. For laying the floor 6 to 8 mm thick mortar shall be spread on the back of the tile/brick. Two adjacent sides of the tile/brick shall be smeared with 4 to 6 mm thick mortar. Tile/brick shall be pressed into the bed and pushed against the floor and with the adjacent tile/ brick, until the joint in each case is 2 to 3 mm thick. Excess mortar shall then be trimmed off and allowed to harden fully. Similar procedure shall be adopted for the work on walls by pressing the tile/brick against the prepared wall surfaces and only one course shall be laid at a time until the initial setting period.

The mortar joints shall be cured for a minimum period of 72 hours with 20 to 25% hydrochloric acid or 30 to 40% sulphuric acid. After acid curing, the joints shall be washed with water and allowed too thoroughly dry. The joints shall then be filled with mortar to make them smooth and plane. Acid curing is not required to be carried out if epoxy or polyester resin is used for the mortar.

Resin mortars are normally self-curing. The area tiled shall not be put to use before 48 hours in case epoxy, polyester and furan type of resin is used for the mortar. If phenolic or cashew nut shell liquid resin is used for the mortar, the area tiled shall not be put to use for 7 to 28 days respectively, without heat treatment. This period shall be 2 to 6 days respectively, if heat treatment is given with infrared lamp.

Epoxy Lining Work:

Materials:

The epoxy resin and hardener formulation for laying of joint less lining work in floors and walls of concrete tanks/trenches etc. shall be as per the requirements of IS:9197.

The epoxy composition shall have the chemical resistance to withstand the following conditions of exposure:

Hydrochloric acid up to 30% concentration

Sodium hydroxide up to 50% concentration

Liquid temperature up to 60deg.C

Ultraviolet radiation

Alternate wetting and drying

Sand shall conform to grading zone III or IV of IS: 383.

The hardener shall be of the liquid type such as Aliphatic Amine or an Aliphatic/Aromatic Amine Adduct for the epoxy resin. The hardener shall react with epoxy resin at normal ambient temperature.

Contractor shall furnish test certificates for satisfying the requirements of the epoxy formulation if so directed by the BMC.

Workmanship:

The minimum thickness of epoxy lining shall be 4 mm. It is essential that the concrete elements are adequately designed to ensure that water is excluded to permeate to the surface, over which the epoxy lining is proposed. The epoxy lining shall be of the trowel type to facilitate execution of the required thickness for satisfactory performance.

The concrete surfaces over which epoxy lining is to be provided shall be thoroughly cleaned of oil or grease by suitable solvents, wire brushed to remove any dirt/dust and laitance. The surfaces shall then be washed with dilute hydrochloric acid and rinsed thoroughly with plenty of water or dilute ammonia solution. The surfaces shall then be allowed to dry. It is essential to ensure that the surfaces are perfectly dry before the commencement of epoxy application. Just adequate quantity of epoxy resin which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for laying and jointing. Rigid PVC/stainless steel/chromium plated tools shall be used for laying. Trowelling shall be carried out to obtain uniformly the specified thickness of lining.

Lining shall be allowed to set without disturbance for a minimum period of 24 hours. The facility shall be put to use only after a minimum period of 7 days of laying of the lining.

Water-Proofing:

General:

The work shall include waterproofing for the building roofs, terraces, toilets, floor slabs, walls, planters, chhajjas, sills and any other areas and at any other locations and situations as directed by the Employers Representative.

The waterproofing treatment shall be carried out on top of lime concrete (brick bat coba) laid to slope on roof surfaces. The brick bat-coba shall be covered as specified below.

The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the BMC.

Modified Bituminous Membrane:

Modified Bituminous Membrane shall be "SUPER THERMOLAY" 4 mm thick weighing 4 Kg/sq.m, manufactured using APP Polymer modified bitumen with a central core of non-woven polyester reinforcement (200 gms/sqm) and with top and bottom layers of thermo fusible film (top layer could also be sand finished) made by STP Limited in collaboration with Bitumen Company Limited. "PLYFLEX" of Bitumen Company Limited, Saudi Arabia supplied by STP Limited shall also be acceptable or other equivalent specification.

Waterproofing of Roofs with Lime Concrete:

Materials:

Broken brick coarse aggregates prepared from well/over burnt bricks shall be well graded having a maximum size of 25mm and shall generally conform to IS:3068.

Lime shall be class C lime (fat lime) or factory made hydrated lime conforming to IS:712.

Workmanship:

Lime concrete shall be prepared by thoroughly mixing the brick aggregates inclusive of brick dust obtained during breaking with the slaked lime in the proportions of 2 1/2 (two and a half) parts of brick aggregates to 1 part of slaked lime by volume. Water shall be added just adequate to obtain the desired workability for laying. Washing soap and alum shall be dissolved in the water to be used. The quantity of these materials required per cum of lime concrete shall be 12kg of washing soap and 4kg of alum. Brick aggregates shall be soaked thoroughly in water for a period of not less than six hours before use in the concrete mix. Lime concrete shall be used in the works within 24 hours after mixing.

The roof surface over which the water-proof treatment is to be carried out shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated in IS: 3067.

The slope of the finished waterproofing treatment shall be not less than 1 in 60 for efficient drainage. This shall be achieved either wholly in the lime concrete layer.

The average thickness of lime concrete, slope and the finish on top of machine-made burnt clay flat terracing tiles conforming to IS:2690 (part I) shall be as specified in the items of work to be prepared by the Contractor. Cement concrete flooring tiles in lieu of clay terracing tiles shall be provided if so specified in the items of work prepared by the Contractor, duly considering the traffic the terrace will be subjected to.

The minimum compacted thickness of lime concrete layer shall be 75mm and average thickness shall not be less than 100mm. In case, the thickness is more than 100mm, it shall be laid in layers not exceeding 100mm to 125mm. Laying of lime concrete shall be commenced from a corner of the roof and proceeded diagonally towards center and other sides duly considering the slopes specified for effectively draining the rain-water towards the down take points. Lime concrete fillet for a minimum height of 150mm shall be provided all along the junction of the roof surface with the brick masonry wall/parapet/column projections. These shall then be finished on top with provision of clay terracing tiles/cement concrete tiles.

After the lime concrete is laid it shall be initially rammed with a rammer weighing not more than 2 Kg and the finish brought to the required evenness and slope. Alternatively, bamboo strips may be used for the initial ramming. Further consolidation shall be done using wooden THAPIES with rounded edges. The beating will normally have to be carried on for at least seven days until the THAPI makes no impression on the surface and rebounds readily from it when struck. Special care shall be taken to properly compact the lime concrete at its junction with parapet walls or column projections. During compaction by hand-beating, the surface shall be sprinkled liberally with lime water (1 part of lime putty and 3 to 4 parts of water) and a small proportion of sugar solution for obtaining improved water-proofing quality of the lime concrete. On completion of beating, the mortar that comes on the top shall be smoothed with a trowel or float, if necessary, with the addition of sugar solution and lime putty. The sugar solution may be prepared in any one of the following ways as directed by the BMC.

a) By mixing about 3 Kg of Jaggery and 1.5 Kg of BAEL fruit to 100 liters of water.

b) By mixing about 600 gm of KADUKAI (the dry nuts shall be broken to small pieces and allowed to soak in water), 200 gm of jaggery and 40 liters of water for 10 sq.m of work. This solution shall be brewed for about 12 to 24 hours and the resulting liquor decanted and used for the work.

The lime concrete after compaction shall be cured for a minimum period of seven days or until it hardens by covering with a thin layer of straw or hessian which shall be kept wet continuously. Machine made flat terracing tiles shall be of the size and

thickness as specified. Tiles shall be soaked in water for at least one hour before laying. Bedding for the tiles shall be 12mm thick in cement mortar 1:3. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and set to plane surface true to slope, using a trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angles to the direction of run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by at least 50 mm. The joints shall be completely filled and flush pointed with cement mortar 1:2 mixed with water proofing compound as per manufacturer's instructions. Curing shall be carried out for a minimum period of seven days. Finishing on top with cement concrete tiles or in-situ cement concrete floor topping shall be carried out in similar fashion as described for clay tiles in above paragraph. Tiles to be used shall be supplied after the first machine grinding of the surface.

Waterproofing of Roofs/Terraces etc.:

(A) Water proofing of Horizontal Surfaces:

The waterproofing shall be applied as follows:

A coat of Blown Bitumen 85/25 shall be applied at the rate of 1.45 kg/sq.km

A roll of Modified Bituminous Membrane shall be unrolled over the primed surface and completely bonded to the substrate by pressing down evenly for the full width of the roll using a wooden roller. Torching shall be done, where recommended by the manufacturer and were directed by the BMC, as the unrolling progresses.

The side overlaps shall be minimum 100 mm whereas the end overlaps shall be minimum 150 mm; both shall be bonded and sealed by flame torching. Care shall be taken that the membrane is lapped with the treatment along the vertical surface and roof gutter treatment for at least 500 mm. The membrane shall be properly overlapped/terminated at all openings, rainwater down takes etc. to ensure that such junctions do not become sources of leakage.

Top of membrane finally shall be painted with anti glouse reflective paint.

(B) Waterproofing of Vertical Surfaces at Roof Level and Gutters:

The Water proofing shall be applied as described in (a) above.

Modified Bituminous membrane shall be unrolled and bonded to the substrate after applying a coat of bitumen and by pressing down evenly for the full width of the roll. Light torching shall be done to ensure complete bonding.

The membrane shall be overlapped with treatment for the horizontal surface by at least 500 mm.

The membrane shall be taken up to a pre-cut chase anchored and sealed.

Khurras and Rainwater down Pipes:

Down pipes shall be isolated from RCC work with 6 mm polyethylene foam fixed with adhesive (Araldite) and sealed with silicone sealant prior to laying membrane. A water proofing flashing composed of one layer of Hessian based self-finished felt Type 3 Grade 1 and two layers of aluminum foil of 0.075 mm thickness shall be provided. This flashing shall be carried into the down take pipes for at least 150 mm and sealed with hot bitumen. The Contractor shall closely coordinate the work with the agency providing and fixing the rainwater down take pipes.

Testing:

The treated area (flat and horizontal only) shall be tested by allowed water to stand on the treated areas to a depth of 150 mm for a minimum period of 72 hours.

The treated area (flat and horizontal) shall have continuous slope towards the rainwater outlets and no water shall pond anywhere on the surface.

Cement Plastering Work:

Materials:

The proportions of the cement mortar for plastering shall be 1:3 (one part of cement to three parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS: 1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the BMC. If so desired by the BMC sand shall be screened and washed to meet the Specifications. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to

evaporation of water this may be re-tempered by adding water as required to restore consistency but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

Workmanship:

Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in IS:1661 and IS:2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels, pipes, conduits etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10mm/20mm for brick/stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

Interior plain faced plaster - This plaster shall be laid in a single coat of 13mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces etc. as shown in the drawing and as directed by the BMC.

Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6mm thickness. Application of mortar shall be as stipulated in above paragraph.

Exterior plain faced plaster - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The rendering coat shall be cured for at least two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied

from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.

Interior plain faced plaster 20mm thick if specified for uneven faces of brick walls or for random/coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in above paragraph.

Exterior Sand Faced Plaster- This plaster shall be applied in 2 coats. The first coat shall be approximately 14mm thick and the second coat shall be 6mm thick. These coats shall be applied as stipulated above. However, only approved quality white sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

Wherever more than 20mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the BMC duly satisfying the requirements of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for at least 7 days.

In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the BMC.

Where specified in the Drawings to be prepared by the Contractor prepared by the Contractor, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the Drawings to be prepared by the Contractor prepared by the Contractor.

Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturer's instruction while preparing the cement mortar.

For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/windows etc. Ceiling plaster shall be completed first before commencing wall plastering.

Double scaffolding to be used shall be as specified in clause 7.2.2.

The finished plaster surface shall not show any deviation more than 4mm when checked with a straight edge of 2m length placed against the surface.

To overcome the possibility of development of cracks in the plastering work following measures shall be adopted.

Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.

Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement.

Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

Cement Pointing:

Material:

The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand). Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by BMC and if so, directed it shall be washed/screened to meet specification requirements.

Workmanship:

Where pointing of joints in masonry work is specified, the joints shall be raked at least 15mm/20mm deep in brick/stone masonry respectively as the work proceeds when the mortar is still green.

Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat,

sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.

The work shall be kept moist for at least 7 days after the pointing is completed. Whenever colored pointing has to be done, the coloring pigment of the colour required shall be added to cement in such proportions as recommended by the manufacturer and as approved by the BMC.

Water-Proofing Admixtures;

Water-proofing admixture shall conform to the requirements of IS: 2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the BMC.

Painting of Concrete, Masonry & Plastered Surfaces:

Materials:

Oil bound distemper shall conform to IS: 428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

Cement paint shall conform to IS: 5410. The primer shall be a thinned coat of cement paint. Lead free acid, alkali and chlorine resisting paint shall conform to IS: 9862.

Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/tint as approved by the BMC.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the BMC for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

Workmanship:

Contractor shall obtain the approval of the BMC regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting. Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub- strata.

The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing

of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS: 2395. Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

White Wash:

The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

Colour Wash:

Colour wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/powdery and come off readily on the hand when rubbed.

Cement Paint:

The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/m². A minimum of 2 coats of the same colour shall be applied. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

Oil bound Distemper:

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. A minimum of two coats of oil bound

distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

Acid, Alkali Resisting Paint:

A minimum of 2 coats of acid/alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer's instructions.

Plastic Emulsion Paint:

The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of emulsion paint. The quantity of thinner shall be as per manufacturer's instructions. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same colour shall be applied unless otherwise specified. Paint may also be applied using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

Acrylic Emulsion Paint:

Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

Painting & Polishing of Wood Work:

Materials:

- Wood primer shall conform to IS: 3536.
- Filler shall conform to IS: 110.
- Varnish shall conform to IS: 337.

- French polish shall conform to IS: 348.
- Synthetic enamel paint shall conform to IS: 2932.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the BMC for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

Workmanship:

The type of finish to be provided for woodwork of painting or polishing, the number of coats, etc. shall be as specified in the respective items of work to be prepared by the Contractor. Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer. Painting shall be either by brushing or spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirements of IS:2338 (Part I). All the wood surfaces to be painted shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothed with abrasive paper using it across the grains and dusted off. Wood primer coat shall then be applied uniformly by brushing. The number of primer coats shall be as specified in the item of work to be prepared by the Contractor. Any slight irregularities of the surface shall then be made-up by applying an optimum coat of filler conforming to IS:110 and rubbed down with an abrasive paper for obtaining a smooth surface for the undercoat of synthetic enamel paint conforming to IS:2932. Paint shall be applied by brushing evenly and smoothly by means of crossing and laying off in the direction of the grain of wood. After drying, the coat shall be carefully rubbed down using very fine grade of sand paper and wiped clean before the next coat is applied. At least 24 hours shall elapse between the applications of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the BMC. The number of coats of paint to be applied shall be as specified in the item of work to be prepared by the Contractor. All the wood surfaces to be provided with clear finishes shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothed with abrasive paper using it in the direction of the grains and dusted off. Any slight irregularities of the surface shall be made up by applying an optimum coat of transparent liquid filler and rubbed down with an abrasive paper for obtaining a smooth surface. All dust and dirt shall be thoroughly removed. Over this prepared surface, varnish conforming to IS:337 shall be applied by brushing. Varnish should not be retouched once it has begun to set. Staining if required shall be provided as directed by the BMC. When two coats of varnish is specified, the first coat should be a hard-drying undercoat or

flattening varnish which shall be allowed to dry hard before applying the finishing coat. The number of coats to be applied shall be as specified. For works where clear finish of French polish is specified the prepared surfaces of wood shall be applied with the polish using a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles to give an even finish over the entire area. The surface shall be allowed to dry before applying the next coat. Finishing shall be carried out using a fresh clean cloth over the pad, slight dampening with methylated spirit and rubbing lightly and quickly in circular motions. The finished surface shall have a uniform texture and high gloss. The number of coats to be applied shall be as specified.

Painting of Steel Work:

Materials:

- Red-oxide – zinc chrome primer shall conform to IS: 2074.
- Synthetic enamel paint shall conform to IS: 2932.
- Aluminum paint shall conform to IS: 2339.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the BMC for the brand of manufacture and the colour/shade. All the materials shall be brought to the site in sealed containers.

Workmanship:

Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS: 1477 (Part 2).

The type of paint, number of coats etc. shall be as specified in the respective items of work. Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer. All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS: 1477 (Part – I) and as indicated in the item of work. It is essential to ensure that immediately after preparation of the surfaces; the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from `holidays. After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied

by brushing with minimum of brush marks. The coat shall be allowed too hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry. The first finishing coat of paint shall be applied by brushing and allowed too hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing. At least 24 hours shall elapse between the applications of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the BMC.

Flashing:

Materials:

Anodized Aluminum sheets shall be 1.00mm thick with anodic film thickness of 0.025 mm.

Galvanized mild steel sheets shall be 1.00mm thick with zinc coating of 800 gms/sq.m.

Bitumen felt shall be either Hessian base self-finished bitumen felt Type-3 Grade I conforming to IS:1322 or glass fiber base self-finished felt Type-2 Grade 1 conforming to IS:7193.

Workmanship:

The type of the flashing and method of fixing shall be as specified.

Flashing shall be of the correct shape and size as indicated in the construction Drawings to be prepared by the Contractor and they shall be properly fixed to ensure their effectiveness.

Flashing shall be of long lengths so as to provide minimum number of joints. The minimum overlap at joints shall be 100mm.

Fixing of the flashing shall be either by bolting with bitumen washers or by tucking into the groove 75 mm wide x 65 mm deep in masonry/concrete along with cement mortar 1:4 filleting as indicated in the Drawings to be prepared by the Contractor.

Curing of the mortar shall be carried out for a minimum period of 4 days.

Bitumen felt flashing of the type as specified shall be provided with 2 coats of bituminous paint at the rate of 0.10 liter/m² after the installation.

Thermal Insulation for Ceiling

Thermal insulation shall be "Thermocole" TF type or similar approved or Resin bonded fiber glass boards.

Fixing:**“Thermocole” Boards:**

Soffit of R.C. Slab shall be thoroughly cleaned with wire brush and 85/25 industrial grade hot bitumen conforming to IS: 702 shall be applied uniformly over the surface at the rate of 1.5 Kg/m².

Thermocole boards (T.F. variety) of 50mm thickness shall be stuck by means of the same grade of hot bitumen. The boards shall be further secured with screws, washers and plugs. The joints of the boards shall be sealed with bitumen.

Fiber Glass Boards:

Timber pegs 50mm x 50mm x 50mm shall be fixed to the slab at 600mm centers with 6mm x 65mm long wood screws. 20-gauge G.I. lacing wire shall be tied to the pegs.

‘Crown’ 200 fiberglass boards 50mm thick shall be stuck to the pegs with CPRX compound or any other suitable adhesive and be held in position by the 20-gauge G.I. lacing wires. The insulation boards shall be covered with 20mm – 24 gauge hexagonal G.I. chicken wire mesh, nailed to the timber pegs and 30 gauge aluminum sheets shall be fixed over the chicken wire mesh with 50mm overlap and secured to the timber pegs by screws. If the insulation is specified to rest on top of the false ceiling, it shall be properly installed and anchored to the framework. In case additional battens are required for proper installation, Contractor shall include its cost in the rate for insulation.

Plaster of Paris Board for False Ceiling:**Materials:****Plaster of Paris Boards:**

- The plaster of Paris boards to be used in the false ceiling shall be of an approved manufacture or manufactured at site by methods and materials approved by BMC.
- The plaster of Paris shall be of the calcium-sulphate hemi-hydrate variety and shall contain not less than 35 percent Sulphur trioxide and other requirements as per IS:2547 (Part I) However, its fineness shall be such that the residue, after drying, and sieving on I.S. sieve designation 3.35mm for 5 minutes shall not be more than 1 percent by weight. Initial setting time shall not be less than 13 minutes. The average compressive strength of plaster determined by testing 5 cm cubes 24 hours

after removal from molds and drying in an oven at 40 Deg. C till the weight of the cubes is constant, shall not be less than 84 Kg per sq.cm.

- The plaster of Paris boards reinforced with hessian cloth or coir shall be prepared in suitable sizes as shown on the drawings or as directed by BMC. Wooden forms of height equal to the thickness of boards shall be placed on truly level and smooth surface such as a glass sheet. The edges of the boards shall be truly square. The glass sheet or surface on which form is kept and the form sides shall be given a thin coat of non-staining oil to facilitate the easy removal of the board. Plaster of Paris shall be evenly spread into the form up to about half the depth and hessian cloth or coir shall be pressed over the plaster of Paris layer. The weight of hessian cloth or coir in the board shall be 250gm per sq.m. The ends of the hessian/coir reinforcement shall be turned over at all edges to form a double layer for a width of 50mm. The hessian cloth shall be of an open web texture so as to allow the plaster below and above to intermix with each other and form an integral board. The form shall then be filled with plaster of Paris which shall be uniform pressed and then wire cut to an even and smooth surface. The board shall then be allowed to set initially for an hour or so and then removed from the form and allowed to dry and harden for about a week. The board after drying and hardening shall give a ringing sound when struck. The boards shall be true and exact to shape and size and the exposed face shall be truly plane and smooth.
- The size of boards shall generally be 600mm x 600 mm x 12 mm thick. Boards shall be kept dry in transit and stored flat in a clean dry place and shall not be exposed to moisture. The boards shall always be carried on edges.

Timber Frame Work:

Timber for frame work of false ceiling grid and hangers shall be of good quality and well-seasoned. It shall have uniform colour, reasonably straight and close grains and shall be free from knots, cracks and sapwood. It shall be treated with approved anti-termite preservative as directed by the BMC. Extreme care shall be taken so that the preservative treatment does not stain the ceiling boards. In case metal hangers are used, these shall be M.S. flats or bars, having two coats of red oxide zinc chromate paint primer, as shown on drawings or as approved by BMC.

Metal Frame Work:

The metal frame work may be made of sections of light metal, such as anodized aluminum, mild steel or as shown on the drawings. The shape of cross-section shall be such as to facilitate proper suspension and proper fixing of the ceiling boards covering them and shall be structurally sound and rigid.

Construction:

- Contractor shall ensure that the frame to support the ceiling is designed for structural strength and the sizes, weight and strength of ceiling boards to be fixed and other loads due to live load, air-conditioning ducts, grills, electrical wiring and lighting fixtures, thermal insulation, etc. as shown on the drawings. Contractor shall also submit a detailed drawing to show the grid work, sizes of grid members, method of suspension, position of openings for air-conditioning and lighting, access doors, etc.
- Structural design of timber member for the frame shall be in accordance with IS: 883, and metal sections shall be of appropriate size and thickness and shall be of approved manufacture, all as approved by BMC.
- The false ceiling grid work shall be carried out as per the approved drawings or as directed by BMC. In case of timber grid work, the grid work shall consist of teak wood runners of minimum size 60mm deep x 40mm wide along one direction at 1.2m center to center and secondary runners of size 50mm deep x 40 mm wide at 60mm center to center perpendicular to the main runners.
- The timber grid work shall be suspended with the help of wooden hangers or metal hangers at 1.2m center to center in both the directions. Wooden hangers shall be adopted for flat R.C. roof slab structures whereas metal hangers for flat R.C. roof or structural steel floors / tresses. Metal hangers shall be fabricated from mild steel / galvanized flats of 35mm x 6mm size or bars of 10mm dia. Threaded at the lower end and anchored securely in the roof concrete or welded to inserts provided on the underside of slabs, beams etc. All M.S. hangers shall be given two coats of red oxide zinc chromate paint primer. In case the roof work is of A.C. sheeting supported on purlins and trusses; hangers shall be suspended from roof steel work. The arrangement of metal hangers shall be such that the level of false ceiling can be adjusted during fixing of the ceiling frame work. The ceiling frame work shall be secured to hangers by means of washers and nuts. The ends of main runners shall preferably be embedded into the masonry work.
- The metal frame work when it is anodized aluminum false ceiling grid system shall consist of aluminum main member of special T-Profile of 38mm x 38mm x 1.5mm thick, interlocking with each other to form frames of various sizes, 600mm x 600 mm or as shown on the drawing. The main members shall be suspended from the roof structures by means of steel hangers as described for timber frame work and supported at the walls by means of anodized aluminum wall angles.
- In the case of timber frame work, all the edges of the plaster of Paris board shall be fixed to frame members by means of counter sunk and rustles screws of 2.74 mm size, 40mm long at a spacing of 100mm to 150 mm c/c and 12mm from the edge of the board. Holes for screws shall be drilled and screws slightly countersunk into the

boards. The boards shall be fixed to wooden framework with a joint clearance of about 3mm. The joints shall always be in perfect line and plane.

- In case of aluminum grid system, boards shall be just placed into the frames formed by the main 'T' members and the cross members fitted with the clips for locking boards. Contractor shall take utmost care so as not to force the boards in position and a slight gap shall be provided so as not to make a tight joint. The boards shall be cut with a saw, if required, to any shape and size.
- As the work of false ceiling may be inter-connected with the work of air-conditioning ducts and lighting, Contractor shall fully co-operate with the other agencies entrusted with the above work, who may be working simultaneously. Contractor shall provide necessary openings in the false ceiling work for air-conditioning, lighting and other fixtures. Additional framing, if required, for the above opening shall also be provided at no extra cost to Employer. Removable or hinged type inspection or access trap doors shall be provided at locations specified by BMC.

Finishing:

It is essential that false ceiling work should be firm and in perfect line and level and all boards free from distortion, bulge, and other defects. All defective boards and other material shall be removed from site immediately and replaced, and ceiling restored to original finish to the satisfaction of BMC. The workmanship shall be of highest order and all joinery work for timber work shall be in the best workmanship manner. The joints for aluminum frame work shall be of inter-locking type so that when the cross member is in place, it cannot be lifted out. The countersunk heads of screws and all joints shall be filled with plaster of Paris and finished smooth. After filling the joints, a thick skin of the finishing material shall be spread about 50mm wide on either side of the joint and on to it shall be trowelled dry a reinforcing scrim cloth about 10mm wide. If metal scrim is used, a stiffer plaster will be necessary to enable the Trowelling of the scrim down to the board.

Fire Stopping:

In case of fire protective ceilings, fire resisting barriers at suitable intervals shall be provided. These shall completely close the gap between the false ceiling and soffit of the structural slab. The material of the barrier shall be as indicated by BMC (Reference may be made to the British Standards Institutions CP 290: Code of Practice for suspended ceiling and lining of dry construction using metal fixing system, for guidance).

**False or Cavity Floor;
Frame Work:**

The false floor shall consist of a framework of suitable structural member designed to carry the loads specified. This frame work shall be supported on suitably designed stools placed at 600mm center to center in both directions. The stools shall consist of a mild steel base plate with a mild steel stud having adjustable lock nut and coupling at the center and another mild steel plate at top serving as a prop head. The above framework shall be suitably designed to accommodate 35mm thick, 600mm square panels. The base plate shall be fixed to the reinforced concrete floor with an approved adhesive compound or with 4 Nos. 6mm dia. Anchor fasteners. Bedding of 1:2 or richer cement sand mortar shall be provided locally under the base plates of stools to provide a level surface.

The prop head shall be provided with mild steel lugs welded on top and each placed perpendicular to the other for proper positioning and supporting the main and cross members. The stools shall be capable of adjustment to accommodate concrete floor level irregularities up to plus or minus 15mm. The framing members shall be completely removable and shall remain in position without screwing or bolting to the prop heads. All steel framework including steel stools shall be given a coat of zinc chromate primer and two coats of enamel paint of approved colour and shade.

Floor Panels:

The floor panels shall be made of 600mm x 600mm x 35 mm thick medium density unvineared/ non-prelaminated teak wood particle boards having a density of not more than 800 kg/cu.m bonded with boiling water proof phenol formaldehyde synthetic resin and shall be of fire resistant, termite resistant and moisture proof quality, generally conforming to IS:3087-specification for wood particle boards (Medium Density)for general purposes.

The thermal conductivity of the boards shall not exceed 0.12 kCal/hrs./sq.m/deg./C/m. The panel size given above may be suitably modified near electrical panel/equipment and also to suit room dimensions with panel size not more than 600mm under any circumstances. Exposed 2mm thick vinyl edging shall be provided on all edges of individual panels. Each panel shall be given a coat or primer and two coats of approved fire-resistant paint from underside. The particle boards shall be faced with 600mm x 600 mm x 2mm thick approved make flooring tiles conforming to IS:3462 – “Specification for unbaked flexible PVC flooring” and of approved colour and shade. The completed panel shall be completely removable and shall remain in position without screwing or bolting to the on the inner side with stickers for easy identification and reassembly whenever required. Suitable backing material shall be provided on the underside of the particle board to prevent warping

and / or to cater to specified loading. Suitable removable covers shall be provided to serve as outlets for the cables.

Imposed Loading:

The finished floor shall be capable of supporting uniformly distributed loads of 500 to 1000 Kg. per m² of floor area as specified in data sheet. A point load of 450 Kg on 600 sq.mm on any part of the panel or a line load of 725 Kg on 100mm strip across the panel length shall not result in a deflection greater than 2.5mm.

Finish:

The finished floor shall be true to lines and levels and present a neat flush surface.

Vendor Drawing:

Vendor shall prepare and submit a layout drawing for false floor giving all details including supporting system for approval. If so called for, vendor shall also submit his calculations for the supporting system with all relevant data assumed, to the BMC for his approval. Work shall be carried out on approved drawings only.

Fire Proof Doors:

Material and Workmanship:

The design of fire proof doors and the materials to be used in their fabrication have to be such that they shall be capable of providing the effective barrier to the spread of fire. The materials, fabrication and erection of fire proof doors shall conform to IS:3614 (Part-I). The fire proof doors shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained beforehand. Sample approval shall also be obtained from testing authority as per the standard IS: 3614 (Part-2) for the specified degree of fire rating in hours. All fire proof doors shall have specified sizes and conform to the description in the respective items of work.

Fire proof door shutters shall be of zinc coated weldable steel (conforming to BS: 6687) or stainless steel (conforming to IS: 304) sheet (18G minimum) fixed in a frame work of rolled channel. The shutter shall consist of an insulating material like mineral wool in required thickness to satisfy the specified fire rating. Normally the thickness of door shutter shall not be less than 35mm for two hour fire rating and 46 mm for four hour fire rating. The shutter with the required insulating material shall be mounted on angle iron frame or the special made frame from zinc coated (16G

minimum) weldable steel sheet. The shutter shall be fixed to frame by means of suitable hinges and shall have a three way latching system. All the doors shall be provided with a coat of primer and one coat of synthetic enamel paint to attain the specified fire rating. All other accessories like hinges, door lock, hold fasts, etc. shall be provided as approved by TAC (Tariff Advisory Committee). All these accessories shall be compatible with the material used for door and shutter.

SPECIFICATIONS

: SECTION - 5:

: STRUCTURAL STEEL WORK:

SECTION - 5 :

STRUCTURAL STEEL WORK

Applicable Codes and Specifications:

The supply, fabrication, erection and painting of structural steel works shall comply with the following specifications, standards and codes unless otherwise specified herein. All standards, specifications and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

IS : 808	Dimensions for Hot Rolled Steel sections
IS : 814	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel
IS : 800	Code of Practice for General Construction in Steel
IS : 801	Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction
IS : 806	Code of Practice for Use of Steel Tubes in General Building Construction
IS : 7205	Safety Code for Erection of Structural Steel Work
IS : 7215	Tolerances for Fabrication of Steel Structures
IS : 4000	High Strength Bolts in Steel Structure – Code of Practice
AISC	Specifications for Design, Fabrication and Erection of Buildings
IS : 1161	Steel Tubes for structural purposes
IS:10 IS:102	Ready Mixed paint, Brushing, Red Lead, Non-setting, Priming.
IS:110	Ready Mixed paint, brushing, grey filler for enamels for use over primers.
IS:117	Ready Mixed paint, Brushing, Finishing, and Exterior Semigloss for general purposes, to Indian Standard colours.
IS:158	Ready Mixed paint, Brushing, Bituminous, Black, Lead free, Acid, Alkali and heat resisting.
IS:159	Ready Mixed paint, Brushing, Acid resisting for protection against acid fumes, colour as required.
IS:341	Black Japan, Types A, B and C

IS:2339	Aluminum paint for general purposes, in Dual container
IS:2932	Specification for enamel, synthetic, exterior, type 1, (a) Undercoating, (b) finishing
IS:2933	Specification for enamel, exterior, type 2, (a) Undercoating, (b) finishing.
IS:5905	Sprayed aluminum and zinc coatings on Iron and Steel.
IS:6005	Code of practice for phosphating of Iron and Steel.
IS:9862	Specification for ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water & chlorine resisting.
IS:13183	Aluminum paint, Heat resistant.
SIS-05-5900	(Swedish Standard)
IS : 1239	Mild steel tubes, tubulars and other Wrought steel fittings
	Part 1 – Mild steel tubes
	Part 2 – Mild steel tubulars and other wrought steel pipe fittings
IS : 1363 (Parts 1 to 3)	Hexagon Head Bolts, Screws and Nuts of product Grade C (Size range M5 to M64)
IS : 1367 (All parts)	Technical Supply Conditions for Threaded Fasteners
IS : 1852	Rolling and Cutting Tolerances for Hot Rolled Steel Products
IS : 1977	Structural Steel (Ordinary Quality)
IS : 2062	Steel for General Structural Purposes
IS : 2074	Ready Mixed Paint, Air drying, Red Oxide Zinc Chrome and Priming
IS : 3502	Steel Chequered Plate
IS : 3757	High Strength Structural Bolts
IS : 5369	General Requirements for Plain Washers and Lock Washers

IS : 5372	Taper Washers for Channels
IS : 5374	Taper Washer for 1 Beams
IS : 6610	Heavy Washers for Steel Structures
IS : 8500	Structural Steel-micro alloyed (medium and high strength qualities)
IS : 803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded storage tanks
IS : 816	Code of Practice for use of Metal Arc Welding for General construction in Mild Steel
IS : 822	Code of Procedure for Inspection of Welds
IS : 1182	Recommended Practice for Radiographic examination of Fusion – Welded Butt Joints in Steel Plates
IS : 1200	Method of Measurement in Building Civil Works
IS : 1477	Code of Practice for Painting of (Parts 1&2) Ferrous Metals in Buildings
IS : 2595	Code of Practice for Radiographic Testing
IS : 3658	Code of Practice for Liquid Penetrate Flaw Detection
IS : 5334	Code of Practice for Magnetic Particle Flaw Detection of Welds
IS : 9595	Recommendations for Metal Arc Welding of Carbon and Carbon Manganese Steel

Steel Materials:

Steel materials shall comply with the referred to in **Sub-Clause 4.1**.

All materials used shall be new, unused and free from defects.

Steel conforming to IS: 1977 shall be used only for the following:

Fe310-0 (St 32-0)	For general purposes such as door/window frames, grills, steel gates, handrails, fence posts, tee bars and other non-structural use.
Fe410-0 (St 42-0)	For structures not subjected to dynamic loading other than wind loads such as: Platform roofs, foot over bridges, building, factory sheds etc.

Fe510-0 (St 42-0)	Grade steel shall not be used
	a) If welding is to be employed for fabrication b) If site is in severe earthquake zone c) If plastic theory of design is used

Drawings prepared by the VENDOR/CONTRACTOR:

The VENDOR/CONTRACTOR shall prepare all fabrication and erection drawings for the entire work. All the drawings for the entire work shall be prepared in metric units. The drawings shall preferably be of one standard size and the details shown there in shall be clear and legible.

All fabrication drawings shall be submitted to the Engineer-In-Charge for approval.

No fabrication drawings will be accepted for Engineer In charge's approval unless checked and approved by the VENDOR/Contractor's qualified structural engineer and accompanied by an erection plan showing the location of all pieces detailed. The VENDOR/CONTRACTOR shall ensure that connections are detailed to obtain ease in erection of structures and in making field connections.

Fabrication shall be started by the VENDOR/CONTRACTOR only after Engineer In charge's approval of fabrication drawings. Approval by the Engineer-In-Charge of any of the drawings shall not relieve the VENDOR/CONTRACTOR from the responsibility for correctness of engineering and design of connections, workmanship, fit of parts, details, material, errors or omissions or any and all work shown thereon. The Engineer In charge's approval shall constitute approval of the size of members, dimensions and general arrangement but shall not constitute approval of the connections between members and other details.

The drawings prepared by the VENDOR/CONTRACTOR and all subsequent revisions etc. shall be at the cost of the VENDOR/CONTRACTOR for which no separate payment will be made.

Fabrication:

General:

All workmanship and finish shall be of the best quality and shall conform to the best-approved method of fabrication. All materials shall be finished straight and shall be machined/ground smooth true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Unless otherwise approved by the Engineer-

In-Charge, reference may be made to relevant IS codes for providing standard fabrication tolerance. Material at the shops shall be kept clean and protected from weather.

Connections:

Shop/field connections shall be as per approved fabrication drawings. In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. In case of high strength friction grip bolts, hardened washers to be used under the nuts or the bolt heads whichever are turned to tighten the bolts. The length of the bolt shall be such that at least one thread of the bolt projects beyond the nut, except in case of high strength friction grip bolts where this projection shall be at least three times the pitch of the thread.

In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

All connections and splices shall be designed for full strength of members or loads. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

All bolts, nuts, washers, electrodes, screws etc., shall be supplied/brought to site 10% in excess of the requirement in each category and size. Rates shall cover the cost of this extra quantity.

All members likely to collect rainwater shall have drain holes provided.

Straightening:

All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened by pressure and shall be free from twists. Heating or forging shall not be resorted to without the prior approval of the Engineer-In-Charge in writing.

Rolling and Forming:

Plates, channels, R.S.J. etc., for circular bins, bunkers, hoppers, gantry girders, etc., shall be accurately laid off and rolled or formed to required profile/shape as called for on the drawings. Adjacent sections shall be match-marked to facilitate accurate assembly, welding and erection in the field.

High Strength Friction Grip Bolting:

Inspection after tightening of bolts shall be carried out as stipulated in the appropriate standards depending upon the method of tightening and the type of bolt used.

Welding:

Welding procedure shall be submitted to the Engineer-In-Charge for approval. Welding shall be entrusted to qualified and experienced welders who shall be tested periodically and graded as per IS 817, IS: 7310 (Part 1) and IS: 7318 (Part 1).

While fabricating plated beams and built up members, all shop splices in each component part shall be made before such component part is welded to other parts of the members. Wherever weld reinforcement interferes with proper fit-up between components to be assembled off welding, these welds shall be ground flush prior to assembly.

Approval of the welding procedure by the Engineer-In-Charge shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

No welding shall be done when the surface of the members is wet nor during periods of high wind.

Each layer of a multiple layer weld except root and surfaces runs may be moderately panned with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from overweening.

No welding shall be done on base metal at a temperature below -5° C. Base metal shall be preheated to the temperature as per relevant IS codes.

Electrodes other than low-hydrogen electrodes shall not be permitted for thickness of 32 mm and above.

All welds shall be inspected for flaws by any of the methods described under **Sub-clause 4.6.3**. The choice of the method adopted shall be agreed with the Engineer-In-Charge.

The correction of defective welds shall be carried out in a manner approved by the Engineer-In-Charge without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means approved by the Engineer-In-Charge shall be used to ensure that the whole of the crack and material up to 25 mm beyond each end of the crack has been removed. The cost of all such tests and operations incidental to correction shall be borne by the Contractor.

Tolerances:

The dimensional and weight tolerances for rolled shapes shall be in accordance with ARE: 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerances for fabrication of structural steel shall be as per ARE: 7215.

Cutting, punching, drilling, welding and fabrication tolerances shall be generally as per relevant IS codes.

End Milling:

Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

Inspection:**General:**

The Contractor shall give due notice to the Engineer-In-Charge in advance of the works being made ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for the Engineer In charge's inspection. The fact that certain material has been accepted at the Contractor's shop shall not invalidate final rejection at site by the Engineer-In-Charge if it fails to conform to the requirements of these specifications, to be in proper condition or has fabrication inaccuracies which prevent proper assembly nor shall it invalidate any claim which the Employer may make because of defective or unsatisfactory materials and/or workmanship.

No materials shall be painted or dispatched to site without inspection and approval by the ENGINEER INCHARGE unless such inspection is waived in writing by the ENGINEER-IN-CHARGE.

The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the Engineer-In-Charge.

Inspection and tests on structural steel members shall be as set forth below.

Material Testing:

If mill test reports are not available for any steel materials the same shall be tested by the Contractor to the Employer's Representative's satisfaction to demonstrate conformity with the relevant specification.

Tests on Welds:**(a) Magnetic Particle Test:**

Where welds are examined by magnetic particle testing, such testing shall be carried out in accordance with relevant IS codes. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and retested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the permission of the Engineer-In-Charge.

(b) Liquid Penetrate Inspection:

In the case of welds examined by Liquid Penetrate Inspection, such tests shall be carried out in accordance with relevant IS Code. All defects shown shall be repaired and rechecked.

(c) Radiographic Inspection:

All full strength butt welds shall be radiographed in accordance with the recommended practice for radiographic testing as per relevant IS code.

Dimensions, Workmanship & Cleanliness:

Members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment, surface finish and painting are in accordance with the requirements shown in the Contractor's approved fabrication drawings.

Test Failure:

In the event of failure of any member to satisfy inspection or test requirement, the Contractor shall notify the Engineer-In-Charge. The Contractor must obtain permission from the Engineer-In-Charge before any repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the Engineer-In-Charge.

The Engineer-In-Charge has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the Employer, only in case of successful testing.

The Contractor shall maintain records of all inspection and testing which shall be made available to the Engineer-In-Charge.

Shop Matching:

For structures like bunkers, tanks, etc. Shop assembly is essential. For other steel work, such as columns along with the tie beams/bracings may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc., if so desired by the Engineer-In-Charge. All these shop assemblies shall be carried out by the Contractor.

Drilling Holes for other works:

As a part of this Contract, holes in members required for installing equipment or steel furnished by other manufacturers or other contractors shall be drilled by the VENDOR/CONTRACTOR at no extra cost of the EMPLOYER. The information for such extra holes will be supplied by the EMPLOYER/ENGINEER-IN-CHARGE.

Marking of Members:

After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible.

All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

Erection marks on like pieces shall be in identical locations. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

Errors:

Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the Engineer-In-Charge as defective workmanship. Where the Engineer-In-Charge rejects such material or defective workmanship, the same shall be replaced by materials and workmanship conforming to the Specifications by the Contractor, at no cost to the Employer.

Painting of Steel Work:

All fabricated steel material, except those galvanized shall receive protective paint coating as specified in specification, which is described below.

Materials:

Red-oxide – zinc chrome primer shall conform to IS: 2074.

Synthetic enamel paint shall conform to IS: 2932.

Aluminum paint shall conform to IS: 2339.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the Engineer-In-Charge for the brand of manufacture and the colour/shade. All the materials shall be brought to the site in sealed containers.

Workmanship:

Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS: 1477 (Part 2).

The type of paint, number of coats etc. shall be as specified in the respective items of work. Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer. All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS: 1477 (Part – I) and as indicated in the item of work. It is essential to ensure that immediately after preparation of the surfaces; the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from 'holidays'.

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied by brushing and allowed to hard dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

At least 24 hours shall elapse between the applications of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the Engineer-In-Charge.

Acceptance of Steel, its Handling & Storage:

The Contractor shall carefully check the steel to be erected at the time of acceptance. Any fabrication defects observed should be brought to the notice of the Engineer-In-Charge.

No dragging of steel shall be permitted. All steel shall be stored 300mm above ground on suitable packing to avoid damage. It shall be stored in the order required for erection, with erection marks visible. All storage areas shall be prepared and maintained by the Contractor. Steel shall not be stored in the vicinity of areas where excavation or grading will be done and, if so stored temporarily, this shall be removed by the Contractor well before such excavation and/or grading commences to a safe distance to avoid burial under debris. Scratched or abraded steel shall be given a coat of primer in accordance with the Specifications for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suitable coating and also from damage.

Anchor Bolts & Foundations:

The Contractor shall carefully check the location and layout of anchor bolts embedded in foundations constructed, to ensure that the structures can be properly erected as shown on the drawings. Any discrepancy in the anchor bolts/foundation shall be reported to the Engineer-In-Charge.

Leveling of column bases to the required elevation may be done either by providing shims or three nuts on the upper threaded portion of the anchor bolt. All shim stock required for keeping the specified thickness of grout and in connection with erection of structures on foundations, crane brackets or at any other locations shall be of good M.S. plates and shall be supplied by the Contractor at his cost.

A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by the Contractor at no extra cost. Here beams bear in pockets or on walls; bearing plates shall be set and leveled as part of the work. All grouting under column base plates or beam bearing plates will be carried out by the Contractor.

Assembly & connections:

Field connections may be effected by riveting, bolting, welding or by use of high strength friction grip bolts as shown on the design and erection drawings.

All field connection work shall be carried as per the drawings. All bolts, nuts, washers, rivets, electrodes required for field connections shall be supplied by the Contractor free of cost. All assembling shall be carried on a level platform. Drifts shall be used only for drawing the work to proper position and must not be used to such an extent as to damage the holes. Size of drifts larger than the normal diameter of hole shall not be used. Any damaged holes or burrs must be rectified to the satisfaction of the Engineer-In-Charge.

Corrections of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets shall be considered as a part of erection. Any error in the shop, which prevents proper fit on a moderate amount of reaming and slight chipping or cutting, shall be immediately reported to the Engineer-In-Charge.

Erection:

All structural steel shall be erected as shown on the drawings prepared by the Contractor. Proper size steel cable slings, etc., shall be used for hoisting. Guys shall not be anchored to existing structures, foundations, etc., unless so permitted by the Engineer-In-Charge in writing. Care shall be taken to see that ropes in use are always in good condition.

Steel columns in the basement, if any, are to be lowered and erected carefully with the help of a crane and/or derrick without damaging the basement walls or floor.

Structural steel frames shall be erected plumb and true. Frames shall be lifted at points such that they are not liable to buckle and deform. Trusses shall be lifted only at node points. In the case of trusses, roof girders, all of the purlins and wind bracing shall be placed simultaneously and the columns shall be erected truly plumb on screed bars over the pedestals. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety and stability.

Chequered plates shall be fixed to supporting members by tack welding or by countersunk bolts as shown/specified in relevant drawings and/or as approved by the Engineer-In-Charge. The edges shall be made smooth and no burrs or jagged ends shall be left. While splicing, care should be taken so that there is continuity in pattern between the two portions. Care should also be taken to avoid distortion of the plate while welding. The erection of chequered plates shall include:

- a) Welding of stiffening angles/vertical stiffening ribs
- b) Cutting to size and making holes to required shape wherever necessary to allow service piping and/or cables to pass through
- c) Splicing as shown in relevant drawings
- d) Smoothing of edges
- e) Fixing of chequered plates by tack welding or by countersunk bolts
- f) Providing lifting hooks for ease of lifting.

As erection progresses, the work shall be securely bolted to take care of all dead load, wind, seismic and erection stresses. No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by the Engineer-In-Charge. No cutting, heating or enlarging of the holes shall be carried out without the prior written approval of the Engineer-In-Charge. The Contractor shall furnish test certificates.

Inspection:

The Engineer-In-Charge shall have free access to all parts of the job during erection and all erection shall be subjected to his approval. In case of faulty erection, all dismantling and re-erecting required will be at the Contractor's cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by the Engineer-In-Charge.

Tolerances:

General:

Tolerances mentioned below shall be achieved after the entire structure or part thereof is in line, level and plumb.

Columns:

Deviation of column axes at foundation top level with respect to true axes:	
(a) In longitudinal direction	±5 mm
(b) In lateral direction	±5 mm
Deviation in the level of bearing surface of columns at foundation top with respect to true level±5mm.	
Out of plumbness (verticality) of column axis from true vertical axis, as measured at column top:	
(a) For columns up to and including 15 meters	±1/1000 of column height in mm or ±15 mm whichever is less
(b) For columns exceeding	±1/1000 of column height in mm or ±20 mm whichever is less
Deviation in straightness in longitudinal transverse planes of column at any height	±1/1000 of column height in mm or ±10 mm whichever is less

Point along the height	
Difference in erected position of adjacent Pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance	±10 mm
Width of building prior to connecting trusses/beams with respect to true distance	±10 mm
Deviation in any bearing or seating level with respect to true level	±5 mm
Deviation in differences in bearing level of a member on adjacent pair of columns both across and along the building	±10 mm

Trusses and Beams:

Shift at the center of span of top chord member with respect to the vertical plane passing through the center of bottom chord.	±1/250 of height of truss in mm or ±15 mm whichever is less
Lateral shift of top chord of truss at the center of span from the vertical plane passing through the center of supports of the truss	±1/1500 of height of truss in mm or ±15 mm whichever is less
Lateral shift in location of truss from its true vertical position	±10 mm
Lateral shift in location of purlin true position	±5 mm
Deviation in difference of bearing levels of trusses or beams from	1. ±20 mm for trusses 2. For beams : the true difference
Depth < 1800mm :	±6mm
Depth > 1800mm :	±10mm
Deviation in sag in chords and diagonals of truss between node points	1/1500 of length in mm or 10mm whichever is smaller
Deviation in sweep of trusses, beams etc. horizontal plan	1/1000 of span in mm subject to a maximum of 10 mm

Crane Girders & Rails

Shift in the center line of crane rail respect to center line of web of with crane girder	±5 mm
Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point	±1 mm
Difference in alignment of crane rail in plan measured between any two points 2 meters apart	±1 mm
Deviation in crane track with respect to true gauge	
For track gauges upto and Including 15 meters	±5 mm
For track gauges more than 15 meters	± [5 + 0.25 (S-15)] where S in meters is true gauge
Deviation in the crane real level at any point from true level	±1/1200 of the gauge distance or ±10mm whichever is less
Difference in the crane rail actual levels between any two points 2 meters apart along the rail length	±2 mm
Difference in levels between crane track Rails at	
(a) Supports of crane girders	±15 mm
(b) Mid span of crane girders	± 20 mm

Relative shift of crane rail surfaces at a joint in plane and elevation surfaces for smooth transition	2 mm
Relative shift in the location of crane stops (end buffer) along the crane tracks with track gauge S	1/1000 of track gauge subject to maximum of 20 mm S in

Painting:

After steel has been erected, all bare and abraded spots, rivet heads, field welds, bolt heads and nuts shall be spot painted with primer. Before paint is applied, the surface shall be dry and free from dust, dirt, scale and grease. All surfaces inaccessible after erection shall receive two coats of the approved paint before erection.

Clean up of Work site:

During erection, the Contractor shall at all times keep the working and storage areas used by him free from accumulation of waste materials or rubbish. Before completion of erection, he shall remove or dispose of in a satisfactory manner all temporary structures, waste and debris and leave the premises in a condition satisfactory to the Engineer-In-Charge.

SPECIFICATIONS

SECTION -6:

WATER SUPPLY AND SEWERAGE WORKS

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Applicable Codes:

The following standards and codes are made a part of this Employer's Requirement. All standards, codes of practice referred to herein shall be the latest editions including all official amendments and revisions.

IS: 210	:	Specification for grey iron castings
IS: 269	:	Specification for ordinary and low heat Portland cement
IS: 383	:	Specification for coarse and fine aggregates from natural sources for concrete
IS: 432	:	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
IS: 456	:	Code of Practice for plain and reinforced concrete
IS: 458	:	Concrete Pipes (with and without reinforcement).
IS: 516	:	Methods of tests for strength of concrete
IS: 554	:	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS: 651	:	Salt glazed stoneware pipes and fittings.
IS: 774	:	Flushing Cisterns for water closets and urinals (valueless siphonic type)
IS: 775	:	Cast iron brackets and supports for wash basins and sinks.
IS: 781	:	Sand-cast brass screw-down bib taps and stop taps for water services.
IS: 783	:	Code of practice for laying of concrete pipes.
IS: 1068	:	Electroplated coatings of nickel and chromium of iron and steel.
IS: 1077	:	Specification for common burnt clay building bricks

IS: 1786	:	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS: 1239	:	Mild steel tubes (Part I) and mild steel tubular and other wrought steel pipe fittings (Part II)
IS : 1536	:	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS : 1626	:	Asbestos cement building pipes, gutters and fittings (spigot and socket types).
IS : 1703	:	Copper Alloy float valves (horizontal plunger type) for water supply purposes.
IS : 1726	:	Cast iron manhole covers and frames.
IS : 1729	:	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1742	:	Code of practice for buildings drainage
IS : 2116	:	Specification for sand for masonry mortars
IS : 2212	:	Code of practice for brickwork
IS : 2250	:	Code of practice for preparation and use of masonry mortars
IS : 2326	:	Automatic flushing cisterns for urinals
IS : 2470	:	Code of practice for design and construction of septic tanks (Parts I & II)
IS : 2556	:	Vitreous sanitary appliances (Part I to Part XV)
IS : 2963	:	Specification for copper alloy waste fittings for wash basins and sinks
IS : 3006	:	Specification for chemically resistant glazed stoneware pipes and fittings
IS : 3311	:	Waste plug and its accessories for sinks and wash basins
IS : 5455	:	Specification for cast iron steps for manholes
IS : 4127	:	Code of Practice for laying of glazed stoneware pipes
IS : 3495	:	Methods of tests of burnt clay building bricks

IS : 4111	:	Code of practice for ancillary structures in sewerage system manholes
IS : 5382	:	Specification for rubber sealing rings for gas mains, water mains and sewers
IS : 5329	:	Code of practice for sanitary pipe work above ground for buildings
IS : 5434	:	Non-ferrous alloy bottle traps for marine use

Cast Iron Soil Waste and Vent Pipes and Fittings:

All cast iron pipes and fittings shall be of uniform thickness with strong and deep sockets, free from flaws, air holes, cracks, sand holes and other defects and conform to IS: 1536. The diameter approved shall be internal diameter of pipe. The pipes and fittings shall be true to shape, smooth and cylindrical and shall ring clearly when struck over with a light hand hammer. All pipes and fittings shall be properly cleaned of all foreign material before being fixed.

All plug bends of drainage pipes shall be provided with inspection and cleaning caps, covers, which shall be fixed with nuts and screws. Pipes shall be fixed to the wall by W.I. or M.S. holder bat clamps, unless projecting ears with fixing holes are provided at socket end of pipe. The pipes shall be installed, truly vertical or to the lines and slopes as indicated. The clamps shall be fixed to the walls by embedding their hooks in cement concrete blocks (1:2:4) 10 cm x 10 cm making necessary holes in the walls at proper places. All holes and breakages shall be made good. The clamps shall be kept 25 mm clear of the finished face of the walls to facilitate cleaning and painting of pipes.

The annular space between the socket and spigot shall be filled with a gasket of hemp or spun yarn soaked in neat cement slurry. The joint shall then be filled with stiff cement mortar 1:2 (1 cement: 2 fine sand) well pressed with caulking tool and finished smooth on top at an angle of 45°. The joint shall be kept wet for not less than 7 days by tying a piece of gunny bag kept moist. Joints shall be perfectly air tight as well as water tight.

C.I. pipes and fittings which are exposed shall be first cleaned and then painted with a coat of red lead primer. Two coats of zinc paint with white base and mixed with pigment of required colour to get the approved shade shall be given over the base

primer coat.

The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions approved for the corresponding sizes of straight pipes.

The connection between the main pipe and branch pipes shall be made by using branches and bends with access for cleaning. Floor traps shall be provided with 25 mm dia. puff pipe where the length of the waste is more than 1800 mm or the floor trap is connected to a waste stack through bends.

All cast iron pipes and fittings including joints shall be tested by a smoke test to the satisfaction of the Employer's Representative and left in working condition after completion. The smoke test shall be carried out as stated under:

Smoke shall be pumped into the pipe at the lowest and from a smoke machine which consists of a bellow and a burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell if there is a leak at any point of the pipeline. Water test and air test shall be conducted as stipulated in IS: 5329.

Galvanized Mild Steel (G.I) Pipe:

The pipes shall be galvanized mild steel welded pipes and seamless screwed and sockets tubes conforming to the requirements of IS: 1239, for medium grade. They shall be of the diameter (nominal bore) approved. The sockets shall be designated by the respective nominal bores of the pipes for which they are intended. The pipes and sockets shall be finished neatly, well galvanized on both inner and outer surfaces, and shall be free from cracks, surface flaws, laminations and other defects. All screws, threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS.554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

The fittings shall be of malleable cast iron or mild steel tubes complying with all the appropriate requirements as approved for pipes. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended. The fittings shall have screw threads at the ends conforming to the requirements of IS: 554.

Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

The pipes and fittings shall be inspected at site before use to ascertain that they conform to the specification. The defective pipes shall be rejected. Where the pipes have to be cut or rethreaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The ends of the pipes shall then be threaded conforming to the requirements of IS.554 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening bent and damaged screw threads and shall not be used for turning of the threads so as to make them slack, water tight joint. The screw- thread of pipes and fittings shall be protected from damage until they are fitted. The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped around the screwed end of the pipe. The end shall then be screwed in the socket, tee, etc., with the pipe wrench. Care should be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burrs from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of soil or any other foreign matter. Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anticorrosive paint to prevent corrosion.

For internal work the galvanized iron pipes and fittings shall run on the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall. Pipes and fittings shall be fixed truly vertical/horizontal. When it is found necessary to conceal the pipes, chasing may be adopted or pipes fixed in the ducts of recesses etc. provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage, but the joints in pipes shall not be buried. M.S. pipe sleeve shall be fixed at a place where a pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion/contraction and other movements/maintenance. In case the pipe is embedded in walls or floors it should

be painted with anti-corrosive bitumastic paint of approved quality. The pipe should not come in contact with lime mortar or lime concrete as the pipe is affected by lime. Under the floors the pipes shall be laid in layer of sand filling or as approved by the Employer's Representative.

G.I. pipes with socket and spigot ends shall be provided with lead caulked joints wherever specified and the joints shall conform to the requirements of IS.3114.

The work of excavation and backfilling shall be done true to line and gradient in accordance with General Employer's Requirements for earthworks in trenches for pipes laid underground.

The pipes shall be laid on a layer of 10.0 cm sand and filled upto 15 cm above the pipes. A sand cushion of 15cm on either side of the pipe shall also be provided. The remaining portion of the trench shall then be filled with excavated earth. The surplus earth shall be got rid of as directed. When excavation is done in rock the bottom shall be cut deep enough to permit the pipes to be laid on a cushion of sand 75 mm minimum.

The pipes and fittings after they are laid and jointed shall be subjected to hydrostatic pressure test as approved by the Employer's Representative and shall satisfactorily pass the test. Pipe line system shall be tested in sections as the work proceeds, keeping the joints exposed for inspection. Pipes shall be slowly and carefully charged with water allowing all air to escape. All draw off taps shall then be closed and water pressure gradually raised to test pressure. Care shall be taken to ensure that pressure gauge is accurate and preferably should have been recalibrated before the test. Pump used having been stopped; the section of the pipeline shall maintain the test pressure for at least half an hour. Any joints or pipes found leaking shall be removed and replaced by the Contractor.

The G.I. pipe line shall be cut to the required length at the position where the meter and stop cock are required to be fixed. The ends of the pipes shall be threaded. The meter and stop cock shall be fixed in position by means of connecting pipe, G.I. nuts, sockets, etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed and meter installed exactly horizontally or vertically and with the arrow cast on the body of the meter pointing in the direction of flow. Care shall be taken that the factory seal of the

meter is not disturbed. Whenever the meter is to be fixed to a newly fitted pipe line, the pipe line will have to be completely washed before fixing the meter. For this purpose, a connecting piece of pipe equal to the length of the meter is to be fixed on the new pipe line. The water shall be allowed to flow completely to wash the pipe line and then the meter installed as described above by replacing the connecting piece.

Stoneware pipes and fittings:

All pipes with spigot and socket ends shall conform to IS: 651/3006 and shall be of grade 'A'. These shall be sound, free from visible defects such as fine cracks or hair cracks. The glaze of the pipes shall be free from crazing. The pipes shall give a sharp clear note when struck with a light hammer.

The following information shall be clearly marked on each pipe and fitting:

- (a) Internal diameter;
- (b) Grade;
- (c) Date of manufacture;
- (d) Name of manufacturer or his registered trade-mark or both.

All pipes and fittings shall have ISI mark.

Jointing of GSW pipes and fittings shall be done as per the requirements of the following Employer's Requirements and the relevant IS. After jointing, extraneous material if any shall be removed from the inside of the pipes and fittings and the newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS: 5382.

Spigot and Socket Joint (Cement Joint):

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. In each joint, spun yarn soaked in neat cement slurry or tarred gasket shall be passed around the joint and inserted in it by means of a caulking tool. More skeins of yarn or gasket shall be added if necessary and shall be well caulked. Yarn or gasket so rammed shall not occupy more than one-fourth of the depth of socket. Cement mortar (1:1) shall be slightly moistened and carefully inserted by hand into the remaining space of the joint after caulking of yarn or gasket. The mortar shall then be caulked into the joint with a caulking tool. More cement mortar shall be added until the space of joint has been

completely filled with tightly caulked mortar. The joint shall then be finished of neatly outside the socket at an angle of 45 degrees. The cement mortar joints shall be cured at least for seven days before testing.

The approximate quantity of cement required for each joint for certain common sizes of pipes are give below for guidance:

Nominal diameter of pipe (mm)	Cement (kg)
150	1.5
200	2.0
250	2.5
300	3.25
350	4.5
400	5.5
450	6.5

Spigot and Socket Joint (Bituminous Joint):

The general requirements for this type of joint shall be as specified in 5.12.1 the material for jointing shall consist of composition of asphalt and sand in the ratio of 1:7. Asphalt and sand shall be boiled together and filled into the socket in a molten state with the aid of special moulds.

Spigot and Socket Joint (Rubber Ring Joint):

The pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The rubber rings conforming to IS: 5382 shall be used, and the manufacturer's instructions shall be deemed to form a part of this Employer's Requirements. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

Cleaning of Pipes:

As soon as a stretch of GSW pipes has been laid complete from manhole to manhole or for a length as approved by the Employer's Representative, the Contractor shall run through the pipes both backward and forward a double disc or solid or closed cylinder 50 mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipeline shall be securely closed as approved by the

Employer's Representative to prevent entry of mud or silt etc. If as a result of the removal of any obstruction the Employer's Representative considers that damages may have been caused to the pipe lines, he shall be entitled to order the length to be tested immediately. Should such test prove unsatisfactory the Contractor shall repair the pipeline and carry out such further tests as are required by the Employer's Representative.

It shall also be ascertained by the Contractor that each length from manhole to manhole or the length as approved by the Employer's Representative is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably illuminated by projected sunlight or otherwise.

After laying and jointing of GSW pipes is completed the pipe line shall be tested as per the following Employer's Requirements and as approved by the Employer's Representative. All equipment for testing at work site shall be supplied and erected by the Contractor. Water for testing of pipeline shall be arranged by him. Damage during testing shall be the Contractor's responsibility and shall be rectified by him to the full satisfaction of the Employer's Representative. Water used for test shall be removed from pipes and not released to the excavated trenches. After the joints have thoroughly set and have been checked by the Employer's Representative and before backfilling the trenches, the entire section of the sewer or storm water drain shall be proved by the Contractor to be water tight. Before commencing the hydraulic test, the pipelines shall be filled with water and maintained full for 24 hours by adding water, if necessary, under a head of 0.6 m of water. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head; or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation. The pipeline shall be subjected to a test pressure of at least 2.5 m head of water at the highest point of the section under test. The tolerance of two liters per centimeter of diameter per kilometer may be allowed during a period of 10 minutes. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good. If any damage is caused to the pipeline during the execution of work or while cleaning/testing the pipeline as specified. The Contractor shall be held responsible for the same and shall replace the damaged pipeline and re-test the same to the full satisfaction of the Employer's Representative.

Water for testing of pipeline shall be arranged by the Contractor.

Stop Cock and Bib Cock:

A bibcock (bib tap) is a draw off tap with a horizontal inlet and free outlet and stopcock (stop tap) is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of the screw down type. The closing device should work by means of a disc carrying a renewable non-metallic washer, which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. The cocks shall open in anti-clockwise direction. When the bib cocks and stop cocks are required to be chromium plated, the chromium plating shall be of service Grade No. 2 conforming to IS.1068. In finish and appearance, the plated articles shall be free from plating defects such as blisters, pits, roughness and shall not be stained or discoloured.

These fittings shall be of brass heavy class; chromium plated (C.P.) and of approved manufacture and pattern with screwed or flanged ends as specified. The fittings shall in all respects comply with the requirements of IS.781. The standard size of brass fittings shall be designated by the nominal bore of the pipe to which the fittings are attached. A sample of each kind of fitting shall be approved by the Employer's Representative and all supplies made according to the approved samples.

All cast fittings shall be sound and free from laps, blow holes and fittings, both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging stopping or patching of the casting shall not be permitted. The bodies, bonnets, spindles and other parts shall be truly machined and when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished. The area of the waterway of the fittings shall not be less than the area of the nominal bore.

The fittings shall be fully examined and cleared of all foreign matter before being fixed. The fittings shall be fitted in the pipe line in a workman like manner. The joints between fittings and pipes shall be made leak- proof. The joints and fittings shall be leak proof when subjected to a pressure test approved by the Employer's Representative and the defective fittings and joints shall be replaced or redone.

Soak Pit:

Soak pit shall be constructed at the location specified by the Employer's

Representative. Earthwork excavation shall be carried out to the exact dimensions. Brick masonry lining with open joints shall be constructed in the pit upto 150 mm below the outlet pipeline. Brick masonry in cement mortar 1:6 shall be constructed above this level up to ground. Well burnt brick aggregates of nominal size 40 mm to 80 mm and coarse sand shall be filled within the chamber. Construction of pit lining and filling of the brick ballast shall progress simultaneously.

Manholes:

Location:

Manholes shall be constructed at places approved by the Employer's Representative.

Excavation:

Excavation, shoring, dewatering etc. for the pits of manholes, laying of pipes and fittings/specials shall be done in accordance with Employer's Requirements described elsewhere in the document.

Bed Concrete:

The bed concrete for manholes shall be done in accordance with Employer's Requirements described elsewhere in the document.

Bricks:

Bricks to be used for construction of manholes shall conform to the relevant Indian Standards. They shall be sound, hard, and homogeneous in texture, well burnt in kiln without being vitrified, table moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing ungrounded particles and/or which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 50 kg/sq.cm. Unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in IS: 1077.

The size of the brick shall be 23.0 x 11.5 x 7.5 cm. unless otherwise specified; but tolerance upto ± 3 mm in each direction shall be permitted. Only full size brick shall

be used for masonry work. Brick bats shall be used only with the permission of Employer's Representative to make up required wall length or for bonding. Sample bricks shall be submitted to the Employer's Representative for approval and bricks supplied shall conform to approved samples. If required by the Employer's Representative, brick sample shall be tested as per IS : 3495 by Contractor. Bricks rejected by the Employer's Representative shall be removed from the Site within 24 hours.

Cement Mortar:

Mortar for brick masonry shall be prepared as per IS: 2250. Manholes shall be constructed in brick masonry with cement mortar (1:2) unless otherwise specified. Gauge boxes for sand shall be of such dimensions that one bag containing 50 kg. of cement forms one unit. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be as approved by the Employer's Representative. If required by the Employer's Representative Sand shall be thoroughly washed till it is free of any contamination.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry conditions. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

The Contractor shall arrange for tests on mortar samples if so required by Employer's Representative. Retendering of mortar shall not be permitted.

Brick Masonry:

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work of manholes shall be in the proportion specified in 5.15.5. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 115 mm thick brick work shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb and square unless otherwise shown on drawing and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be leveled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes unless otherwise specified. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 degrees. But in no case the level difference between adjoining walls shall exceed 1.25 M. Workmanship shall conform to IS: 2212.

Brick shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plastering to be done. When plastering is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If mortar in the lower courses has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid.

Cement Plaster:

All joints in masonry shall be raked to a depth of 12 mm with hooked tool made for the purpose when the mortar is still green and in any case within 48 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

The proportion of the cement mortar shall be as approved on relevant drawings. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as

per relevant I.S. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to remain for more than 25 minutes after mixing with water.

Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

Plastering shall be done on both faces of brick masonry in cement mortar (1:2) and 20 mm thick unless otherwise specified.

Plastering work shall be carried out in two layers, the first layer being 14 mm thick and the second layer being 6 mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise approved by the Employer's Representative.

Cement Concrete Channel:

The channel for the manhole shall be constructed in cement concrete of M15 grade. Both sides of the channel shall be taken up to the level of the crown of the outgoing sewer. They shall be benched up in concrete and rendered in cement mortar (1:1) of 20 mm thickness and formed to a slope of 1 in 12 towards the channel.

Pipe Entering or Leaving Manhole:

Whenever a pipe enters or leaves a manhole, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks.

Cast Iron Steps:

Cast iron steps shall be as per IS: 5455. The steps shall be of grey cast iron of grade 15 as per IS: 210. The steps shall be clean, well cast and they shall be free from air and sand holes, cold shuts and warping. The portion of the step which projects from the wall of the manhole shall have a raised chequered design to provide an adequate non-slip grip. C.I. steps shall weigh not less than 4.5 kg each and shall be of 150 mm x 375 mm overall dimensions. These steps shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when

exposed to a temperature of 63 degrees C and shall not be brittle as to chip off at temperature of 0 degree C.

Where the depth of invert of manhole exceeds 800 mm, cast iron steps of approved pattern shall be fixed in the brick work at the interval of 300 mm vertically and staggered at 380 mm horizontally centre to centre. In case of pipe diameter greater than 600 mm, box type C.I. steps weighing 19 kg each shall be provided at 300 mm vertically in channel of manhole.

Frame and Covers:

Frame and covers for manholes shall be of required type and dimensions as per the relevant drawings prepared by the Contractor. Following information shall be clearly marked on each cover.

- i. Year of manufacture,
- ii. Identification mark of the Employer: PROJECT DIRECTOR AND CHIEF ENGINEER.
- iii. Arrow showing direction of flow.

(a) Cast Iron Frame and Cover:

The cast iron frame and cover shall be of grey cast iron as per IS: 1726. The general requirements for casting and coating of CI frame and cover shall be as specified for CI steps in Clause 5.15.10. The covers shall have a raised chequered design to provide an adequate non-slip grip. The rise of the chequered shall not be less than 4 mm. The locking device for the cover shall be provided as approved by the Employer's Representative. The CI covers for the load test shall be selected at one for every lot of fifty or part thereof for each type and size manufactured and as approved by the Employer's Representative. The frame shall be fixed in cement concrete of M15 grade all round and finished with neat cement. The manhole frame shall have 560 mm diameter clear opening and shall weigh not less than 208 kg. Including cover. In case of rectangular CI frame and cover of 900 mm x 600 mm clear opening, the total weight shall not be less than 275 kg. In case of scraper manhole the frame shall have clear opening of 1200 mm x 900 mm and shall weigh not less than 900 kg including cover. The manhole cover and frame shall be painted with three coats of anti-corrosive paint after fixing in position.

(b) Fiber Reinforced Concrete Frame and Cover:

Fiber reinforced concrete frame and cover shall be capable of withstanding load of

35 tonnes. The frame shall be fixed in cement concrete of M15 grade all around and finished with neat cement. The fiber reinforced frame shall have clear opening of 560 mm diameter and weighing 102 kg. The cover shall have a minimum thickness of 100 mm and weighing 78 kg. The fiber shall constitute 1% of the weight of the concrete in the form of 50 mm to 100 mm long high tensile steel wires. For the cover, MS sheet lapping of 18 gauge shall be provided to avoid damage to the edges. Similarly for frame, MS angle/flat shall be provided along the edge. Both MS sheet and angle shall be painted with black bituminous paint. The cover should have suitable lifting arrangement. The fiber reinforced frame and cover shall be manufactured as approved.

(c) **Reinforced Cement Concrete Frame and Cover:**

Reinforced cement concrete frame and cover for manholes shall be of required dimensions and shape as shown on the drawing prepared by the Contractor. The frame and cover shall be cast in cement concrete of M25 grade. Minimum cover to the reinforcement shall be 40 mm. The edges of frame and covers shall be provided with mild steel angles to avoid damages to the corners. These angles shall be painted with black bituminous paint. The covers should have suitable lifting arrangement.

Drop Manhole:

When a sewer connects a main sewer, and where the difference in level between water line (peak flow levels) of main line and the invert level of branch lines is more than 600 mm or a drop of more than 600 mm is required to be given in the same sewer line and it is uneconomical or impractical to arrange the connection within 600 mm, a drop connection shall be provided for which a manhole shall be constructed as per relevant drawing, incorporating a vertical drop pipe from the higher sewer to the lower one. This pipe shall be provided outside the shaft and encased in concrete. A continuation of the branch sewer should be built through the shaft wall to form a rodding and inspection eye, which should be provided with a half blank flange. The diameter of the back drop should be at least as large as that of the incoming pipe. The drop pipe should terminate at its lower end with a plain or duck-foot bend turned so as to discharge its flow at 45 degrees or less to the direction of the flow in the main sewer. The pipe unless of cast iron should be surrounded with 150 mm thick concrete.

In the case of sewers over 450 mm in diameter the drop in level may be

accomplished by one of the following approved methods:

- (a) A cascade;
- (b) A ramp;
- (c) By drops in previous manholes.

RCC Manhole:

M25 grade of concrete used for construction of RCC manhole shall have minimum cement content of 360 kg/cum of concrete. Minimum cover to the reinforcement shall be 50 mm.

Vent Shafts:

(a) General:

Vent shafts shall be erected at such places as approved by the Employer's Representative.

(b) Mild Steel Vent Shaft:

Mild steel vent shaft shall be of 150 mm diameter and 12.17 m height from ground level with C.I. ornamental cap. This shall be fixed firmly and encased in cement concrete of M15 grade as shown on relevant drawing with necessary mild steel bolts, plates etc. for foundation. The vent shaft shall be painted with one coat of silver paint over one coat of red lead oxide paint. The vent shaft shall be connected to manhole by 150 mm diameter glazed stoneware pipe encased by M10 concrete of 150 mm thickness all around as approved by the Employer's Representative.

(c) RCC Vent Shaft:

Reinforced cement concrete vent shaft shall be of M25 grade concrete, 200 mm diameter at bottom and tapered to 100 mm diameter at top (both inside clear openings) and 6 m height from ground level. The vent shaft shall be embedded in concrete of M10 grade and anchored by 2 nos. of 16 mm diameter and 600 mm long MS bars. The vent shaft shall be connected to manhole as specified in (b) above through a brick masonry flue chamber.

Miscellaneous:

If any damage is caused to the other services such as water supply pipeline, sewer, cable, etc. during the construction of manholes and erection of vent shafts, the Contractor shall be held responsible for the same and shall replace the damaged services to the full satisfaction of the Employer's Representative.

SPECIFICATIONS

SECTION -7:

EARTHWORK

SECTION -7:

EARTHWORK

Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

IS 3764 - 1992	Excavation work - Code of Safety.
IS 2720	Methods of test for soils:
(Part-1) - 1983	Part 1 Preparation of dry soil samples for various tests.
(Part-2) - 1986	Part 2 Determination of Water Content.
(Part-4) - 1985	Part 4 Grain size analysis.
(Part-5) - 1985	Part 5 Determination of liquid and plastic limit.
(Part-7) - 1980	Part 7 Determination of water content - dry density relation using light compaction.
(Part-9) - 1971	Part 9 Determination of dry density - moisture by constant weight of soil method.
(Part-14) - 1983	Part 14 Determination of density index (relative density) of cohesion less soils.
(Part-22) - 1978	Part 22 Determination of organic matter.
(Part-26) - 1987	Part 26 Determination of pH Value.
(Part-27) - 1987	Part 27 Determination of total soluble sulphates.
(Part-28) - 1974	Part 28 Determination of dry density of soils in place by the sand replacement method.
(Part-33) - 1971	Part 33 Determination of the density in place by the ring and water replacement method.
(Part-34) - 1972	Part 34 Determination of density of soil in place by rubber balloon method.
(Part-38) - 1976	Part 38 Compaction control test (Hilf Method).

General:

The Contractor shall furnish all tools, plant, instruments, qualified supervisory

personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Employer's Requirements.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and leveling the same so as to provide natural drainage. Rock/soil & murrum excavated shall be stacked properly as approved by the Employer's Representative. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately. Top soil shall be stock piled separately for later re-use.

Clearing:

The area to be excavated / filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Employer's Representative. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

Excavation:

All excavation work shall be carried out by mechanical equipment unless, in the opinion of Employer's Representative, the work involved requires it to be carried out by manual methods.

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings provided by the Contractor or such other lines and grades as may be agreed with the Employer's Representative. Rough

excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care.

Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Employer's Representative. The final excavation should be carried out just prior to laying the blinding course.

To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the drawings provided by the Contractor as agreed with the Employer's Representative. Should any excavation be taken below the specified elevations, the Contractor shall fill it up with concrete of the same class as in the foundation resting thereon, up to the required elevation at no cost to the Employer.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Employer's Representative shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

Rock:

General:

'Rock' means a natural aggregate of mineral crystals, which for its excavation would normally require the use of heavy pneumatic/hydraulic breaker and/or cutting equipment or explosives. The term shall exclude any material that can be removed by ordinary excavating machinery and which in any individual mass has a volume not exceeding 1m³ or 0.25m³ where the net width of excavation is less than 2 m. Ordinary excavating machinery means a hydraulic back hoe with rated output of 50 kW or less.

Before classification of material as rock the Contractor shall demonstrate to the satisfaction of the Employer's Representative his inability to excavate it without resort to heavy percussion tools complete with rock bits, hydraulic wedges or blasting. Excavation by the use of explosive will not normally be permitted except for pipeline.

Material shall not be classified as rock unless the Employer's Representative has agreed to such classification on the basis of such a demonstration before its excavation. Excavations where rock has been encountered and classified as such shall not be backfilled before examination of the excavated faces by the Employer's Representative to enable the extent of the rock excavation to be determined.

Excavation by the Use of Explosives

Unless otherwise stated herein, I.S. Specification "IS: 4081: Safety Code for Blasting and related Drilling Operations" shall be followed. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines specified for the excavation, in the soundest possible condition. The quantity and strength of explosives used shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Employer's Representative, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Employer's Representative at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

The contractor shall obtain a valid Blasting License from the authorities concerned. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done; and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as far possible from the area to be blasted. Employer's Representative's prior approval shall be taken for the location proposed for the magazine.

In no case shall blasting be allowed closer than 30 meters to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.

For blasting operations, the following points shall be observed.

- i) Contractor shall employ a competent and experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.

- ii) Before any blasting is carried out, Contractor shall intimate Employer's representative and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.
- iii) Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200 m radius from the firing point, at least 15 minutes before firing time by sounding warning whistle. The area shall also be given a warning by sounding a distinguishing whistle.
- iv) The blasting of rock near any existing buildings, equipment or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by MS plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Employer's Representative; a trench shall have to be cut by chiseling prior to the blasting operation, separating the area under blasting from the existing structures.
- v) The firing shall be supervised by a Supervisor and not more than 6 (six) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.
- vi) A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming, which may consist of sand or stone dust or similar inert material.
- vii) Contractor shall preferably detonate the explosives electrically.
- viii) The explosives shall be exploded by means of a primer, which shall be fired by detonating a fuse instantaneous detonator (F.I.D) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.
- ix) In dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatin with detonator and fuse wire may be used. Underwater or for excavation in rock with substantial accumulated seepage electric detonation shall be used.
- x) Holes for charging explosives shall be drilled with pneumatic drills, the

drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.

- xi) When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level.

Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by Employer's Representative, with concrete of strength not less than M10. Stopping in rock excavation shall be done by hand trimming.

- xii) Contractor shall be responsible for any accident to workmen, public or Employer's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of explosives, or any other Authority duly constituted under the State and / or Union Government as applicable at the place of excavation.

Stripping Loose Rock:

All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Employer's Representative, to fall or otherwise endanger the workmen, equipment, or the work shall be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion, which was originally sound and safe.

Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Employer's Representative, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed.

Classification of Strata:

The decision regarding, classification of strata shall rest with the Engineer in charge and his decision shall be final and binding to the contractor.

All the materials encountered in the excavation shall be classified as under: -

ORDINARY SOIL AND SOFT MURRUM:

These will include all materials of an earthy or sandy nature, which can be easily ploughed or small shingle, and gravel, which can be easily removed.

HARD MURRUM:

This shall include all kinds of disintegrated rock or shale or inundated clay which can be removed with a shovel without difficulty and which do not require blasting.

SOFT ROCK:

This shall include all materials which is rock or hard conglomerate, all decomposed and whether rock, highly fissured rock old masonry and also soft rock boulders bigger than 1/2 cubic meter and other varieties of rock. Which do not require blasting and which can be removed with the pie crowbars wedges and hammer.

HARD ROCK:

This shall include rocks, occurring in masses, which could best be removed by chiseling or by blasting.

Fill, Backfilling and Site Grading:**General:**

All fill material shall be subject to the Employer's Representative's approval. If any material is rejected by Employer's Representative, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Employer's Representative after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Employer's Representative.

Material:

To the extent available, selected surplus spoil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material.

All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murrum or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Employer's Representative. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Topsoil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer's Representative. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

Filling in pits and trenches around foundations of structures, walls, etc.

As soon as the work in foundations has been accepted and measured, the spaces

around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Employer's Representative. Earth shall be ramming with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Employer's Representative is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Employer's Representative.

Plinth Filling:

Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 15cm, watered and compacted with mechanical compaction machines. The Employer's Representative may, however, permit manual compaction by hand tampers where he is satisfied that mechanical compaction is not possible. The finished level of the filling shall be trimmed to the level/slope specified.

The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300mm. The Contractor will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used and the approval of the Employer's Representative obtained prior to commencing filling.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated, then filled and consolidated.

Sand Filling in Plinth and Other Places:

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer's Representative has inspected and approved the fill.

Filling in Trenches:

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated taking due care so that no damage is caused to the pipes.

Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the center line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of

the center line of the pipes shall be done with selected earth by hand compaction, or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling up to a level 30 cm above the top of the pipe shall be done with fine materials such as earth, murrum, etc. The filling up to the level of the centerline of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centerline of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

General Site Grading:

Site grading shall be carried out as indicated in the drawings and as approved by the Employer's Representative. Excavation shall be carried out as specified in the Employer's Requirements. Filling and compaction shall be carried out as specified under Clause 2.7 and elsewhere unless otherwise indicated below.

If no compaction is called for, the fill may be deposited to the full height in one operation and leveled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and leveled uniformly and compacted as indicated in Clause 2.7 before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.

The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way, the Contractor shall remove the affected material and make good.

If so specified, the rock as obtained from excavation may be used for filling and leveling to indicate grades without further breaking. In such an event, filling shall be done in layers not exceeding 50cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded

so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12-ton roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

Fill Density:

The compaction, under the plant road area and building plinths shall comply with minimum 95% compaction by Standard Proctor at moisture content differing not more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by **field and laboratory tests that the specified density has been obtained.** In other areas the soil should be backfilled and compacted suitably as specified by the Engineer.

Timber Shoring:

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 cm x 4 cm sections or as approved by the Employer's Representative. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 meter spacing, strutted with bullies or as approved by the Employer's Representative. The length of the bully struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by the Employer's Representative. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

Timber shoring may also be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer's Representative.

The withdrawal of the timber shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Concrete or masonry shall not be damaged during the removal of the

timber.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm x 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacing shall be subject to the approval of the Employer's Representative. In all other respects, the Employer's Requirements for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

Dewatering:

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction planning. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Employer's Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer's Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Employer's Representative. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a buildup of water in the opinion of the Employer's Representative obstructs the progress of the work, leads to unsanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled

is considered in the opinion of Employer's Representative, to be large, a well point system- single stage or multistage, shall be adopted. The Contractor shall submit to the Employer's Representative, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

Rain Water Drainage:

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Employer's Representative.

***GENERAL TECHNICAL
SPECIFICATIONS
FOR
BUILDING WORKS***

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GENERAL TECHNICAL SPECIFICATIONS FOR BUILDING WORKS

GENERAL:

1. In the specifications "as directed" / "approved" shall be taken to mean "as directed" / "approved by the Engineer-in-Charge".
2. Wherever a reference to any Indian Standard appears in the specifications, it shall be taken to mean as a reference to the latest edition of the same in force on the date of agreement.
3. In "Mode of Measurement" in the specifications wherever a dispute arises in the absence of specific mention of a particular point of aspect the provisions on these particular points, or aspects in the relevant Indian Standards shall be referred to
4. All measurements and computations, unless otherwise specified, shall be carried out nearest to the following limits:

(i)	Length, width and depth (height)	0.01	meter
(ii)	Areas	0.01	Sq.Mt.
(iii)	Cubic Contents	0.01	Cu.Mt.

In recording dimensions of work the sequence of length, width and height (depth) or thickness shall be followed.
5. The distance which constitutes lead shall be determined along the shortest practical route and note necessarily the route actually taken The decision of the Engineer-in-charge in this regard shall be taken as final.
6. Where no lead is specific, it shall mean "all leads"
7. Lift shall be measured from plinth level.
8. Up to "floor two level" means actual height of floor (Maxi 4 M) up to 3 Mt. above plinth level.
9. Definite particulars covered in the items of work, though not mentioned or elucidated in its specifications shall be deemed to be included therein.
10. Reference to specifications of materials as made in the detailed specification of the items of works is in the form of a designation containing them under the specification of the material and prefix 'M' e.g. 'M-5',
11. Approval to the samples of various materials given by the Engineer-in-charge shall not absolve the contractor from the responsibility of replacing defective material brought on site or materials used in the work found defective at a later date. The contractor shall have no claim to any payment or compensation whatsoever on account of any such materials being rejected by the Engineer-in-charge.
12. The contract rate of the item of work shall be for the work completed in all aspects.
13. No collection of materials shall be made before it is got approved from the Engineer-in-charge.
14. Collection of approved materials shall be done at site of work in a systematic manner. Materials shall be stored in such a manner as to prevent damage, deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work
15. Materials, if and when rejected by the Engineer-in-charge, shall be immediately removed from the site of work.
16. No materials shall be stored prior to, during and after execution of a structure in such a way as to cause or lead to damage or overloading of the various components of the structure.
17. All works shall be carried out in a workmanlike manner as per the best techniques for the particular item.
18. All tools, templates, machinery and equipment for correct execution of the work as well as for checking lines, levels, alignment of the works during execution shall be kept in sufficient numbers and in good working condition on the site of the work.
19. The mode, procedure and manner of execution shall be such that it does not cause damage or over-loading of the various components of the structure during execution or after completion of the structure.
20. Special modes of construction not adopted in general Engineering practice if proposed to be adopted by the Contractor, shall be considered only if the contractor provides satisfactory evidence that such special mode

Of construction is safe, sound and helps in speedy construction and Completion of work to the required strength and quality. Acceptance of the same by the Engineer-in-Charge shall not, however absolve the contractor of the responsibility of any adverse effects and consequences of adopting the same in the course of execution of completion of the work.

21. All installations pertaining to water supply and fixtures there of as well as drainage lines and sanitary fittings shall be deemed to be completed only after giving satisfactory tests by the contractor.
22. The contractor shall be responsible for observing the rules and regulations imposed under the "Minor Minerals Act", and such of the laws and rules prescribed by Government from to time.
23. All necessary safety measures and precautions (including those laid down in the various relevant Indian Standards) shall be taken to ensure to ensure the safety of men. Materials and machinery on the works as also of the work itself.
24. The testing charges of all materials shall be borne by the Contractor.
25. Approval to any of the executed items for the work does not in any relieve the contractor of his responsibility for the correctness, soundness and strength of the structure as per the drawings and specifications

GENERAL**STANDARD TECHNICAL SPECIFICATIONS**

Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable specification
1		25		49	
2		26		50	
3		27		51	
4		28		52	
5		29		53	
6		30		54	
7		31		55	
8		32		56	
9		33		57	
10		34		58	
11		35		59	
12		36		60	
13		37		61	
14		38		62	
15		39		63	
16		40		64	
17		41		65	
18		42		66	
19		43		67	
20		44		68	
21		45		69	
22		46		70	
23		47		71	
24		48		72	

Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable Specification	Sr. No. of the item in the Schedule 'B' of tender	Sr. No. of applicable specification
73		99		125	
74		100		126	
75		101		127	
76		102		128	
77		103		129	
78		104		130	
79		105		131	
80		106		132	
81		107		133	
82		108		134	
83		109		135	
84		110		136	
85		111		137	
86		112		138	
87		113		139	
88		114		140	
89		115		141	
90		116		142	
91		117		143	
92		118		144	
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95		121		147	
96		122		148	
97		123		149	
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SPECIFICATIONS OF MATERIALS

M-1. Water

1.1. Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standard specified in I.S. 456-1978.

1.2. If required by the Engineer-in-Charge it shall be tested by comparison with distilled water Comparison shall be made by means of standard cement tests for soundness time of setting and mortar strength as specified in I.S. 269-1976. Any indication of unsoundness change in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength, of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

1.3. Water for curing mortar, concrete or masonry should not be too acidic or too alkaline .

It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces

1.4. Hard and bitter water shall not be used for curing

1.5. Potable water will generally found suitable for curing mortar or concrete.

M-2. Lime

2.1. Lime shall be hydraulic lime as per I.S. 712-1973 Necessary tests shall be carried out as per I.S. 6932 (Parts I to X) 1973

2.2. The following field tests for limes are to be earned out:

(1) A very rough idea can be formed about the type of lime by its visual examination i.e. fat lime bears pure white colour, lime in form of porous lumps of dirty white colour indicates quick lime, and solid lumps are the un burnt lime stone.

(2) Acid tests for determining the carbonate content in lime Excessive amount of impurities and rough determination of class of lime.

2.3. Storage shall comply with J.S. 712-1973 The slaked lime, if stored, shall be kept in a weather proof and damp-proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged" in any way shall be rejected and all rejected materials shall be removed from site of work.

2.4. Field testing shall be done according to I.S 1624-1974 to show the acceptability of materials.

M-3. Cement

3.1. Cement snail be ordinary Portland slag cement as per I.S.269-1976 or Portland slag cement as per I.S. 455-1976

M-4. White Cement

4.1. The white cement shall conform to I S. 8042-E-1978.,

M-5. Coloured Cement

5.1. Coloured cement shall be with white of grey Portland cement as specified in the item of the work.

5.2. The pigments used for coloured cement shall be of approved quality and shall not exceed 10% of cement used in the mix. The mixture of pigment add cement shall be properly ground to have a uniform colour and shade. The pigments shall have such properties to provide for durability underexposure to sunlight and weather.

5.3. The pigment shall have the property such that it is neither affected by the cement nor detrimental to it

M-6 Sand

6.1. Sand shall be natural sand, clean, well graded hard strong, durable and gritty particles free from injurious amounts of dust, clay kankar nodules, soft or flaky particles shale, alkali salts organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-Charge. The sand shall not contain more contain more than 8 percent of silt as determined by field test, if necessary the sand shall

be washed to make it clean.

6.2. Coarse Sand :The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse shall be as under.

I.S. Designation	Sieve passing sieve	Percentage by weight Designation	I.S. Sieve Percentage by weight passing Sieve
4.75 mm	100	600 micron	30 - 100
2.36 mm	90 to 100	300 micron	50 - 70
1.18 mm	70 to 100	150 micron	0 - 50

6.3. Fine Sand :

The fineness modulus shall not exceed 1.0 The sieve analysis of fine sand shall be as under.

I.S. Designation	Percentage by weight Sieve passing	I.S. Designation	Percentage by weight Sieve passing
4.75 mm	100	600 micron	40 - 85
2.36 mm	100	300 micron	5 - 50
1.18 mm	75 to 100	150 micron	0 - 10

M-7. Stone Dust

7.1. This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under :

7.2. A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm. mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

7.3. The height of silt, visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

7.4. The fineness modules of stone dust shall not be less than 1.80

M-8. Stone Grit

8.1. Grit shall consist of crushed or broken stone and be hard, strong, dense, durable, clean of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar Grit shall generally be cubical in shape and as far as possible flakey elongated pieces shall be avoided. It shall generally comply with the provisions of I.S. 383-1970. Unless special stone of particular quarries is mentioned grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer-in-charge. The grit shall have no deleterious with cement.

8.2. The grit shall conform to the following gradation as per sieve analysis :

I.S. sieve designation	Percentage by weight	I.S. Sieve designation	Percentage by weight
12,50 mm	100 %	4.75 mm	0-20%
1000 mm	85 - 100%	2.36 mm	0-25%

8.3. The crushing strength of grit will be such as to allow the concrete in which it used to build-up the specified strength of concrete

8.4. The necessary tests for grit shall be carried out as per the requirements of I.S.2386- (parts-I to VIII) 1963, as per instructions of the Engineer-in-charge. The necessity of test will be decided by the Engineer-in-charge.

M-9. Cinder

9.1. Cinder is will burnt furnace residue which has been fused or sintered into lumps of varying sizes

9.2. Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only It shall be sound clean and free from clay dirt, ash or other deleterious matter

9.3. The average grading for cinder aggregates shall be as mentioned below .

I.S. Designation	Percentage by weight Sieve passing	I.S. Designation	Percentage by weight Sieve passing
20 mm	100	4.75 mm	70
10 mm	86	2.36 mm	52

M-10. Lime Mortar

10.1. Lime : Lime shall conform to specification M-2, Water : Water shall conform to specification M-1 and Sand: Sand shall conform to specification M-6

10.2. Proportion of Mix:

10.2.1. mortar shall consist of such proportions of slaked lime and sand as may be specified in item The slaked lime and sand shall be measured by volume

10.3. Preparation of mortar;

10.3.1. Lime mortar shall be prepared by wet process as per I S 1625-1971 .Power driven mill shall be used for preparation of lime mortar. The slaked lime shall be placed in the mill in an even layer and ground for 180 revolutions with a sufficient water. Water shall be added as required during grinding (care being taken not to add more water) that will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.

10.4. Storage:

10.4.1. Mortar shall always be kept damp, protected from sun and rain till used up, covering it by tarpaulin or open sheds.

10.5. Use:

10.5.1. All mortar shall be used as soon as possible after grinding. It should be used on the day on which it prepared, But in no case mortar made earlier than 36 hours shall be permitted for use.

M-11. Cement Mortar

11.1. Water shall conform to specification M-1, Cement : Cement shall conform to specifications M-3 and Sand : Sand shall conform to M-6

11.2. Proportion of Mix

11.2.1. Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes, the proportion of cement will be by volume on the basis of 50 Kg/Bag of cement being equal to 0.0342 Cu.m. The mortar may be hand mixed or machine mixed as directed.

11.3. Proportion of Mortar :

11.3.1. In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed

11.3.2. The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes

M-12. Stone Coarse Aggregate For Nominal Mix Concrete

12.1. coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar

12.2. The aggregate shall generally be cubical in shape Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall generally be as per the table given below.

However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6- mm. less than the cover whichever is smaller.

I.S. Sieve Designation	Percentage passing for single Sized aggregates of Nominal size			I.S. Sieve Designation	Percentage passing for single Sized aggregates of Nominal size		
	40 mm	20 mm	16 mm		40 mm	20 mm	16 mm
80 mm	-	-	-	12.5 mm	-	-	-
63 mm	100	-	-	10 mm	05	0.20	0.30
40 mm	85-100	100	-	4.75 mm	-	0.5	0.5
20 mm	0.20	85-100	100	2.35 mm	-	-	-
16 mm	85-100						

Note : This percentage may be varied some what by the Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

12.3. The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests, indicated in I.S. 383-1970 and 456-197f shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If she aggregates are covered with dust, they shall be washed with water to make them clean. .

M-13. Black Trap or Equivalent Hard Stone Coarse

13.1. Aggregate For Design Mix Concrete . Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

13.2. The aggregates shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed, from the best, black trap or equivalent hard stones as approved, Aggregate shall have no deleterious with cement

13.3. The necessary tests indicated in I S. 383-1970 and I.S.456-1978 shall have to be carried out to ensure the acceptability of the material.

13.4. If aggregate is covered with dust it shall be washed with water to make it clean.

M-14. Brick Bats Aggregate

14.1. Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense bricks. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40 mm - 50 mm. size unless otherwise specified in the item The under burnt or over burnt brick bats shall not be allowed.

14.2. The brick bats shall be measured by suitable boxes or as directed.

M-15. Bricks

15.1. The bricks shall be hand or machine molded and made from suitable soils and kiln burnt. They shall be free from cracks and flaws and nodules of free lime they shall have smooth rectangular faces with sharp corners and shall be of uniform colour.

The bricks shall be- moulded with a frog of 100 mm. x 40 mm. and 10 mm. to 20 mm. deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 600 mm.

15.2. The size of modular bricks shall be 190 mm.x 90 mm.x 90 mm.

15.3. The size of the conventional bricks shall be as under :

(9" x 4.3/8" x 2,3/4") 225 x 110 x 75 mm.

15.4. Only bricks of one standard size shall be used on one work. The following tolerances shall be permitted in the conventional size adopted in a particular work.

Length \pm 1/8" (3.0 mm.) Width \pm 1/16" (1.50 mm.) Height \pm 1/16" (1.50 mm.)

15.5. The crushing strength of the bricks shall not be less than 35 Kg/Sq. Cm. The average water absorption shall not be more the 20 percent by weight Necessary tests for crushing strength and water

absorption etc. shall be carried out as per I.S. 3495 (Part-I to IV) - 1976

M-16. Stone

16.1. The stone shall be of the specified variety such as Granite/Trap Stone/ Quartzite or any other type of good hard stones. The stones shall be only from the approved quarry and shall be hard sound, durable and free from defects like cavities, cracks, sand holes, flaws injurious veins, patches of loose or soft materials etc., and weathered portions and other structural defects Or imperfections tending to affect their soundness and strength. The stone with round surface shall not be used. The percentage of water absorption shall not be more than 5% of dry weight. When tested in accordance with I.S. 1124-1974. The minimum crushing strength of stone shall be 200 Kg/Sq. Cm. unless otherwise, specified

16.2. The samples of the stone to be used shall be got approved before the work is started

16.3. The Khanki facing stone shall be dressed by chisel as specified in the item for khanki facing in required shape and size. The face of the stone shall be-so dressed that the bushing on the exposed face shall not project by more than 40 mm. from the general wall surface and on face to be plastered it shall not project by more than 19 mm. nor shall it have depressions more than 10 mm. from the average wall surface

M-17. Laterite Stone

17.1. Laterite stone shall be obtained from the approved quarry it shall be compacted in texture sound, durable and free from soft patch. It shall have minimum crushing strength of 100 Kg/Sq. Cm. in its dry condition. It shall not absorb water more than 20% of its own weight, when immersed for 24 hours in water. After quarrying, the stone shall be allowed to weather for some time before using in work.

17.2. The stone shall be dressed into regular rectangular blocks so that all faces are free from waviness and unevenness, and the edges true and square

17.3. Those types of stone in which white clay occurs should not be used

17.4. Special corner stones shall be provided where so directed.

M-18. Mild Steel Bars

18.1. Mild steel bars reinforcement for R.C C. work shall conform to I.S. 432 (Part -II) 1966 and shall be of tested quality. It shall also comply with relevant part of I.S. 456-1978.

18.2. All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose or thick rust at the time of placing

18.3. For the purpose of payment, the bar shall be measured correct up to 10 mm. length and weight payable worked out at the rate specified below :

1.	6 mm	0.22 Kg/Rmt.	8.	20 mm.	2.47 Kg/Rmt
2.	8 mm.	0.39 Kg/Rmt.	9	22 mm.	2.98 Kg/Rmt.
3.	10 mm.	0.62 Kg/Rmt.	10.	25 mm.	3.85 Kg/Rmt.
4.	12 mm.	0.89 Kg/Rmt.	11.	28 mm.	4.83 Kg/Rmt.
5.	14 mm	1.21 Kg/Rmt.	12.	32 mm.	6.31 Kg/Rmt.
6.	16 mm	1.58 Kg/Rmt	13.	36 mm.	7.99 Kg/Rmt. *
7.	18 mm.	2.00 Kg/Rmt.	14.	40 mm.	9.86 Kg/Rmt.

M-19. High Yield Strength Steel Deformed Bars

19.1. High yield strength steel deformed bars shall be either cold twisted other rolled and shall conform to I.S. 1786-1966 and I.S. 1139-1966 respectively.

19.2. Other provisions and requirements shall conform to specification No. M-18 for Mild Steel Bars.

M-20. High Tensile Steel Wires

20.1. The high tensile wires for use in pre stressed concrete work shall conform to I.S.2090-1962.

20.2. The tensile strength of the high tensile steel bars shall be as specified in the item. In absence of the given strength the minimum strength shall be taken as per Para 6-1 of the I.S. 1785-1962. Testing shall be done as per I.S. requirements.

20.3. The high tensile steel shall be free from loose mill scale, rust, oil, grease, or any other harmful matter. Cleaning of steel bars may be carried out by immersion in solvent solution, wire brushing or passing through

a pressure box containing Carborundum.

20.4. The high tensile wire shall be obtained from manufacturers. in coils having diameter not less than 350 times the diameter of wire itself so that wire springs back straight on being uncoiled .

M-21. Mild Steel Binding Wire

21.1. The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 to 18 gauge) diameter and shall conform to I.S. 280-1972.

21.2. The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust oil paint, grease loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar

M-22. Structural Steel

22.1. All structural Steel shall conform to I S. 226-1985: The steel shall be free from the defects mentioned in I.S 226-1975 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. River bars shall conform to I.S. 1148-1973.

22.2. When the steel is supplied by the Contractor test certificate of the manufacturers shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

M-23. Galvanised Iron Sheets

23.1. The galvanised iron sheets shall be plain or corrugated sheets of gauges as specified in item The G.I. Sheets shall conform to I.S.277-1977. The sheets shall be undamaged in carnage and handling either by rubbing off of zinc coating or otherwise. They shall have clean and bright surface and shall be free from dents, bends, holes, rust or white powdery deposit.

23.2. The length and width of G.I. sheets shall be as directed as per site condition.

M-23.A :G.I. Valleys gutter, ridges

23.A.1. The G.I. ridges and hips shall be of plain galvanised sheets Class - 3 of the thickness as specified in item. These shall be 600 mm. in width and properly bent up to shape without damage to the sheets in process of bending.

23.A.2. Valleys gutters and flashings shall also be of galvanised sheet of thickness as specified in item Valleys Shall be 900 mm. wide overall and flashing shall be 380 mm. wide overall They shall be bent to the required shape without damage to the sheet in the process of bending.

M-24. Asbestos Cement Sheets

24.1. Asbestos cement sheets plain, corrugated of semi-corrugated shall conform to I.S.459-1970 The thickness of the sheets shall be as specified in the item. The sheets shall be free from all defects such as cracks, holes, deformities chipped edges or otherwise damaged.

24.2. Ridges & Hips :

24.2.1. Ridges and hips shall be of same thickness as that of A.C. sheets. The types, of ridges shall be suitable for the type of sheets and location.

24.2.2. Other accessories to be used in roof such as flashing pieces eaves filler pieces, valley gutters, north light, and ventilator curves, barge boards etc, shall be of standard manufacture and shall be suitable for the type of sheets and location.

M-25. Mangalore Pattern Roof Tiles

25.1. The mangalore pattern tiles shall conform to I S 654-1972 for Class AA or Class A type as specified in item. Samples of the tiles to be provided shall be got approved from the Engineer-in-charge. Necessary tests shall be carried out as directed.

M-26. Shuttering

26.1. The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel lining or of steel plates stiffened by steel angles The shuttering shall be supported on battens and beams and props of vertical bullies properly cross braced together so as to make the centering rigid. In places of bullies props, brick pillar of adequate section built in mud mortar may be used

26.2. The form work shall be sufficiently strong and shall have camber so that it assumes correct shape after deposition of the concrete and shall be able to resist forces caused by vibration of live load of men working over it and other incidental loads associated with it. The shuttering shall have smooth and even

surface and its joints shall permit leakage of cement grout

26.3. If at any stage of work during or after placing concrete in the structure, the form work sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work. The complete form work shall be got inspected by and got approved from the Engineer-in-charge, before the reinforcement bars are placed in position.

26.4. The props shall consist of bullies having 100 mm minimum diameter measured at mid length and 80 mm. at thin end shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm. thick and minimum bearing area of 0-10 sq m laid on sufficiently hard base.

26.5. Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.

26.6. The timber used in shuttering shall not be so dry as to absorb water from concrete and swell or bulge nor so green or wet as to shrink after erection. The timber shall be properly sawn and planed on the sides and the surface coming in contact with concrete. Wooden form work with metal sheet lining or steel plates stiffened by steel angles shall be permitted.

26.7. As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.

26.8. The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of raw linseed oil or oil of approved manufacture may be applied in place of soap solution. In case of steel shuttering either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black or burnt oil shall be permitted.

26.9. The shuttering for beams and slabs shall have camber of 4 mm per meter (1 in 250) or as directed by the Engineer-in-charge so as to offset the subsequent deflection. For cantilevers, the camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-charge.

M- 27. Expansion Joints - Permoulded filler

27.1. The item provides for expansion joints in R.C.C. frame structures for internal joints, as well as exposed joints, with the use of premoulded bituminous joint filler.

27.2. Premoulded bituminous joints filler i.e. performed strip of expansion joints filler shall not get deformed, or broken by twisting bending or other handling when exposed to atmospheric condition. Pieces of joints filler that have been damaged shall be rejected.

27.3. Thickness of the per-moulded joints filler shall be 25 mm. unless otherwise specified.

27.4. Premoulded bituminous joints filler shall conform to I S 1838-1961

M-28. Expansion joints-Copper strips & hold .fasts

28.1. The item provide for expansion joints in R.C.C. frame structure for internal joints, as well as exposed joints, with the use of premoulded bituminous joints filler.

28.2. Copper sheet shall be of 1.25 mm. width and or 1 25 mm. width and the " U " shape in the middle. Copper strip shall have holdfast of 3 m.m diameter copper rod fixed to the plate soldered on strip at intervals of about 30 cm or as shown in the drawing or as directed. The width of each flange (horizontal side) of the copper plate Jo be embedded in the concrete work shall be 25 mm depth of "U" to be provided in the expansion joint, in the copper plate shall be of 25 mm.

M-29. Teak wood

29.1. The teak wood shall be of good quality as required for the item to be executed. When the kind of wood is not specifically mentioned, good Indian teak wood as approved shall be used.

29.2. Teak wood shall generally be free from large, loose dead or cluster knots, flaws, shakes, warps, twists, bends or any other defects. It shall generally be uniform in substance and of straight fibers as far as possible. It shall be free from rot decay, harmful fungi and other defects of harmful nature which will affect the strength, durability or its usefulness for the purpose for which it is required. The colour shall be uniform as far as possible. Any effort like painting using any adhesive materials made to hide the defects shall render the pieces liable to rejection by the Engineer-in-charge.

29.3. All scantlings, planks etc., shall be sawn in straight lines and planes in the direction of grains and of uniform thickness.

29.4. The tolerances-in the dimensions shall be allowed at the rate of 1.5 mm. per face to be planed.

29.5. First class teak wood

29.5.1. First class teak wood shall have no individual hard and-sound knots, more than 6 sq. cm. in size and the aggregate area of such knots shall not be more than 1% of area of piece, The timber shall be closed grained.

29.6. Second Class Teak Wood:

29.6.1. No individual hard and sound knots shall be more than 15 sq. cms. in size and aggregates area of such knots shall be not exceed 2% of the area of piece.

M-29. A Non-teak wood:

The non-teak wood shall be chemically treated, seasoned as per I.S. Specifications and of good quality. The type of wood shall be got approved before collecting the same on site Fabrication of wooden members shall be started only after approval.

For this purpose wood of Bio, Kalai, Sires. Saded, Behda, Jamun, Sisoo will be used for door where as only Kalai. Sires, Halda. Kalam etc. will be permitted for shutters after proper seasoning and chemical treatment.

The non-teak wood shall be free from large loose dead of cluster knots, flows, shakes, warps, bends or any other defects, It shall be uniform in substance and of straight fibers as far as possible It shall be free fro rots, decay, harmful fungi and other defects of nature which will effect the strength, durability or its usefulness for the purpose for which it is required. The colour of wood shall be uniform as far as possible. The scantlings planks etc. shall be saw in straight lines and planes in the direction of grain and of uniform thickness. The department will use the Agency to produce certificate from Forest Department in event of dispute and the decision of the Department shall be final and binding to the contractor. The tolerance in the dimension shall be allowed at 1.5 mm. per face to be planed.

M-30. Wooden flush door shutters (solid core)

30.1. The solid core type flush door shutters shall be of decorative or non-decorative type as specified in the drawing. The size and thickness of the shutter shall be as specified in drawings or as directed. The timber species for core shall be used as per I.S.2202 (part -I) 1980. The timber shall be free from decay and insect attack Knots and knot holes less than half the width of cross-section of the members in which they occur may be permitted. Pitch pockets, pitch streaks and harmless pin holes shall be permissible except in the exposed edges of the core members. The commercial plywood, cross-bands shall conform to I.S. 303-1275

30.2. The face-panel of the shutters shall be formed by gluing by the hot press process on both faces of the core with either plywood or cross-bands and face veneers. The¹ hopping, rebating. opening of glazing, venation etc., shall be provided if specified in the drawing.

30.3. All edges of the door shutters shall be square. The shutters shall be free from twist or warp in its plane. Both faces of the shutters shall be sand papered to smooth even texture.

30.4. The shutters shall be tested for-

(1) End immersion test: The test shall be carried out as per I.S.2202 (part-1) 1980 There shall be no delamination at the end of the test.

(2) Knife Test : The face panel when tested in accordance with I.S 1659-1979 shall pass the test.

(3) Glue adhesion test : The flush door shall be tested for glue adhesive test in accordance with I S 2202 (part -I) 1980. The shutters shall be considered to have passed the test, if no delamination occurs in the glue lines in the plywood and if no single determination more than 80 mm in length and more than 3 mm in depth has occurred in the assembly glue lines between the plywood face and the style and rail. Delamination at the corner shall be measured continuously around the corner Delamination at the knots, knot hole and other permissible wood defectects shall not be considered in assessing the sample.

30.5. The tolerance in size of scud core type flush door shall-be as under :

In Nominal thickness ± 1.2 mm. In Nominal height ± 3 m

30.6. The thickness of the shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any points.

M-31. Aluminum doors, windows, ventilators

31.1. Aluminum alloy used in the manufacture of extruded window sections shall conform to I.S. designation HEA-WP of I.S. 733-1975 and also to I.S. Designation WVG-WP of I.S 1285-1975 The section shall be as specified in the drawing and design. The fabrication shall be done as directed

31.2. The hinges shall be cast or extruded aluminum hinges of same type as in window but of larger size.

31.3. The hinges shall normally be of 50 mm. projecting type. Non-projecting type of hinges may also be used if directed. The handles of door shall be of specified design A suitable lock for the door Operable either from outside or inside shall be provided. In double shutter door, the first closing shutter shall have concealed aluminum alloy bolt at top and bottom.

M-32. Rolling Shutters

32.1. The rolling shutters shall conform to I.S.6248-1979 Rolling shutters shall be supplied of specified type with accessories. The size of the rolling shutters shall be specified in the drawings. The shutters shall be specified in the drawings. The shutters shall be constructed with interlocking lath sections formed from cold rolled steel strips not less than 0.9 mm. thick and 80 mm. wide for shutters up to 3.5 m .width not less than 1.25 mm. thick and 80 mm wide for shutters 3.5 m. in width and above unless otherwise specified.

32.2. Guide channels shall be of mild steel deep channel section and of rolled pressed or built up (fabricated) joint less construction The thickness of sheet used shall not be less than 3 15 mm.

32.3. Hood covers shall be made of M S. Sheets not less than 0.90 mm. thick. For shutters having width 3.5 Meter and above, the thickness of M.S. sheet for the hood cover shall be not less than 1 25 mm.

32.4. The spring shall be of best quality and shall be manufactured from tested high tensile spring steel wire of strip of adequate strength to balance the shutters in all position. The spring pipe shaft etc . shall be supported on strong M S of malleable C I. brackets. The brackets shall be fixed on or under the lintel as specified with-raw! plugs and screws bolts etc.

32.5. The rolling shutters shall be of self rolling up to 8 Sq. m. clear area without ball bearing and up to 12 Sq.m. clear area with ball bearing. If the rolling shutters are of larger, then gear operated type shutters shall be used.

32.6. The locking arrangement shall be provided at the bottom of shutter at both ends The shutters shall be opened from outside.

32.7. The Shutters shall be completed with door suspension shafts, looking arrangements, pulling hooks, handles and other accessories.

M-33. Collapsible Steel Gate

33.1. The collapsible steel gate shall be in one or two leaves and size as per approved drawings or as specified. The gate shall be fabricated from best quality mild steel channels, flats etc. Either steel pulleys or ball-bearings shall be provided in every double channel Unless otherwise specified the particulars of collapsible gate shall be as under.

(a) Pickets : These shall be of 20 mm. M.S. channels of heavy sections unless otherwise shown on drawings. The distance centre to centre of pickets shall be 12 cms .with an opening or 10 Cms

(b) Pivoted M.S. flats shall be 20 mm x6 mm

(c) Top and bottom guides shall be from tee of flat iron of approved size.

(d) The fittings like stoppers fixing, locking cleats, brass handles and cast iron rollers shall be of approved design and size

M-34. Welded Steel Wire Fabric

34.1 Welded steel wire fabric for general purpose shall be manufactured form cold drawn steel wire "as drawn" or galvenised steel conforming to I.S. 226-1975 with longitudinal and transverse wire securely connected at every intersection by a process of electrical resistance welding and conforming to I.S.4948-1974. it shall be fabricated and finished in workmanlike manner and shall be free from injurious defects and shall be rust proof The type of mesh shall be oblong or square as directed The mesh sizes and sizes if wire for square 3b well as oblong welded steel wire fabric shall be as directed The steel wire fabric in panels shall be in one whole piece in each panel as far as stock sizes permit.

M-35 Expanded Metal Sheets

35.1. The expanded metal sheets shall he free from flaws joints broken strands laminations and other harmful surface defects. Expanded metal steel sheet shall confirm to IS-412-1975. except that blank sheets need not be with guaranteed mechanical properties The size of the diamond mesh of expanded metal and dimensions of strands (width and thickness) shall be as specified. The tolerance on nominal weight of expanded metal sheets shall be of ± 10 percent.

35.2. Expanded metal in panels shall be in one whole piece in each panel as far as stock sizes permit. The expanded metal sheets shall be coated with suitable protective coating to prevent corrosion.

M-36. Mild Steel Wire (Wire Gauze Jali)

36.1. Mild steel wire may be galvanized as indicated. All finished steel wire shall be well cleanly drawn to the

dimensions and size of wire as specified in item. The wire shall be sound free from splits surface flaws, rough jagged and imperfect edges and other harmful surface defects and shall conform to I.S. 280-1978.

M-37. Plywood

37.1. The plywood for general purpose shall conform I.S. 303-17-1975.

Plywood is made by cementing together than boards or starts of wood into panels. There are always an odd number of layers, 3,5,7,9, ply etc. The piles are placed so that grain of each layer is at right angles to the grain in the adjacent level.

37.2. The chief advantages of plywood a single board of the same thickness is the more uniform strength of the plywood, along the length and width of the plywood and greater resistance to cracking and splitting with charge in moisture content.

37.3. Usually synthetic resins are used to gluing, phenolic resins are usually cured in a hot press which compresses and simultaneously heats the plies between hot plates which maintain a temperature of 90 degree C to 140 degree C and a pressure of 11 to 14 Kg/ Sq. Cm on the wood. The time of heating may be anything from 2 to 60 minutes depending upon thickness

37.4. When water glue are used the wood absorbs so much water that the finished plywood must be dried carefully. When synthetic resins are used as adhesive the finished plywood must be exposed to an atmosphere of controlled humidity until the proper amount of moisture has been absorbed.

37.5. According to I.S. 303-1975 the plywood for general purpose shall be of the grades namely BWR, WWR and CWR depending up to the adhesives used for bonding the veneers and it will be further classified into six types namely AA, AB, AC, BB, BC and CC based on the quality of the two faces each face being of three kinds namely A, Band C After pressing, the finished plywood should be reconditioned to a moisture content not less than 8 percent and not more than 16 percent.

37.6. Thickness of plywood Boards.

TABLE

Board	Thickness	Board	Thickness	Board	Thickness	Board	Thickness
3 ply.	3 mm.	5 ply.	5 mm.	7 ply.	9 mm.	9 ply.	16 mm
	4 mm.		6 mm.		13 mm.		19 mm.
	5 mm.		7 mm.		16 mm.	11 ply.	19 mm.
	6 mm.		8 mm.	9 ply.	13 mm.		25 mm.

M-38. Glass

38.1. All glass shall be of the brief quality, free from specks, bubbles, smokes veins, air holes blisters and other defects. The kind of glass to be used shall be as mentioned in the item or specification or in the special provision or as shown in detailed drawings. Thickness of glass panes shall be uniform. The specifications for different kinds of glass shall be as under.

38.2. Sheet Glass

38.2.1. In absence of any specified thickness or weight in the item or detailed specifications of the item of work, sheet glass shall be weighing 7.5 Kg/Sq. m for panes up to 600 mm x 600 mm.

38.2.2. For panes larger than 600 mm x 600 mm and up to 800 mm x 800 mm the glass weighing not less than 8.75 Kg/Sq m shall be used For bigger panes up to 900 mm x 900 mm. glass weighing not less

than 8.75 Kg/Sq. m shall be used. For bigger panes up to 900 mm x 900 mm. glass weighting not less than 11.25 Kg/Sq. m. shall be used

38.2.3. Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to I.S. 1761-1960. Sheet glass of the specified colours shall be used, if so shown, on detailed drawings or so specified For important buildings and for panes with any dimension over 900 mm plate glass of specified thickness shall be used

38.3. Plate Glass:

38.3.1. When plate glass is specified it shall be "polished patent plate glass" of best quality It shall have both the surface ground flat and parallel and polished to obtain clear undisturbed vision and reflection The plate glass shall be of the thickness mentioned in the item or as shown in the detailed drawing or as specified. In absence of any specified thickness, the thickness of plate glass to be supplied shall be 6 mm. and a tolerance of 0.20 mm shall be admissible

38.4. Obscured Glass:

38.4.1. This type of glass transmits light so that vision is partially or almost completely obscured. Glass shall be plain rolled, figured, ribbed or fluted, or frosted glass as may be specified as required. The thickness and type of glass shall be as per details on drawings or as specified or as directed

38.5. Wired Glass:

38.5.1. Glass shall be with wire netting embedded in a sheet of planet glass. Electrically welded 13 mm Georgian square mesh shall be used Thickness of glass shall not be less than 6 mm Wired glass shall be of type and thickness as specified

M-39. Acrylic Sheets

39.1. Acrylic sheets shall be of thickness as specified in the item and of an specified shape and size as the case may be panels may be flat or curved It should be light in weight it shall be colourless or coloured or opaque as specified in the item. Colourless sheet shall be as transparent as the finest optical glass. Its light transmission rate shall be about 95% Transparency shall not be affected for the sheets of larger thicken, it shall be extremely resistant to sunlight weather and low temperatures.

It shall not sow any significant yellowing or change in physical properties or loss of light transmission over a longer period of use. The sheet shall be impact resistant also Sheets should be of such quality that they can be cut, bent jointed as desired Solution for the joints shall be used as per the requirement of manufacturer.

M-40. Particle board

40.1. The particle boards used for face panels shall of best quality free from any defects. "I he particle boards shall be made with phenolmaldehyde adhesive The particle boards shall conform I S 3087-1905" Specification for wood particle board for general purpose" The size and the thickness shall be as indicated.

M-41. Expanded polystyrene or framed styroper slabs

41.1. The expanded polystyrene ceiling boards and tiles shall be of approved make and shall be of sizes, thickness, finish and colour as indicated. It shall be of high density and suitable for use as insulating material. The insulating material shall be like slabs of Thermocole etc.

M-42. Resin bonded fiber glass.

42.1. The resin bonded fiber glass tiles or roils shall be of approved make and shall be of sizes. thickness, and finish as indicated.

42.2. For test of Mineral wool thermal insulation [Blanket I S 3144-1965 shall be followed

42.3. Insulation wool blanks shall be with the following coverings on one or both sides as indicated

- (1) Bituminous Hessian Kraft paper suitable for use in position where moisture has to be excluded.
- (2) Hessian cloth or Kraft paper for keeping out dust
- (3) G.I wire netting, suitable for surfaces to be plaster over

M-43. Fixtures and fastenings

43.1. General:

43.1.1. The fixtures and fastenings, that is butt hinges tee and strap hinges sliding door bolts, tower bolts, door latch, bath-room latch, handles door stoppers, casement window fasteners, casement

stays and ventilators catch shall be made of the metal as specified in the item or its specification.

43.1.2. They shall be of iron, brass, aluminum chromium plated iron, chromium plated brass, copper oxidised iron, copper oxidised brass or anodised aluminum as specified

43.1.3. The fixtures shall be heavy medium or light type. The fixtures and fastenings shall be smooth finished and shall be such as will ensue ease of operations.

43.1.4. The samples of fixtures and fastenings shall be got approved as regards, quality and shape before providing them in position

43.1.5. Brass and anodised aluminium fixtures and fastenings shall be bright finished

43.2. Holdfasts:

43.2.1. Holdfasts shall be made from mild steel flat 30 cm length and one of the holdfasts shall be bent at right angle and two nos of 6 mm. diameter holes, shall be made in it for fixing it to the frame with screws. At the other end, the holdfast shall be forked and bent at right angles in opposite directions

43.3. Butt hinges:

43.3.1. Railway standard heavy type butt hinges shall be used when so specified

43.3.2. Tee and strap hinges shall be manufactured from M S Sheet

43.4. Siding door bolts (Aldrops):

43.4.1. The aldrops as specified in the item shall be used and shall be got approved.

43.5. Tower bolts (Barrel Type):

43.5.1. Tower bolts as specified in the item shall be used and shall be got approved

43.6. Door Latch:

43.6.1. The size of door latch shall be taken as the length of latch.

43.7. Bathroom Latch:

43.7.1. Bathroom latch shall be similar to tower bolt.

43.8. Handle:

The size of the handles shall be determined by the inside grip length of the handles. Handles shall have a base plate of length 50 mm. more than the size" of the handle.

43.9. Door Catch:

43.9.1. Door stoppers shall be either floor door stopper type or door catch type Floor stopper shall be of overall size as specified and shall have a rubber cushion.

43.10. Door Stoppers:

43.10.1. Door catch shall be fixed at a height to about 900 mm from the floor level such that one part of the catch is fitted on the inside of the shutter and the other part is fixed in the wall with necessary wooden plug arrangements for appropriate fixity The catch shall be fixed 20 mm inside the face of the door for easy operation of catch.

43.11. Wooden Door Stop with hinges:

43.11.1. Wooden door stop of size 100 mm x GO mm x 40 mm shall be fixed on the door frame with a hinges of 75 mm. size and at a height of 900 mm. from the floor level The wooden door stop shall be provided with 3 coats of approved oil paint

43.12. Casement Window Fastener:

43.12.1. Casement window fastener for single leaf window shutter shall be left or right handed as directed

43.13. Casement stays (Straight Red Stay):

43.13.1. The stays shall be made from a channel section having three holes at appropriate position so that the window can be opened either fully or partially as directed. Size of the stay shall be 250 mm to 300 mm. as directed.

43.14. Ventilator Catch:

43.14.1. The pattern and shape of the catch shall be as approved

43.15. Pivot:

43.15.1. The base and socket plate shall be made from minimum 3 mm. thick plate; and projected pivot shall not be less than 12 mm 'diameter and 12 mm. length and shall be firmly riveted to the base plate in

case of iron pivot and in single piece plate in the case of brass pivot.

M-44. Paints:

44.1. (A) Oil paints :

44.1.1. Oil paints shall be of the specified colour and as approved. The ready mixed paints shall only be used. However, if ready mixed paint of specified shade or tint is not available white ready mixed paint with approved stainer will be allowed. In such a case the contractor shall ensure that the shade of the paint so allowed shall be uniform.

44.1.2. All the paints shall meet with the following general requirements

(i) Paint shall not show excessive setting in a freshly opened full can and shall easily be ready spread with a paddle to a smooth homogeneous state. The paint shall show no curdling, levering, caking or colour separation and shall be free from lumps and skins

(ii) The paint as received shall brush easily, possess good leveling properties and show no running or sagging tendencies

(iii) The paint shall not skin within 48 hours in a three quarters filled closed container

(iv) The paint shall dry to a smooth uniform finish free from roughness, grit, unevenness and other imperfections

44.1.3. Ready mixed paint shall be used exactly as received from the manufacturers and generally according to their instructions and without any admixtures whatsoever

44.2. (B) Enamel paints:

44.2.1. The enamel paint shall satisfy in general requirements in specification of oil paints, Enamel paint shall conform to I.S. 2933-1975.

M-45. French Polish

45.1. The French polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials:

(i) Denatured spirit of approved quality (ii) Chandras (iii) Pigment.

45.2. The French polish so prepared shall conform to I S : 348-1 9C8.

M-46. Marble chips for marble mosaic terrazzo

46.1. The marble chips shall be of approved quality and shades. It shall be hard, sound, dense and homogeneous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering.

46.2. The size of various colours of marble chips ranging from the smallest up to 20 mm shall be used where the thickness of top wearing layer is 6 mm. The marble chips of approved quality and colours only as per grading as decided by the Engineer-in-charge shall be used for marble mosaic tiles or works

46.3. The marble chips shall be machine crushed. They shall be free from foreign matter, dust etc. Except as above, the chips shall conform to I S 2114-1962

M-47. Flooring Tiles

47.1. (A) Plain Cement tiles;

47.1.1. The plain cement tiles shall be of general purpose type. These are the tiles in the manufacture of which no pigments are used. Cement used in the manufacture of tiles shall be as per Indian Standards.

47.1.2. The tiles shall be manufactured from a mixture of cement and natural aggregates by pressure process. During manufacture the tiles shall be subjected to pressure of not less than 140 Kg/Sq. Cm. The proportion of cement to aggregate in the backing of the tiles shall be not less than 1 .3 by weight. The wearing face, through the tiles are of plain cement, shall be provided with stone chips of 1 to 2 mm. size. The proportions of cement to aggregate in the wearing layer of the tiles shall be three parts of cement to one parts chips by weight. The minimum thickness of wearing layer shall be 3 mm. The colour and texture of wearing layer shall be uniform throughout its face and thickness. On removal from mould, the tiles shall be kept in moist condition continuously at least for seven days and subsequently, if necessary, for such long period as would ensure their conformity to requirements of I.S.1237-1980 regarding strength resistance to wear and water absorption.

47.1.3 The wearing face of the tiles shall be plane, free from projections, depressions and cracks and shall be reasonably parallel to the back face of the tile. All angles shall be right angle and all edges shall be sharp and true.

47.1.4. The size of tiles generally be square shapes 24.85 Cm x24.85 Cm. or 25 Cm x 25 Cm The thickness of tiles shall be 20 mm.

47.1.5. Tolerance of length and breadth shall be plus or minus one millimeter Tolerance on thickness shall be plus 5mm.

47.1.6. The tiles shall satisfy the tests as regards transverse strength, resistance to wear and water absorption as per I.S 1237-1980.

47.2. (B) Plain Coloured Tiles:

47.2.1. The tiles shall have the same specification as for plain cement tiles as per (A) above expect that they shall have a plain wearing surface wherein pigments are used. They shall conform it I.S. 1237-1980.

47.2.2. The pigments used for colouring cement shall not exceed 10 percent by weight of cement used in the mix. The pigments, synthetic or otherwise, used for colouring tiles shall have permanent colour and shall not contain materials detrimental to concrete

47.2.3 The colour of the tiles shall be specified in the item or as directed

47.3. (C) Marble mosaic tiles:

47.3.1. These tiles have same specification as per plain cement tiles except the requirements as stated below

47.3.2. The marble mosaic tiles shall conform to I.S 1237-1980. The wearing face of the tiles shall be mechanically ground and filled. The wearing face of tiles shall be free from projections depressions and cracks and shall be reasonably parallel to the back face of the tiles. All angles shall be right angles and all edges shall be sharp and true.

47.3.3. Chips used in the tiles be from smallest up to 20 mm. size. The minimum thickness of wearing layer of tiles shall be 6 mm. For pattern of chips to be had on the wearing face, a few samples with or without their full size photographs as directed shall be approved by the Engineer-in-charge, for approval.

47.3.4. Any particular samples if found suitable shall be approved by the Engineer-in-charge, or he may ask for a few more samples to be presented The samples shall have to be made by the contractor till a suitable sample is finally approved for use in the work. The Contractor shall ensure that the tiles supplied for, the work shall be in conformity with the approved sample only, in terms of its dimensions, thickness of backing layer and wearing surface, materials, ingredients, colour, shade, chips, distribution etc. required.

47.3.5. The tiles shall be prepared from cement conforming to Indian Standards or coloured port land cement generally depending upon the colour of tiles to be used or as directed.

47.4. (D) Chequered Tiles :

47.4.1. Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per (A) above and the latter as per marble mosaic tiles as per (C) except as mentioned below

47.4.2. The tiles shall be of nominal size of 250 mm. x 250 mm. or as specified. The centre to centre distance of chequer shall not be less than 25 mm. and not more than 50 mm. The overall thickness of the tile shall be 22 mm

47.4.3. The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be plain coloured or mosaic as specified The thickness of the upper layer measured from the top of the chequers shall not be less than 6 mm. The tiles shall be given the first grinding with machine before delivery to site

47.4.4. Tiles shall conform or relevant I.S 1237-1980. 47.5.

(E) Chequered Tiles For Stair Cases :

47.5.1. The requirements of these tiles shall be the same as chequered tiles as per (D) above except in following respects :

(1) The length of a tile including nosing shall be 300 mm (2) The minimum thickness shall be 28 mm (3) The nosing shall have also the same wearing layer as at the top. (4) The nosing edge shall be rounded (5) The front portion of the tile for a minimum length of 75 mm. from and including the nosing shall have grooves running parallel to nosing and at centers not exceeding 25 mm Beyond that the tiles shall have normal chequer pattern.

M-48. Rough Kotah Storm

48.1. The Kotah stones shall be hard even, sound, and regular in shape and generally uniform in colour. The colour of the stone shall generally be green Brown coloured shall not be allowed for use They shall be without any soft veins, cranks of flaws.

48.2. The size of the stones to be used for flooring shall be of size 600 mm x 600 mm and/or size 600 mm. x 450 mm as directed However smaller sizes will be allowed to be used to the extent of maintaining required pattern. Thickness shall be as specified

48.3. The edges of minus 30 mm on accounts of chisel dressing of edges shall be permitted for length as well as breadth. Tolerance in thickness shall be ± 3 mm

48.4. The edges of stones shall be truly chiseled and table rubbed with coarse sand before paving. All angles and edges of the stones of shall be true, square and free from chipping and surface shall De true and plain

48.5. When machine cut edges are specified, the exposed and the edges at joints shall be machine cut The thickness of the exposed machine cut edges shall be uniform

M-49. Polished Kotah Stoics

49.1. Polished kotah stone shall have the same specification as per rough kotah stone except as mentioned below

49.2. The stones shall have machine polished surface. When brought on site, the stones-shall be single polished or double polished depending upon its use. The stones for paving shall generally be single polished The stones to be used for dedo, skirting, sink, veneering, sills steps etc. where machine polishing after the stones are fixed in situ is not possible shall be double polished

M-50. Dholpur Stone Slab

50.1. Dholpur stone slab shall be of best quality as approve by the Engineer-m-charge The stone slab shall be without my veins, cracks, and flaws The stone slab shall be even sound and durable regular in snaps and of uniform colour

50.2. The size of the stone shall be as specified in the item or detailed drawing or as approved by the Engineer-in-charge The thickness of the stone shall be as specified in the item of work with the permissible tolerance of plus or minus 2 mm. The provision in respect of .polishing as for polished kotah stone shall apply to polished Dholpur stone also. All angles and edges of the face of the stone slab shall be fine chiseled or polished as specified in the item of work and all the four edges shall be machine cut All angles and edges of the stone slab shall be true and plane

50.3. The sample of stone shall be got approved by the Engineer-in-charge for a particular work It shall be ensured' that the stones to be used in a particular work shall not differ much in shade or tint from the approved sample

M-51. Marble Slab

51.1. Marble slab shall be white or of other and of best quality as approved by the Engineer-in-charge

51.2. Slabs shall be hard, close, uniform and homogeneous in texture. They shall have even crystalline gram and free from defects and cracks. The surface shall be machine polished to an even and perfect plane surface and edges machine cut true and square. The rear f ice shall be rough to provide key for the mortar

51.3. Marble slabs with natural veins, if selected shall have to be laid as per the pattern given by the Engineer-in-charge. Size of the slab shall be minimum 460 mm x450 mm and preferably 600 mm 'x 600 mm. However, smaller sizes will be allowed to be used of the extent of maintaining required pattern.

51.4. The slab shall not be thinner than the specified thickness at its thinnest part. A few specimen of finished slab to be used shall be deposited by the Contractor in the office for reference

51.5. Except as above the marble slabs shall conform to I.S. 1130-1969

M-52. Granite Stone slab

52.1. Granite shad be of approved colour and quality. The stone shall be hard, even sound and regular in shape and generally uniform in colour. It shall be without any soft veins, cracks of flaws

52.2. The thickness of the stone shall be specified in items

52.3. AH exposed faces shall be double polished to tender truly smooth and even reflecting surface. The

exposed edges and corners shall be rounded off as directed The exposed edges shall be machine cut and shall have uniform thickness.

M-53. P.V.C. Flooring

53.1. P.V.C. sheets for P.V.C., floor covering shall be of homogenous flexible type conforming to I S 3462-1966. The P.V.C. covering shall neither develop any toxic effect while put to use nor shall give off any disagreeable odour.

53.2. Thickness of flexible type covering tiles shall be as specified in the description of the item

53.3. The flexible type shall be backed with Hessian or other woven fabric The following tolerances shall be applicable on the nominal dimensions of the rolls or tiles :

(a) Thickness ± 015 mm.

(b) Length or Width

(1)	300 mm. Square tiles	± 0.20 mm.	(3)	900 mm Square tiles	± 0.60 mm.
(2)	600 mm. Square tiles	± 0.40 mm.	(4)	Sheets and roll	± 0.10 percent.

53.4. Adhesive:

53.4.1. The adhesive for PVC flooring shall be of the type and make recommended by the manufactures of PVC sheets/tiles.

M-54. Facing Tiles

54.1. The facing tiles (burnt clay facing bricks) shall be free from cracks, and nodules of free lime. They shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right angled faces. The texture of the finished surface that will be exposed when in place shall conform to an approved sample consisting not less than for stretcher bricks each representing the texture desired. The facing tiles shall have a pleasing appearance, sufficient resistance to penetration by ram and greater durability than common bricks. The tiles shall conform to I.S. 2691-1972.

54.2. The standard size of facing brick tiles shall be 19 x 9 x 4 cms. The facing brick tiles shall be provided with frog which shall conform to I.S. 11077-1976.

54.3. The permissible tolerance in dimensions specified above shall be as follows:

Size	Tolerance for	
	1st Class Brick	2nd Class Brick
19 cm.	± 6 mm.	± 10 mm.
9 cm.	± 3 mm.	± 7 mm.
4 cm.	± 1.5 mm.	± 3 mm.

The tolerance for distortion or warpage of face or edges of individual brick from a plane surface and from a straight line respectively shall be as follows:

Facing dimensions	Permissible tolerance
Max. below 19 cms.	Max. 2.5 mm.
-do- above 19 cms.	Max. 3.0 mm.

54.5. The average compressive strength obtained as a sample of five tiles when tested in accordance with the procedure laid as per I S 1077-1976 shall be not less than 175 Kg/Sq Cm. The average compressive strength of any individual bricks shall be not less than 160 Kg / Sq.Cm.

54.6. The average water absorption for five bricks tiles shall not exceed 12 percent of average weight of brick before testing. The absorption for each individual bricks shall not exceed 25 percent.

54.7. The brick tiles when tested in accordance with I.S. 1077-1976, the rate of efflorescence shall not be more than "Slightly effloresced"

M-55. White glazed tiles

55.1. The tiles shall be of best quality as approved by the Engineer-in-charge. They shall be flat and true to shape They shall be free from cracks, crazing sports chipper) edges and corners. The glazing shall be of uniform shade.

55.2. The tiles shall be nominal size of 150 mm x 150 mm unless otherwise, specified. The maximum

variation the stated sizes other than the thickness of tile shall be plus or minus 1.5 mm. The thickness of tile shall be 6 mm. Except as above the tiles shall conform to I.S. 1977-19/0

M-56. Galvanised iron pipes and fittings

56.1. Galvanised iron pipes shall be of the medium type and of required diameter and shall comply with I.S. 1239-1979. The specified diameter of the pipes shall refer to the inside diameter of the bore. Clamps, screw and all galvanised iron fittings shall be of the standard 'R' or equivalent make

M-57. Bib cock and stop cock

57.1. A bib cock is a draw off tap with a horizontal inlet and free outlet A stop cock is a valve with suitable means of connection for insertion in a pipe line for controlling or stopping the flow

57.2. They shall be of screw down type and of brass chromium plated and of diameter as specified in the description of the item. They shall conform to I.S. 781-1977 and they shall be of best Indian make. They shall be polished bright.

57.3. The minimum finished weight of bib cock and stop cock shall be as given below

Diameter	Bib cock	Stop cock	Diameter	Bib cock	Stop cock
8 mm	0.25 kg.	0.25 kg.	15 mm	0.40 kg.	0.40 kg.
10 mm	0.30 kg.	0.35 kg.	20 mm	0.75 kg.	0.75 kg.

M-58. Gun metal wheel valve

58.1. The gun metal wheel valve shall be of approved quality. These shall be of gun metal fitted with wheel and shall be of gate valve opening full way and of the size specified. These shall conform to I.S. 778-1971.

M-59. White glazed porcelain wash basin

59.1. Wash basin shall be of white porcelain first quality best Indian make and it shall conform to I.S. 2556 (Part -IV) -1972 and I.S. 771-1979. The size of the wash basin shall be as specified in item. Wash basin shall be of one piece construction with continued over flow arrangements All internal angles shall be designed so as to facilitate cleaning. Wash basin shall have single tap hole as specified. Each basin shall have a circular waste hole which is either riveted or beveled internally with 65 mm. diameter at top and 10 mm. depth to suit the waste fitting. The necessary stud slot to receive the bracket on the under side of the basin shall be provided Basin shall have an internal soap holder which shall fully drain into the bowl.

59.2. White glazed pedestal of the quality and colour as that the basin shall be provided where specified in the item. It shall be completely recessed at the back for reception of supply and wash pipe. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor to top of the rim of basin 750 mm. to 800 mm. as directed.

M-60. European type water closet/with low flushing

60.1. The European type water closet shall be white glazed porcelain first quality and shall be of wash down type conforming to I.S. 2556-1973 and I.S. 771-1979

60.2. 'S' trap shall be provided as required with water seal not than 50 mm. The solid plastic seat and cover shall be of best Indian make conforming to I.S 2548-1980. They shall be made of moulded synthetic materials which shall be tough and hard with high resistance to solvents and shall be free from blisters and surface defects and shall have chromium plated brass hinges and rubber buffer of suitable size.

M-61. Orrissa type water closet

61.1. The Specification of Orrissa type white glazed water closet of first quality shall conform to I.S. 2256 (Part-III) -1981 and relevant specification of Indian type water closet except that pan will be with the integral squatting pan of size 580 mm x 400 mm with raised footrest.

M-62. Indian type water closet

62.1. The Indian type white glazed water closet of first quality shall be of size as specified in the item and conforming to I.S. 771-1979 and I.S. 2556 – (Part-II) 1981. Each pan shall have integral flushing. It shall

also have an inlet at back or front for connecting flush pipes as directed. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and surface shall be uniform and smooth. Pan shall be provided with 100 mm. diameter 'P' or 'S' trap with approximately 50 mm. Water seal and 50 mm. diameter vent horn.

M-62. A. Foot Rests

62.A.1. A pair of whit glazed earthen ware rectangular foot to minimum size 250 mm.x 130 mm. x 20 mm shall be provided with the water closet.

M-63. Glazed Earthen Ware Sink

63.1. The glazed earthen-ware sink shall be of specified size, colour and quality. The sink shall conform, to I.S. 771 part – II – 1979. The brackets for sinks shall conform to I.S 775-1970

63.2. The pipes shall conform to I.S. 1239-part-I 1973 and I.S. 404-1962. for steel and lead pipes respectively. 32 mm. brass waste coupling of standard pattern with brass chain and rubble plug shall be provided with sink.

M-64. Glazed earthen-ware Lipped type flat back urinal/corner type urinal

64.1. The lipped type urinal shall be fiat back or corner type as specified in the item and shall conform to I.S 771-1979. It shall be of best Indian make and size as specified and approved by the Engineer-in-charge. The flat back of corner type urinal must be of 1st quality free from any defects, cracks etc.

M-65. Low level Enamel flushing tank

65.1. The low level enamel flushing tank shall be of 15 liters capacity. It shall conform of I S 774-1971. The flushing cistern shall be of best quality and free from any defects. The flushing tank shall have outlet 32 mm. diameter. The outlet shall be connected with W.C. pan by lead pipe or P.V.C. pipe as specified. The flushing tank shall be provided with inlet and outlet for fixing G.I. inlet pipes and over-flow pipes. The flushing cistern shall be provided with chromium plated handle for flushing The flushing tank shall be provided with bracket of cast iron so that it can be fixed on wall at specified height. The brackets shall conform to I.S. 775-1970.

M-66. Cast iron flushing cistern.

66.1. The cast iron flushing cistern shall be of 15 liters capacity. It shall conform to I.S. 774-1971. The flushing cistern shall be of best quality free from any defects. The flushing cistern shall have outlet of 32 mm diameter. The lead pipe shall conform to I.S 404 (Part-I) - 1962; For fixing G.I. inlet pipes and overflow pipe 20 mm. dia. inlet and outlet shall be provided The flushing cistern shall be provided with galvanised iron chain and pull of sufficient length and shall be got approved from the Engineer-in-charge. The cast iron flushing cistern shall be painted with one coat of anticorrosive paint and two coats of paints The flushing cistern shall be fixed on two C I brackets The C I brackets shall conform to I S 775-1970.

M-67. Flush cock.

67.1. Half turn flush cock (Heavy weight) shall be of gun metal chromium plated of diameter as specified in the description of the item. The flush cock shall conform to relevant Indian Standard.

M-68. Cast iron pipes and fittings.

68.1. All soil water, vent and anti syphonage pipes and fitting shall conform to I S.1729-1964. The pipes shall have spigot and socket ends with head on spigot end. The pipes and fitting shall be true to shape smooth, cylindrical, their inner and outer surfaces being as nearly as practicable concentric. They shall be sound and nicely cast and shall be free from cracks, laps, pinholes or there imperfection and shall be neatly dressed and carefully fettled.

68.2. The end of pipes and fittings shall be reasonable square to their axis.

68.3. The sand of cast iron pipes shall be of the diameter as specified in the description and shall be in lengths of 1.5 M., 1.8 M. including socket ends of the pipe unless shorter lengths are either specified or required at junctions etc. The pipes and fittings shall be supplied without ears unless specified or directed otherwise.

68.4. Tolerances :

68.4.1. The Standard weights and thickness of pipes shall be as shown in the following table
A tolerance up to minus 10 per cent may however be -allowed against these standard weights

Sr. No.	Nominal dia. of bore	Thickness	Overall		
			Weight of pipe 1.5 m. long	Weight of pipe 1.8 m long	Weight of pipe 2.m long
1.	75 mm.	5.0 mm.	12.38 Kg.	16.52 Kg.	18.37 Kg.
2	100. mm.	5.0 mm.	18.14 Kg.	21.67 Kg.	24.15 Kg.

68.4.2. A tolerance up to minus 15 percent in thickness and 20 mm. length will be allowed For fittings tolerance in lengths shall be plus 25 mm. and minus 10 mm.

68.4.3. The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The tolerance in weights and thickness shall be the same as for straight pipes.

M-69. Nahni Trap

69.1. Nahni trap shall be of cast iron and shall be sound and free from porosity or other defects which affect serviceability The thickness of the base metal shall not be less than 6.5 mm The surface shall be smooth and free .form craze, chips and other flaws or any other kind of defects which affect serviceability The size of nahni trap shall be specified and shall be of self cleaning design.

69.2. The Nahni trap shall be of-quality approved by the Engineer-in-charge and shall generally conform to the relevant Indian Standards.

69.3. The Nahni trap provide shall be with deep seal, minimum 50 mm. except at places where trap with deep seal cannot be accommodated. The cover shall be cast iron perforated cover shall be provided on the trap of appropriate size.

M-70. Gully Trap

70.1. Gully trap shall conform to I.S. 651-1980. If shall be some, free .from defects such as fire-cracks or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters.

70.2. The size of the gully trap shall be as specified in the item.

70.3. Each gully trap shall have one C.I. grating of square size corresponding to the dimensions, of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 mm. x 300 mm. the cover with frame inside dimensions 300 mm. x 300 mm. the cover and weighing not less than 4.53 Kg. and the frame not less than 2.72 Kg. The grating cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

M 71. Glazed Stone Ware pipe And Fittings

71.1. The pipes and fittings shall be of best quality as approved, by the Engineer-m-charge. The pipe shall be of best quality manufactured from stone- ware of fire clay, salt glazed thoroughly burnt through the whole thickness, of a close, even texture, free from air blows, fire blisters, cracks and other imperfections, which affect the serviceability. The inner and outer surfaces shall be smooth and perfectly glazed. The pipe shall be capable to withstand pressures or 1.5 M lead without showing sign of leakage. The thickness of the wall shall not be less than 1/12th of the internal dia. The depth of socket shall not be less than 38 mm. The socket shall be sufficiently large to allow a joint of 6 mm. around the pipe.

71.2. The pipes shall generally conform to relevant I S 651-1980.

M-72. Wall Peg Rail

72.1. The aluminum wall peg rail shall have three aluminum pegs approved quality and size. It shall be fixed on teakwood plank of size 450 mm x 75 mm x 20 mm. The teakwood shall be French polished or oil painted as specified.

M-73. G.I. Water Spot

73.1. The G.I. pipes of 40 mm dia shall be of medium quality and specials shall be of 'R' brand or equivalent brand of best approved quality

73.2. The pipe shall have length as required for the thickness of wall in which it is fixed and at outside end tee bend cut at half the length shall be provided and at other end coupling shall be provided to have better fixing. The water spout shall be provided as per detailed drawing or as directed

M-74. Asbestos Cement pipe (A.C. pipe)

74.1. The asbestos cement pipe of diameter as specified in the description of the item shall conform to I.S. 1626-1980. Special like bends, shoes, cowls, etc. shall conform to relevant Indian Standards The intent of pipe shall have is smooth finish, regular surface and regular internal diameter. The tolerance in all dimensions shall be as I.S. 1626-part-I-1980.

M-75. Crydon Ball valve

75.1. Ball valve of screwed type including polythene float and necessary level etc shall be of the size as mentioned in the description of item and shall conform to I.S 1703-1977

M-76. Bitumen Felt For Water proofing And Damp Proofing

76.1. Bitumen felt shall be on the fiber bases and shall be of type 2, self finished felt grade-2 and shall conform to I.S. 1322-1970

M-77. Selected Earth

77.1. The selected earth shall be that obtained from excavated material or shall have to be brought from outside as indicated in the items If item does not indicate anything the selected earth shall have to be brought from outside.

77.2. The selected earth shall be good yellow soil and shall be got approved from the Engineer-in-charge. In no case black cotton soil or similar expansive and shrinkable soil shall be used. It shall be clean and free from all rubbish and perishable materials, stones or brick bats. The clods shall be broken to a size of 50 mm or less. Contractor shall make his own arrangement at his own cost for land for borrowing selected earth. The stacking of material shall be done as directed by the Engineer-in-charge in such a way not to interfere with any construction all activities and in proper stacks.

77.3. When excavated material is to be used only selected stuff got approved from the Engineer-in-charge shall be used. It shall be stacked separately and shall, comply with all the requirements of selected earth mentioned above

M-78. Barbed Wire

78.1. The barbed wire shall be of galvanised steel and it shall generally conform to I.S. 278-1978. The barbed wire shall be of types-I whose nominal diameter for line wire shall be 2.5 mm. and point wire 2.24 mm. The nominal distance between two barbs shall be 75 mm unless otherwise specified in the item. The barbed wire shall be formed by twisting together two fine wires. One containing the barbs. The size of the line and point wires and barb spacing shall be as specified above. The permissible deviation from the nominal diameter of the line wire and point wire shall not exceed ± 0.08 mm

78.2. The barbs shall carry four points and shall be formed by twisting two point wires, each two turns tightly round one line wire making altogether four complete turns. The barbs shall have a length of not less than 13 mm and not more than 18 mm. The point shall be sharp and cut at an angle not greater than 35 degree of the axis of the wire forming the barbs.

78.3. The line and point wires shall be circular in section, free from scale and other defects and shall be uniformly galvanized. The line wire shall be in continuous length and shall not contain any welds other than those in the rod before it is drawn. The distance between two successive splices shall not be less than 15 meters.

78.4. The lengths per 100 Kg. of barbed wire I.S. type I shall be as under:

Nominal 1000 meter Minimum 934 meter Maximum 1066 Meter.

SECTION -4
Excavation

4.0.0. (A) Excavation for foundation up to 1.5 M. depth including sorting out and stacking of useful materials and disposing of the excavated stuff up to 50 meter lead in loose or soft soil.

1.0. General

1.1. Any soil which generally yields to the application of pickaxes and shovels, phawaras rakes or any such ordinary excavating implement or organic soil, gravel silt, sand turf loam, clay, peat etc., fall under this category

2.0. Clearing the site

2.1. The site on which the structure is to be built shall be cleared, and all obstructions loose stone, materials and rubbish of all kind bush wood and trees shall be removed as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50 m lead. The roots of the trees coming in the sides shall be cut and coated with a hot asphalt

2.2. The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.

3.0. Setting out

After clearing the site the centre lines will be given, by the Engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Contractor shall supply labours materials, etc. required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

4.0. Excavation

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and shutting or providing necessary slopes to a safe angle, at his own cost. The payment for such precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transversely as directed by removing and watering as required. No earth filling will be allowed for bringing it to level. If by mistake or any excavation is made deeper or wider than, that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 m depth shall be measured under this item.

5.0. Disposal of the excavated stuff

5.1. The excavated stuff of the selected type shall be used in filling the trenches and plinth or leveling the ground in layers including ramming and watering etc.

5.2. The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead up to 50 M. and all lift.

6.0. Mode of measurements & payment

6.1. The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by the Engineer-in-charge. No payment shall be made for surplus excavation made in excess of above requirements or due to stopping and sloping back as found necessary on account of conditions of soil and requirements of safety.

6.2. The rate shall be for a unit of one cubic meter

4.0.0. (B): Excavation for foundation up to 1.5 M. depth including sorting out and stacking of useful materials and disposing of the excavated stuff up to 50 meter lead in dense or hard soil.

1.0. Dense or Hard Soil

Any soil which generally require close application of picks or jumpers or scarifiers to loosen it stiff clay, gravel and stone etc. fall under this category.

2.0. Workmanship

The relevant specifications of item No. 4.0.0.(A) shall be followed except that the excavation work shall be carried out in dense or hard soil,

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 4.0.0. (A) shall be followed

3.2. The rate shall be for unit of one cubic meter.

4.0.0.(C): Excavation for foundation up to 1.5 M. depth including sorting out and stacking of useful

materials and disposing of the excavated stuff up to 50 meter lead in hard murrum.

1.0. Hard murrum.

The hard murrum shall be clean of good binding quality and of approved quality obtained from approved quarries of disintegrated rocks which contain some materials and natural mixture of clay of clastic origin. The size of hard murrum shall not be more than 20 mm.

2.0. Workmanship

The relevant specification of item No. 4.0.0.(A) shall be followed except that the excavation work shall be carried in hard murrum.

3.0. Mode of measurements & Payments

3.1. The relevant specifications of item No. 4.0.0. (A) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

4.0.0.(D): Excavation for foundation up to 1.50 M. depth including sorting out and stacking of useful materials and disposing of the excavated stuff up to 50 meter lead-soft rock not requiring blasting.

1.0. Workmanship

1.1. The relevant specifications of item No. 4.0.0.(A) shall be followed except that the excavation shall be earned out for foundation upon 1.5 M lift in soft rock not requiring blasting

1.2. The excavation in soft or disintegrated rock shall be carried out by crow bars, pickaxes or pneumatic drills or any other suitable means

1.3. If contractor desires to resort to blasting, he can do so with permission of the Engineer-in-charge but nothing extra shall be paid to him.

1.4. The materials available from soft excavation shall be properly stacked within 50 M. lead and 1.5 m. lift and shall be the property of department.

1.5. The classification of strata of the foundation soil shall be done by the Engineer-in-charge and shall be acceptable to the contractor

1.6. However this shall include the type of rock and boulder which may be quarried or split with crow bars. Laterite and conglomerate also come under this category.

2.0. Mode of measurements & Payment

2.1. The relevant specifications of item No. 4.0.0 (A) shall be followed.

2.2. The rate shall be for a unit of one cubic metre.

4.0.0.(E): Excavation for foundation up to 1.5 M. depth including sorting out and stacking of useful material and disposing of the excavated stuff up to 50 meter lead in hard rocks.

1.0. Workmanship

1.1. The relevant specification of item No. 4.0.0.(A) shall be followed except that the excavation for foundation work shall be carried out in hard rock.

1.2. Excavation shall be done by blasting to the dimensions shown in the drawings or as directed. The blasting shall be carried out only with written permission of the Engineer-in-charge. All the laws, regulations etc., pertaining to the precautions, acquisition, transport, landing and use of explosive shall be rigidly followed. The Magazine for the storage of the explosive shall be built to the design and specifications of explosive authority and located at the approved site. No unauthorised persons shall be admitted into the magazine and when not in use it shall be kept securely locked. No matches or inflammable materials shall be allowed in Magazine. The Magazine shall have an effective lightning conductor. The rules of explosive 1940 revised from time to time shall be followed strictly for obtaining, starting, handling, undertaking blasting work.

1.3. The contractor shall be responsible for damage to property, workmen public due to any accident due to use of explosives and operations

1.4. Precautions

1.4.1. The blasting operation shall remain in charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the detail of handling explosive and blasting operations. The blasting shall be carried out during fixed hours of the day, preferably during the mid-day lunch hours or at the close of the work as ordered in writing by the Engineer-in-charge. The hours of blasting shall be notified in advance to the people in the vicinity. All the charges shall be prepared by the man in charge only.

1.4.2. Red danger flags shall be displayed prominently in all directions during the blasting operations.

1.4.3. People except those who actually light the fuse shall be prohibited from entering into this area. The flags shall be stationed at 200 m. from the firing-site in all directions and all persons including workmen shall be excluded from the flagged area at least 1.0 minutes before the firing warning whistle being sounded for this purpose

1.4.4. During excavation in rock by blasting, the lowest 15 cm. of strata shall be blasted with light charge so

as not to shatter or weaken the underlying rock on which the foundation will be actually laid. If excavation in rock is done to large widths and length than those shown on the drawings or as directed, no payment shall be made for such over break. If excavation is done to depths greater than shown on the drawings or directed, excess depth shall be made up with foundation grade concrete as directed at the contractor's cost.

1.4.5. The charged hole shall be drilled to the required depth and in suitable places when blasting is done with powder, the fuse cut to the required length shall be inserted in the holes and the powder dropped in. The powder shall be gently tamped with copper rod with rounded ends. The explosive powder shall then be covered with trapping materials which shall be tamped lightly out firmly. When blasting is done with dynamite and other high explosive, dynamite cartridges shall be prepared by inserting the square cut ends of fuse into the detonator, and finished with dippers at the open ends. The detonator should be gently pushed into the detonator and finished with dippers at the opened ends. The detonator should be gently pushed explosive. Bore holes shall be of such size that the cartridges can be easily passed down. The holes shall be cleared of all debris and explosive inserted. The space for about 20 cms, above the charge shall then be gently filled with dry clay pressed home and rest of tamping is with firmed any convenient materials gently packed with a wooden cover.

1.4.6. At a time not more than 10 such charge shall be prepared and fired. The man in charge shall blow a whistle in a recognised manner for cautioning the people. All the people shall then be required to move to number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go to the work site.

1.4.7. The contractor shall be fully responsible to strictly follow the prevailing rules and procedures regarding blasting procedures

1.5. Misfire

1.5.1. In case of a misfire the following procedure shall be observed :

1.5.2. Sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charge.

1.5.3. If it is the blasting powder charge it shall be completely flooded with water. A new hole shall be drilled at, about 45 cm. from the old and fired. This should blast the old charge. Should it not blast the old charge, the procedure shall be repeated till the old charge is blasted.

1.5.4. In case of charge of gelatins, dynamite etc, the man in charge shall gently remove the tamping and the primer with detonator and primer shall then be used to blast the charge. Alternatively the hole may be cleared of one foot of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 15 cm away and parallel to it. The man in charge shall report to the office all cases of misfire and cause of the same and what steps were taken in connection therewith.

1.5.6. If a misfire has been found to be due to defective or dynamite, the whole quantity in the box from which defective article was taken must be sent to authority as directed for inspection to ascertain whether all the remaining materials in the box are also defective or not.

1.6. Accidents:

1.6.1. The contractor shall be solely responsible for any accident during the entire procedure of handling explosive and blasting and shall pay necessary compensation to persons affected or damage to lands or property etc, due to the blasting, without extra claims on the department.

1.7. Account:

1.7.1. A careful and day to day account of explosives shall be maintained by the contractor in an approved manner and shall be open to inspection of the Engineer-in charge. Surprise visits may also be paid by the Engineer-in-charge to the storage and in case of any unaccountable shortage or unsatisfactory accounting, the contractor shall be liable to be penalised by forfeiture of part or whole of his Security Deposit or by cancellation of tender in which case he shall not be entitled for any compensation .-

1.8. Disposal of Excavated Materials:

1.8.1 No materials excavated from foundation trenches of whatever kind they may be, are to be placed even temporarily nearer than 1.5 m. or distance prescribed by the Engineer from the outer edge of excavation. All materials excavated shall remain the property of Government. Rate for excavation includes sorting out of useful materials and stacking them separately as directed within the specific lead. Materials suitable and useful for backfilling or other use shall be stacked in convenient places but not in such a way as to obstruct free movement of men, animals and vehicles or encroach upon the area required for constructional purpose. The site shall be left clean of all debris on completion.

1.8.2. Disposal of excavated materials is subject to the following :

Unsuitable materials obtained from clearing site and excavation shall be disposed off within a lead of 50 meters as directed. Useful materials obtained from clearing site and excavation shall be stacked within a lead of 50 M beyond the building areas is directed. Materials suitable for back-filling shall be stacked at convenient places within a lead of 50 M. from the structure for reuse. Useful stones from rock excavation shall be stacked neatly. within a lead of 50 M. and will be allowed to be used by the contractor on payment at rates laid down in the contract or if not so laid down, at scheduled rates of the Division or at a mutually agreed rates if there are no such rates in the schedule of rates.

1.8.3. If surplus materials are required to be conveyed beyond 50 M, conveyance will be paid for under a separate item

2.0. Mode of measurements & Payment

2.1. The work shall be measured for the work limited to the dimensions shown on drawings or directed Excavation to dimension in excess of the above will not be measured or paid for and if so ordered by the Engineer the contractor shall have to fill up the excess depth with cement concrete specified for foundation without extra payment.

2.2. Driving of sounding bars, drill holes to explore the nature of substratum up to a total length of meter distributed in 2 or 3 places in each foundation if necessary, will be considered incidental work and will not be paid for separately.

2.3. Removal of slips and blows in the foundation trenches will not be measured or paid for.

2.4. if it is necessary in the opinion of the Engineer-in-charge to carry foundation below the levels shown on the plans, the excavations for the 1.5 M of addition depth will be included in the quantity for the particular classification and will be paid for as extra at rate to be decided under the general conditions of contract unless, the contractor is willing to accept payment as tendered rates.

2.5. The rate shall be for a unit of one cubic meter

4.0.0.1.(A): Excavation for foundation for depth from 1.5 M. to 3.0 M. including sorting out and stacking of useful materials and disposing of the excavated stuff up to 50 M. lead-loose or soft soil.

1.0. Workmanship

1.1. The relevant specifications of item No. 4 0.0. (A) shall be followed except that the excavation work shall be carried out to loose or soft soil with lift 1.5 M. to 3.0 M.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 4.0 O.(A) shall be followed.

2.2. The excavation work of from 1.5 M. to 3.0 M. shall be measured under this item

2.3. The rate shall be for a unit of one cubic meter

4.0.0.1.(B): Excavation for foundation for depth from 1.5 M. to 3.0 M. including sorting out and stacking of useful materials and disposing of excavated stuff up to 50 M. lead in Dense or Hard soil.

1.0. Workmanship

The relevant specifications of item No. 4.0 0.(B) shall be followed except that the excavation work shall be carried out with 1.5 M. to 3.0 M. lift in dense or hard soil.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No.4.0.0.(A) shall be followed.

2.2. The excavation work from 1.5 to 3.0M shall be measured under this item

2.3. The rate shall be for a unit of one cubic meter.

4.0.0.1.(C): Excavation for foundation for depth from 1.5 M. to 3.0 M. including sorting out and stacking of useful materials and disposing of excavated stuff up to 50 M. lead in Hard murrum.

1.0. Workmanship

1.1. the relevant specifications of item No. 4.0.0. (A) shall be followed except that the excavation work shall be carried out from 1.5 M. to 3.0 M lift in hard murrum.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 4.0.0. (A) shall be followed.

2.2. The excavation work from 1.5 M to 3.0 M shall be measured under

2.3. The rate shall be for unit of one cubic meter

4.0.0,1.(D): Excavation for foundation for depth 1.5 M. to 3.0 M. including sorting out and stacking

of useful materials and disposing of excavated stuff up to 50 M. lead in soft rock not required blasting.

1.0. Workmanship

The relevant specifications item No. 4.0.0.(D) shall be followed except that the excavation work shall be earned out from 1.5 M. to 3.0 M. lift in soft rock not required blasting.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No 4.0.0.(A) shall be followed.

2.2. The excavation work from 1.5 M, to 3.0 M lift shall be measured under this item.

2.3. The rate shall be for a unit of one cubic meter

4.0.0.1.(E): Excavation for foundation for depth 1.5 M. to 3.0 M. including sorting out and stacking of useful materials and disposing of excavated stuff up to 50 M. lead in hard rock

1.0. Workmanship

1.1. The relevant specifications of item No. 4.0.0.(E) shall be followed except that the excavation work shall be carried out from 1.5 M. to 3.0 M. lift in hard rock.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 4.0.0. (A) shall be followed.

2.2. The excavation-work from 1.5 M, to 3.0 lift shall be measured under this item

2.3. The rate shall be for a unit of cubic meter

4.0.0.2. (A): Excavation for foundation for depth from 3.0 M. to 5.0 M. including sorting out and stacking of useful materials and disposing of the excavated stuff Upton 50 M. lead in loose or soft soil.

1.0. Workmanship

1.1. The relevant specifications of item No. 4.0.0.(A) shall be followed except that the excavation work shall be carried out from 3.0 M. to 5.0. M. lift in loose or soft soil.

2.0. Mode of Measurement & Payment

2.1. Relevant specifications of item No. 4.0.0.(A) shall be followed.

2.2. The excavation work from 3.0 M. to 5.0 M. lift shall be measured under this item.

2.3. The rate shall be for a unit of one cubic meter.

4.0.0.2.(B): Excavation for foundation for depth from 3.0 M. to 5.0 M. including sorting our and stacking of useful materials and disposing of the excavated stuff up to 50 M. lead in Dense or Hard soil.

1.0. Workmanship

1.1. The relevant specifications of item No. 4 0.0.(B) shall be followed except that the excavation work shall be carried out from 3.0.m. to 5.0.m. lift in Dense or Hard soil.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 4.0.0.(A) shall be followed:

2.2. The excavation work from 3.0. M. to 5,0 M. lift shall be measured under this item.

2.3. The rate shall be for a unit of one cubic metre.

4.0.0.2.(C): Excavation for foundation for depth from 3.0 M. to 5.0 M. including sorting out and stacking of useful material and disposing of the excavated stuff up to 50 M. lead in Hard murrum.

1.0. Workmanship

1.1. The relevant specifications items No. 4 0.0. (C) shall be followed except that the excavation work shall be carried out from 3.0 m to 5 0 M in Hard murrum.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 4.0.0.(A) be followed.

2.2. The excavation work from 3.0 M. to 5.0. lift shall be measured under this item.

2.3. The rate shall be for a unit of one cubic metre.

4.0.0.2.(D) Excavation for foundation for depth from 3.0 M. to 5.0 M. including sorting out and stacking of useful materials and disposing of the excavated stuff up to 50 M. in soft rock not required blasting.

1.0. Workmanship

1.1. The relevant specification-of item NO 4 0.0.(D) shall be followed except that the excavation work shall be carried out from 3.0. M to 5.0. M soft rock not requiring blasting

2.0. Mode of Measurement & Payment

- 2.1. The relevant specification of item No. 4.0 O.(A) shall be followed.
- 2.2. The excavation work from 30 M. to 50 M. lift shall be measured under this item.
- 2.3. The rate shall be for a unit of one cubic meter
- 4.0.0.2.(E): Excavation for foundation depth from 3.0 M. to 5.0 M. including sorting out and stacking of useful material land .disposing of the excavated stuff up to 50 M. lead in Hard rock.**
- 1.0. Workmanship**
- 1.1. The relevant specifications of item No 4.0.0.(E) shall be followed except that the excavation work shall be earned out from 3.0. M. to 5.0 M in hard rock
- 2.0. Mode of Measurement & Payment**
- 2.1. The relevant specification of item No. 4.0.0.(A) shall be followed.
- 2.2. The excavation work from 3.0. M to 5.0 M. lift shall be measured under this item.
- 2.3. The rate shall be for a unit of one cubic meter.
- 4.0.0.3.(A): Extra for additional depth more than 5.0 M. for excavation for foundation including sorting out and stacking of useful material disposing of the excavated stuff up to 50 M. lead in loose or soft soil.**
- 1.0. Workmanship**
- 1.1. The relevant specification of item. No 4 0.0 (A) shall be followed except that the excavation work shall be earned out from more than 50 M. lift in loose or soft soil
- 2.0. Mode of Measurement & Payment**
- 2.1. The relevant specifications of item No. 4.0.0.(A) shall be followed
- 2.2. The rate shall be paid extra over and above the rate of item No. 4 0 0.2.(A) for carrying' out excavation work for additional depth from 5.0 M. and above.
- 2.3. The rate shall be for a unit of cubic per meter
- 4.0.0.3.(B): Extra for additional depth more than 5.0 M. for excavation for foundation including sorting and stacking of useful materials disposing of excavated stuff up to 50 M. lead in Dense or Hard soil.**
- 1.0 Workmanship**
- 1.1. The relevant specifications of item No. 4.0.0.(B) shall be followed except that the excavation work shall be carried out from more than 5.0. M. lift in dense or hard soil.
- 2.0. Mode of Measurement & Payment**
- 2.1. The relevant specifications of item No. 4 0.0 (A) shall be followed.
- 2.2. The rate shall be paid extra over and above the rate of item No 4 0.0 2.(B) for carrying out excavation work for additional depth from 5 0 M. and above.
- 2.3. The rate shall be for a unit of one cubic meter.
- 4.0.0.3.(C): Extra for additional depth more than 5.0 M. for excavation for foundation including sorting out and stacking of useful materials disposing of excavated stuff up to 50 M. lead in Hard murrum.**
- 1.0. Workmanship**
- 1.1. The relevant specification of item No. 4.0.0 (C) shall be followed except that the excavation work shall be carried out from more than 50 M. lift in hard murrum.
- 2.0. Mode of Measurements & Payment**
- 2.1. The relevant specification of item No. 4.0.0.(A) shall be followed.
- 2.2. The rate shall be paid extra over and above the rate item No 4.0.0 2.{C}for carrying out excavation work for additional depth from 50 M. and above.
- 2.3. The rate shall be for a unit of one cubic meter.
- 4.0.0.3.(D): Extra for additional depth more than 5.0 M. for excavation for foundation including sorting out and stacking of useful materials disposing of excavated stuff up to 50 M. lead in soft rock not requiring blasting.**
- 1.0. Workmanship**
- 1.1. The relevant specifications of Item No. 4.0.0.(D) shall be followed except that the excavation work shall be carried out from more than 5.0 M. lift in soft rock not requiring blasting.
- 2.0. Mode of Measurement & Payment**
- 2.1. The relevant specifications of item No. 4.0.0.(A) shall be followed.

2.2. The rate shall be paid extra over and above the rate of item No. 4.0.0.2.(D) for carrying out excavation work for additional depth from 5.0.(M) and above.

2.3. The rates shall be for a unit of one cubic meter per meter

4.0.0.3.(E): **Extra for additional depth more than 5.0 M. for excavation for foundation including sorting out and stacking of useful material disposing of excavated stuff up to 50 M. lead in hard rock.**

1.0. Workmanship

1.1. The relevant specification of item No 4.0.0(E) shall be followed except that the excavation work shall be carried out from more than 50 m. lift in hard rock

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No.4.0 O.(A) shall be followed.

2.2. The rates shall be paid extra over and above the rate of item No. 4.0.0 2.(E) for carrying out excavation work for additional depth from 5.0. M. and above.

2.3. The rate shall be unit of one cubic meter per meter

4.1.2. **Filling available excavated earth (excluding rock) in trenches, plinth sides of foundations, etc., in layers not exceeding 20 CM. depth, consolidating each deposited layer by ramming and watering.**

1.0. Workmanship

1.1. The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

1.2. As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats: mortar dropping etc., and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid The earth shall be rammed with iron rammers where feasible and with the but ends of crow-bars, where rammer cannot be used.

1.3. The plinth shall be similarly filled with earth in layers not exceeding 20 cms. adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

1.4. The finished level of filling shall be kept to shape intended to be given to floor.

1.5. In case off large heavy duty flooring like factory flooring, the consolidation may be done by power rollers, where so specified. The extent of consolidation required, shall also be as specified.

1.6. The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.

2.0. Mode of Measurements & Payment

2.1. The payment shall be made for filling in plinth and trenches. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.

2.2. The rate shall be for a unit of one cubic meter.

4.2.4. **Filling in plinth with sand under floors including watering, ramming consolidating and dressing etc. complete.**

1.0. Materials

1.1. Sand shall conform to M 6

2.0. Workmanship

The relevant specifications of item No. 4.12 shall be followed except that sand shall be filled in under floors, including watering, ramming, consolidating and dressing etc , complete.

3.0. Mode of Measurements & Payment

3.1. The relevant specifications of item No. 4.12 shall be followed.

3.2. The rate includes cost of collecting, carting sand with all lead and labour for filling the same in plinth under floors.

3.3. The rate shall be for a unit of one cubic meter.

4.0.0.4. **Filling in foundation arid plinth with murrum or selected soil in layers of 20 cm. thickness including watering, ramming and consolidating etc., complete.**

1.0. Materials

1.1. Murrum shall be clean, of good binding quality and of approved quality obtained from approved pots/ quarries of disintegrated rocks which contain silicon material and natural mixture of clay of clarions origin. The size of murrum shall not be more than 20 mm

2.0. Workmanship

2.1. The relevant specifications of item No. 4.12 shall be followed except that the murrum or selected soil shall be filled in foundations and plinth in 20 cms layer including consolidating, ramming, watering, dressing etc. complete

3.0. Mode of Measurements & Payment

3.1. The relevant specifications of item No. 4.12 shall be followed-

3.2. The rate includes cost of collecting and carting murrum / or selected earth of approved quality with all lead and labour required for filling in trenches and plinth.

3.3. Rate shall be for a unit of one cubic meter.

4.0.0.5. Filling in foundation and plinth with brick-bats / chhara in layers of 20 cms. thickness including watering, ramming and consolidating etc. complete.**1.0. Materials**

Brick bats shall conform to M.14

2.0. Workmanship

The relevant specification of item No. 4.12 shall be followed except that brick bats of-burnt bricks shall be filled in foundation and plinth in 20 cms layer including watering, ramming, consolidating etc.,*complete.

3.0. Mode of Measurements & Payment

3.1. The relevant specification item No. 4 12 shall be followed.

3.2. The rate includes cost of collecting and carting brick bats/chhara with all lead and labour required filling in trenches and plinth.

3.3. The rate shall be for a unit of one cubic meter

4.27. Boring holes 3.5 M. deep in ordinary soil (for cast in situ piles) and getting out the soil disposal of the surplus excavated soil as directed within a lead of 50 M. for following diameter for piles, (i) 200 mm. (ii) 250 mm, (iii) 300 mm.**1.0. Workmanship**

1.0. The ground shall be roughly leveled and after making the position of piles, the holes shall be bored with a spiral angle to the 3.5 M. depth and specified diameter using boring guide.

2.0. The bore holes shall be truly vertical and uniform bore through out of specified diameter, After boring to the required depth, the bore shall be cleared off the loose soil and disposal of surplus excavated stuff as directed within a lead of 50 M. . 2.0? Mode of Measurement & Payment

2.1. The rate for boring holes shall include :

(a) roughly leveling the ground in positions where piles are to be provided (b) Making the position of piles by pegs and boring guide and also for shifting of boring guide. (c) Bailing out water, if any met with during boring, (d) Disposal or surplus excavated soil within a lead of 50 M and'(e) All tools, plants, equipments and labour required for satisfactory completion or. work.

2.2. The rate shall be for a unit of one Number.

4.28. Extra for under ramming inside the bore holes for under rammed piles of following nominal diameter :(i) 200 mm. (ii) 250, (iii) 300 mm.**1.0. Workmanship**

The relevant specifications of item No. 4.27 shall be followed except that after boring to the required depth, the bore shall be enlarged at the bottom by an under rammer 2 to 2 1/2 times the diameter of the bore as directed It shall be ensured that the bore for the pile shall be enlarged to the correct diameter.

2.0. Mode of Measurement & Payment

2.1. The relevant specification of item No. 4.27 for under reaming the piles.

2.2. The rate shall be paid extra over and above the rate of item No. 4.27 for under ramming the piles.

2.3. The rate shall be for a unit of one number.

SECTION 5
Plain & RCC Work

5.1.6. Providing and laying in foundation and plinth/under floors lime concrete with hard broken aggregate 40 mm. nominal size and 40% mortar comprising of 1 Lime putty : 2 fine sand and curing complete excluding cost of form work.

1.0. Materials

Water shall conform to M-1. Sand shall conform to M-6 Lime shall conform to M-2. Graded aggregate 40 mm. nominal size shall conform to M-12

2.1. General

2.1.1. Before starting the concrete the bed of the foundation trenches shall be cleared of all loose materials and watered and rammed as directed.

2.2. Proportion of Mix

2.2.1. The proportion of lime, sand and aggregate shall be specified in the item of the work and shall be measured by volume.

2.2.2. The lime mortar shall consist of proportion of 1 lime putty : 2 sand by volume. The lime mortar shall be prepared by wet process. Power driven mill shall be used for preparation of lime mortar. The slaked lime shall be placed in the mill in even layer and ground for 180 revolutions with sufficient water. The water shall be added as required during grinding and care shall be taken not to add more water so that it will bring the mixed materials to a consistency of stiff paste, thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.

2.2.3. Lime mortar shall be kept, protected from sun and rain till used-up, covering it by tarpaulin or open sheds.

2.2.4. All the lime mortar shall be used as soon as possible after grinding. It should be used on the day on which it is prepared but in no case mortar- made earlier than 36 hours shall be permitted for use.

2.3. Mixing:

2.3.1. The concrete shall be mixed in mechanical mixer. Mixing shall be continued until there is uniform distribution of the materials and the mass is uniform in colour and consistency but in no case mixing shall be done for less than 2 to 3 minutes.

2.4. Laying & Compacting:

2.4.1. The concrete shall always be used while quite fresh It shall be laid (not thrown) in layers not exceeding 150 mm. in thickness and shall be well and quickly rammed with wooden or iron rammers, till the required compaction is achieved. The concrete laid shall not be of too fluid consistency. After it has been mixed no more water shall be added, but the surface during and after compaction shall be kept damp. In laying consecutive layers, the layer cast shall be well watered and made rough before the upper layer is laid. The concrete shall be kept continuously wet for period of 7 days from the date of placing of until it- is built over whichever is more.

2.5. Mode of Measurement & Payment :

2.5.1. The concrete work shall be measured in length, breadth and depth as specified on drawing or as directed, correct up to nearest centimeter and cubical content shall be worked out nearest up to two places of decimals.

2.5.2. The rate shall be for unit of one cubic meter.

5.1.8. Providing and laying in foundation and plinth/under floors lime concrete with graded bricks aggregate 40 mm. nominal size and 40% mortar comprising of 1 lime putty : 2 fine sand and curing complete, excluding cost of form work.

1.0. Materials

1.1. Water shall conform to M-1. Lime mortar shall conform to M-10. Brick bats aggregate 40 mm. nominal sizes shall conform to M-14.

2.0. Workmanship

2.1. The relevant specification of item No. 5.1.6. shall be followed except that brick aggregate shall be used instead of graded stone aggregate.

3.0. Mode of Measurements & Payment

3.1. The concrete work shall be measured in length, breadth and depth as specified in drawing or as directed. Correct up to nearest centimeter and cubical content shall be worked out up to two places of decimals.

3.2. The rate shall be for a unit of cubic meter.

5.3.2.(A) Providing and laying cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 40 mm. nominal size) and curing complete excluding the cost of form work in foundations and plinth.

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3 Sand shall conform to M-6. Stones aggregate 40 mm. nominal size shall conform to M-12.

2.0. Workmanship

2.1. General

2.1.1. Before stating concrete the bed of foundation trenches shall be cleared of all loose materials, leveled, watered and rammed as directed

2.2. Proportion of Mix:

2.2.1. The proportion of cement, sand and coarse aggregate shall be one part of cement. 3 parts of sand and 6 parts of stone aggregates and shall be measured by volume.

2.3. Mixing:

2.3.1. The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of break-down of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency, However in such case 10% more cement than otherwise period 1 1/2 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

2.4. Transporting & Placing the Concrete:

2.4.1. The concrete shall be handed from the place, of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final-position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

2.4.2. The concrete shall be laid in layers of 15 cms. to 20 cms.

2.5.1. The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

2.6. Curing:

2.6.1. After the final set, the concrete shall be kept continuously wet if required by ponding for a period of not less than 7 days from the date of placement.

2.7. Mode of Measurement & Payment:

2.7.1. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plan or as directed.

2.7.2. The rate shall be for a unit of one cubic meter.

5.3.3.(A) Providing and laying cement concrete 1:4:8 (1 cement: 4 coarse sand : 8 graded stone aggregate 40 mm. nominal size) and curing complete, excluding cost of form work in foundations and plinth.

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6 stone aggregate 40 mm. nominal size shall conform to M-12.

2.0. Workmanship

2.1. Relevant Specifications of item No. 5.3.2. shall be followed except that cement concrete shall be mixed in the preparation of 1:4:8 instead of 1:3:6 by volume.

3.0. Mode of measurement and payment

3.1. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plans or as directed

3.2. The rate shall be for a unit of one cubic meter

5.3.14.(A) Providing and laying cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 crushed stone aggregate 20 mm. nominal size) and curing complete including cost of form work in wall caps/coping.

1.0. Material & Workmanship

1.1. The relevant specification of item No. 5.3.2. (A) shall be followed except that the work shall be carried out for coping and wall caps, except the stone aggregate 20 mm. nominal size shall be used. The concrete work of wall caps/coping.

2.0. Mode of measurements and payment

2.1. The relevant specification of item No. 5.3.2. (A) shall be followed except that the rate includes cost of necessary form work.

- 2.2. The rate shall be for a unit of one cubic meter.
- 5.3.3. **Providing and laying brick bats cement 1:4:8 (1 cement : 4 coarse sand : 8 graded bricks bats), and curing complete excluding the cost of form work in foundation and plinth.**
- 1.0. **Materials**
- 1.1. Water shall conform to M-1 Cement shall conform to M-3. Sand shall conform to M-6 Brick bat shall conform to M-14
- 2.0. **Workmanship**
- 2.1. The specification of this item shall be followed as per item No 5.3.14 (A) except that the proportion of brick bat cement concrete shall be 1 4:8 i e 1 part of cements 4 part of coarse sand and 8 parts of graded brick bat by volume, using graded brick bat as coarse aggregate instead of stone aggregates
- 3.0. **Mode of Measurements & Payment**
- 3.1. The concrete work shall be measured in length, breadth and depth as specified on drawing limiting dimensions to those specified on drawings or as directed.
- 3.2. The rate shall be for a unit of one cubic meter.
- 5.3.4.(A) **Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm. nominal size) and curing complete, excluding the cost of form work, for foundation and plinth.**
- 1.0. **Materials**
- 1.1. Water shall conform to M-1. Cement shall conform to M-3 Sand shall conform to M-6 Stone aggregate 40 mm nominal size shall conform to M-12.
- 2.0. **Workmanship**
- 2.1. The relevant specification of item No. 5.3.2. (A) shall be followed for the work except that the work is to be carried out in cement concrete 1:5:10
- 3.0. **Mode of Measurement & Payment**
- 3.1. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plans or as directed.
- 3.2. The rate shall be for a unit of one cubic meter.
- 5.3.8.(A) **Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded brick bats 10 mm. nominal size) and curing complete excluding, cost of form work in foundation and plinth.**
- 1.0. **Materials**
- 1.1. Water shall conform to M-1 Sand shall conform to M-6 Cement shall conform to M-3. Brick bats shall conform to M-14.
- 2.0. **Workmanship**
- 2.1. The relevant specification of item No 5.3.4 shall followed except that brick bats aggregate shall be used instead of stone aggregate.
- 3.0. **Mode of Measurement & Payment**
- 3.1. The relevant specification of item No 5.3.4 shall be followed
- 3.2. The rate shall be for a unit of one cubic meter
- 5.3.2.(B) **Providing and laying brick bat cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded-brick bats) and curing complete excluding cost of form work in foundation and plinth.**
- 1.0. The specification of item No 5 3.2 (A) shall be followed except that the brick bats shall be used as coarse aggregate instead of stone aggregates.
- 2.0. **Mode of Measurement & Payment**
- 2.1. The relevant specification of item No 5.3.5 (A) shall be followed for mode of measurements and payment except that it excludes the cost of form work.
- 2.2. The rate shall be for a unit or one cubic meter.
- 5.4.18. **Providing throating or plaster drip and molding to R.C.C. Chhajas.**
- 1.0. **Materials**
- Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6 Cement mortar shall conform to M-11
- 2.0. **Workmanship**
- 2.1. The work shall be carried out as directed. The proportion of mix for finishing shall be in C.M. 1:2 by volume. Curing shall be done for not less than 7 days. The work shall be carried out in best workman like manner. The throating or plaster drip and mounding shall be one centimeter in thickness.

5.7.5. Extra for providing and mixing Water Proofing material in cement concrete in mix proportions recommended by the manufacturers.

2.0. Workmanship

2.1. The proportions of materials for the cement concrete shall be mentioned with the specifications of that item. The quantity of water proofing materials to be added and the method of addition shall be as specified by manufacturers.

2.2. Mixing:

2.2.1. The mixing of the water proofing materials in cement, water or concrete shall be done according to the specifications of the manufacture.

3.0. Mode of Measurements and Payment

3.1. The payment is extra over and above the rate of concrete for mixing water proofing proper.

3.2. The rate shall be for a unit of one lithe or kg. per quintal of cement in which water proofing material is added.

5.7.1. Providing and laying damp proof course 25 mm. thick cement concrete 1:2:4 (1 cement : coarse sand :4 stone aggregate 10 mm. nominal size) and curing complete.

1.0. The specifications of item No. 5.3.13. (A) of ordinary concrete with or without reinforcement shall be followed except that the size of the stone aggregate shall be 10 mm nominal size and the concrete work shall be carried out in 25 mm. thick damp proof course

2.0. Mode of measurements & payment

2.1. The rate includes cost of all materials and labour required to complete the item

2.2. The rate shall be for a unit one sq. meter.

5.3.13. Providing and laying cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) and curing complete excluding cost of form work in (A) foundation and plinth, (B) Independent piers, columns and pillars up to floor two level.

1.0. Materials

Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Graded stone aggregate 20 mm nominal size shall conform to M-12.

2.0. General

2.1. The concrete mix is not required to be designed by preliminary testes. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) by volume concrete work shall have exposed concrete surface or as specified in the item

2.2. The designation ordinary M-100, M-150m M-200, M-250 specified as per I.S. correspond approximately to 1:3:6, 1:2:4, 1:1:1/2:3 and 1:1:2 nominal mix of ordinary concrete by volume respectively

2.3. The ingredients required for ordinary concrete containing one beg of cement of 50 kg. by weight (0.0342 Cu M.) for different proportions of mix shall be as under:

Grade of concrete	Total quantity of dry aggregate by volume per 50 kgs. of cement to be taken as the sum of individual volume of fine and coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kecs. of cement maximum
1	2	3	4
M-100 (1:3:6)	300 Liters	Generally 1:2 for line aggregate to coarse aggregate by volume 160 but subject to an upper limit of 1:1.1/2 and lower limit	34 Liters
M-150 (1:2:4)	220 Liters		32 Liters
M-200 (1:1.1/2:3)			30 Liters
M-250 (1:1:2)	100 Liters		1:3 27 Liters

2.4. The water cement ratios shall not be more than specified in the above table. The cement content of the mix specified in the table shall be increased if the quantity of water in mix has to be met eased to overcome the difficulties of placements and compaction so that the water-cement ratio specified in the table is not exceeded.

2.5. Workability of the concrete shall be controlled by maintaining a water -cement-ratio that is found to give a concrete mix which is just sufficient wet to be placed and compacted without difficulty with the means available.

2.6. The maximum size of course aggregate shall be as large as possible within the limits specified but in no case greater than one forth of the minimum thickness of the member provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and to fill the corners of the form.

2.7. For reinforced concrete work; coarse aggregates having a nominal size of 20 mm. are generally considered satisfactory.

2.8. For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of coarse aggregate should usually be restricted to 5 mm. less than the minimum clear distance between the main bar or 5 mm. less than the minimum cover to the reinforcement whichever is smaller.

2.9. Where the reinforcement is widely spaced as in solid slabs, limitations of size of the aggregate may not be so important, and the nominal maximum size may some times be as great as or greater than the minimum cover.

2.10. Admixture maybe used in concrete only with approval of Engineer-in-charge based upon the evidence that with the passage of time neither the compressive strength of concrete is reduced nor are other requisite qualities of concrete and steel impaired by the use of such admixtures.

3.0. Workmanship

3.1. Proportioning : Proportioning shall be done by volume, except which shall be measured in terms of bags of 50 kg. weight, the volume of one such bag being taken as 0.0342 cu. meter Boxes of suitable size shall be used for measuring sand aggregate. The size of boxes (internal) shall be 35 x 25 cms. and 40 cms deep while measuring the aggregate and sand the boxes shall be filled without shaking ramming or hammering. The proportioning of sand shall be on the basis of its dry volume and in case of damp saner, allowances for bulk age shall be made.

3.2. Mixing :

3.2.1. For all work, concrete shall be mixed in a mechanical mixed which along with other accessories shall be kept in first class working condition and so maintained throughout the construction Measured quantity of aggregate, sand and cement required for each batch shall be poured into the claim of the mechanical mixer while it is continuously running. After half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and a half minute Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after oil ingredients have been put into the mixer.

3.2.2. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on the smooth watertight platform large enough to allow efficient tuning over the ingredients of concrete before and after adding water Mixing platform shall be so arranged that no foreign material gets mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement shall then be mixed thoroughly by turning over to get a mixture to uniform colour. Specified quantity water shall then be added gradually through a rose can and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified

3.2.3. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer in-charge the first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate Mixing plant shall be thoroughly cleaned before changing from one type of cement to another

3.3. Consistency:

3.3.1. The degree of consistency which shall depend upon the nature of the work and methods of vibration of concrete, shall be determined by regular slump tests in accordance with I.S. 1199-193. The slump of 10 mm. to 25 mm shall be adopted when vibrators are used and 80 mm. when vibrators are not used.

3.4. Inspection:

3.4.1. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for the safety of men machinery materials and for results obtained immediately before concreting all forms shall be thoroughly cleaned.

3.4.2. Centering design and its erection shall be got approved from the engineer-in-charge. One carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber kapachi or metal pieces shall not be used for this purpose.

3.5. Transporting and laying:

3.5.1. The method of transporting and placing concrete shall be as approved. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work shall be cleaned and made free from standing water dust, snow or ice immediately before placing of concrete. No concrete

shall be placed in any part of the structure until the approval of the engineer-in-charge has been obtained.

3.5.2. Concreting shall proceed continuously over the area between construction joints. Fresh concrete proper contraction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrators are used and not exceeding 0.30 meter in all other cases.

3.5.3. Unless otherwise agreed to by the Engineer-in-charge concrete shall be dropped in to place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept close and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13 mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all lateness shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness and shall be well rammed against old work, particular attention being given to corners and close spots.

3.5.4. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the even of breakdowns. Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. within 30 minutes of addition of water to dry mixture. During compaction, it shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

3.6. Curing:

Immediately after compaction, concrete weather including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking has Sian or other similar absorbent material approved, soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days.

3.7. Sampling and testing of concrete:

3.7.1. Samples from fresh concrete shall be taken as per I.S. 1199-1959 and cubes shall be made, cured and tested at 7 days of 28 days as per requirements in accordance with I.S. 526-1959. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

Quantity of concrete in the work.	No of samples	Quantity of concrete in the works	No of samples
1-5 cmt.	1	16-30 cmt.	3
6.15 cmt.	2	31-50 cmt.	4
51 and above	4+ one additional for each additional 50 mm. or part thereof.		

Note : At least one sample shall be taken from each shift, Ten test specimens shall be made from each sample, five for testing at 7 days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting as per above frequency. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

3.7.2. The average of the group of cubes cast for each day shall not be less than the specified cube strength of 150 K/g Cm² at 28 days. 20% of the cubes cast for each day may have value less than the specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportions given for a particular grade does not yield the specified strength, such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the Proportions given for a particular grade shall not, however be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

3.8. Stripping:

3.8.1. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time of removal of form work, due consideration shall be given to local conditions,

character of the structure, the weather and other conditions that influence the setting of concrete and of the materials used in the mix. In normal circumstances (generally where temperatures are above 20.C) and where ordinary concrete is used, forms may be struck after expire or periods specified in item No.9.1 (A) for respective item of form work.

3.8.2. All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soft and struts are removed, the concrete surface shall be gradually exposed, where necessary in order to ascertain that concrete has sufficiently hardened. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal tiles are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer-in-charge. After removal of form work and shutting, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

3.8.3. Immediately after the removal of forms, all exposed bolts etc. passing through the cement concrete member and used for stuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 m. below the surface of the concrete and the resulting holes be filled by cement mortar, all fins, caused by form joints, all cavities produced by the removal of form tiles and all other holes and depressions, honeycomb spots, broken edges or comers and other defects, shall be thoroughly cleaned", saturated with water and carefully pointed an rendered true with mortar of cement and fine aggregate mixed in proportions used in the grade of concrete that is being furnished and of as dry consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure through filling in all voids. Surface which are pointed shall be kept moist for a period of 24 hours. If rock pockets/honeycombs in the opinion of the Engineer-in-charge are of such an extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of structure affected.

4.0. Mode of Measurement & Payment

4.1. The consolidated cubical contents of concrete work as specified in item shall be measured. No deduction shall be made for

(a) Ends of dissimilar materials such as joints, beams, posts, girders, falters, purling trusses, corbels and steps etc., up to 500 Sq, Cm. in section.

4.2. The rate includes cost of all materials labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing, as directed, curing and all other incidental expenses for producing centre of specified strength. The rate excludes the cost of form work.

4.3. The rate shall be for a unit of one cubic meter.

5.4.1. Providing and laying cement concrete 1:2:4 (1 cement : 2 coarse sand :4 graded stone aggregate 20 mm. nominal size) and curing complete excluding cost of form work and reinforcement for reinforced work in : (A) Foundations, footing base of columns and mass concrete. (C) Slabs, landings, shelves, balconies, lintels, beams, girders and cantilever up to floor two level. (D) Columns, pillars, pots, and struts up to floor up to floor two level (E) Staircase up to floor two level (K) Vertical and horizontal fins up to floor two level.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 5.3.13 shall be followed except that the work shall be carried out for reinforced concrete work for work as specified in item 1.2. In addition, the following stipulations shall be followed for:

(a) The bars shall be kept in position by the following methods :

(i) In case of beam and slab construction, sufficient number of precast cover blocks in cement mortar 1:2 (1 cement : 2 coarse sand) about 4 cms. x 4 cms. section and of thickness equal to the specified cover shall be placed between the bars and shattering as to secure and maintain the requisite cover of concrete over the reinforcement. In case of cantilevered or doubly reinforce beams or slabs, the main reinforcing bars shall be held in position by introducing chain spacers or supports bars at 1.0 to 1.2 meter centers.

(ii) In case of columns and walls, the vertical bars shall be kept in position be means of timber temphthes with slots accurately out in them, the tamphthes shall be removed after concreting has been done below it. The bars may be also be suitably tied by means of annealed steel wires to the shuttering to maintain their position during concreting.

1.2. AH bars projecting form pillars, columns, beams, slabs etc, to which other bars and concrete are to be attached of bounded to later on, shall be protected with a coat of thin neat cement grout, if the bars are not likely to be incorporated with succeeding mass of concrete within the following 10 days. This coat of thin neat cement shall be removed before concreting.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 5.3.13 shall be followed.

- 2.2. The volume Occupied by reinforcement shall not be deducted from R.C.C. work.
- 2.3. The rate shall be for a unit of one cubic meter.
- 5.4.4. **Providing and laying cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) for reinforced concrete chhajjas not exceeding 10cms. thickness up to floor two level including finishing the exposed surface with cement mortar 1:3 (1 cement : 3 fine sand) to give a smooth and even surface, centering and form work and curing complete excluding cost of reinforcement.**
- 1.0. **Materials & Workmanship**
- 1.1. The cement mortar shall conform to m-11.
- 1.2. The relevant specification of item No. 5.3.13 and 5.4.1 shall be followed except that the work shall be carried out for reinforced concrete chhajjas not exceeding 10 cms. in thickness.
- 1.3. The specifications for form work and centering shall be as per item No. 9.1.
- 1.4. The finishing work in cement mortar 1:3 (1 cement : 3 fine sand) shall be carried out as per specifications of item No. 17.49 (I), Before the plastering is done, the surface of the concrete shall be raked for proper bond.
- 2.0. **Mode of measurements & payment**
- 2.1. The relevant specification of item No. 5.3.13 and 5.4.1 shall be followed except that the work of chhajjas up to 10 cms. shall be earned out including centering form work and finishing the surface with cement mortar 1:3 (1 cement : 3 fine sand).
- 2.2. The rate shall be for a unit of one cubic meter,
- 5.4.10. **Providing an Mild Steel reinforcement for R.C.C. work including bending binding and placing in position etc. complete up to floor two level.**
- 1.0. **Materials**
- 1.1. Mild Steel bars shall conform to M-18. Mild steel binding wires shall conform to M-21.
- 2.0. **Workmanship**
- 2.1. The work shall consist of furnishing and-placing reinforcement to the shape and dimensions shown as on the drawings or as directed
- 2.2. Steel shall be clean and free from rust and loose mill scale at the time of fixing in position and subsequent concreting.
- 2.3. Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to specified shape and dimensions or as directed, using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport-or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending Unless otherwise specified a "U" type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.
- 2.4. All the reinforcement bars shall lie accurately placed in exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size, and by using stay blocks or metal chair spacers, metal hangers supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports nor displaced during concreting or any other operations of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of concrete, except where shown on drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed Pieces of broken stone or brick and wooden blocks shall not be used Layers of bars shall be separated by spacer bars, precast mortar blocks or other approved devices Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All the bars protruding from concrete and to which other bars are to be lapped and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.
- 2.5. Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm. in such a manner that they do not slip over each other at the time of fixing and concreting.
- 2.6. As far possible, bars of full length shall be used. In case this is not possible. Over lapping of bars shall be done as directed When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm. Where not feasible, overlapping bars shall be bound with annealed wires not less than 1 mm. thick

twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither shear nor bending moment is maximum.

2.7. Whenever indicated on the drawings or desired by the Engineer-in-charge, bars shall be jointed by couplings which shall have a cross-section sufficient to transmit the full stresses of bars. The ends of the bars that are joined by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross-section of the bar. Threads shall be standard threads Steel for coupling shall conform to I.S. 226.

2.8. When permitted or specified on the drawings, joints of reinforcement bars shall bull-welded so as to transmit their full stresses. Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, stains, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. electrodes used for welding shall conform to I.S. 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.

3.0. Mode of Measurements & Payment

3.1. For the purpose of calculating consumption, wastage shall not be permitted beyond 5 percent. Excess consumption over 5% will be charged at penal rate.

3.2. Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to in place lap joints, such joints shall be measured for payment as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in tones on the same basis of as per M-18 even though steel is supplied to the contractor by the department on actual weight. Length shall include hooks at the ends. Wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be deemed to be included in the rate for reinforcement.

3.3. The rate for reinforcement includes cost of steel binding wires, its carting from Department store to work site, cutting, bending, placing, binding and fixing in position as shown on the drawings and as directed. It shall also include all devices for keeping reinforcement in approved position, cost of joining as per approved method and all wastage and spacer bars.

3.4. The rate shall be for a unit of One Kg.

5.4.11. High yield deform bars steel reinforcement for R.C.C. work including bending, binding and placing in position complete up to floor two level.

1.0. Materials

1.1. Cold twisted steel bars (high yield strength deformed bars) shall conform to M.19 Mild steel binding wires shall conform to M-21.

2.0. Workmanship

2.1. The specifications of item No. 5.4.10 shall be followed except that the cold twisted steel bars shall be used with or without hooks at the ends. Deformed bars without hooks shall, however, comply with relevant anchorage requirements.

3.0. Mode of Measurement & Payment

3.1. The relevant specifications of item No. 5.4.10 shall be followed.

3.2. The rate shall be for a unit of One kg.

5.4.13. Extra for additional lift of concrete for all R.C.C. work above floor two level excluding cost of reinforcement.

1.0. Materials & Workmanship

The relevant specifications for item No. 5.4.1 shall be followed for the work except that the R.C.C. work shall be done for ground floor i.e. above plinth level to first floor level.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 5.4.1 shall be followed except that rate shall be for extra lift above plinth to floor two level over and above the rate of concrete at floor two level.

2.2. The rate shall be for a unit of one cubic meter per floor.

5.4.13.(A) Extra for additional lift of reinforcement steel for all R.C.C. work above floor two level.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 5.4.10 as may be applicable, shall be followed except that the work shall be carried out above floor two level for each floor.

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 5.4.10 or 5.4.11 as may be applicable shall be followed except

that the work shall be carried out above floor tow level.

2.2. The rate shall be for a unit of one kg. per floor.

5.6.2. **Providing up to floor two level precast cement concrete or grill 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm: nominal size) reinforced with 1.6 mm. dia mild steel size wire including roughening, cleaning fixing and finishing in cement mortar 1:3 and curing complete.**

(A) 50 mm. thick (B) 40. mm. thick (C) 25. mm. thick (E) 100 mm. thick.

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Mortar shall conform to M-11. Aggregates shall conform to M-12. Mild steel wire shall conform to M-21. Shattering shall conform to M-26.

2.0. Workmanship

It shall be cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm. nominal size), reinforced with 1.6. mm. dia mild steel wire unless otherwise specified. The thickness of the jali shall be as specified in the item. The jali shall be set in position true to line and level before the jambs sills and soffits to the opening are plastered. It shall then be properly cemented with cement mortar 1:3 (1 cement : 3 sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered gripping the jali uniformly on all sides.

3.0. Mode of measurement of payment

3.1. The item shall be measured in square meter.

3.2. The rate shall be for a unit of one square meter,

5.8.1. **Providing and laying controlled concrete M-150 and curing complete excluding the cost of form work and reinforcement for reinforced concrete work in:**

(A) Foundation, footings, base of columns, and mass concrete, (B) Walls from top of foundation/level up to floor two level. (C) Slabs, pillars, posts and struts, up to floor two level (E) Staircase up to floor two level. (F) Vertical and horizontal fins up to floor two level.

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8 Course aggregate shall conform M-12.

2.0. General

2.1. The relevant specification of item No. 5.4.1. of ordinary concrete shall be followed except that the concrete mix shall be designed form preliminary tests. The proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350 & M-400 with prefix controlled added to it. The letter M refers to mix and the numbers specify 28 days works cube compressive strength of 150 mm. cubes of the mix expressed in Kg./Cmnt.

2.2. The proportion of cement, sand and coarse aggregate shall be determined of weight. The weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The strength requirements of different grades of concrete shall be as under:

Grade Concrete	Compressive strength of 15 cms. cubes in Kg./Cmt. at 28 days, conducted in accordance with I.S. 516-1959. Preliminary test Min.	Work test Min.
M-1 50	200	150
M-200	260	200
M-250	320	250
M-300	380	300
M-350	440	350
M-400	500	400

In all cases, the 28 days compressive strength specified in above be the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for purpose as concrete belonging to the lower of the grades between which its strength lies.

3.0. Workmanship

3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work question and can be property compacted with means available except where ft can be shown to the satisfaction of the Engineer-in-charge, that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate shall be controlled by obtaining the coarse aggregates in different sizes and bending them in the right proportions as required. Aggregates of different sizes shall be

stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests..

3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted from bulk stocks at site and not by bags, it shall be weighed separately from the aggregate. Water, shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in clean, and serviceable condition. Their accuracy shall be periodically checked.

3.3. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates. I.S. 2386 (Part-III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 220 kg./M³ in plain concrete and not less than 250 kg/M³ in reinforced concrete.

4.0. Mode of measurement & payment

4.1. The relevant specifications of item No.5.4.1 shall be followed, except that the controlled concrete R.C.C. work as specified in item shall be measured under this item. The rate excludes cost of form work.

5.8.2. Providing and laying controlled cement concrete M-200 and curing complete, excluding the cost of form work and reinforcement for reinforced concrete work in :

(A) Foundations, footings base of columns, and mass concrete. (B) walls from top of foundation up to floor two level (C) Slabs, landings, shelves, balconies lintels, beams, girders and cantilever up to floor two level, (D) Columns, pillars, posts and struts upto floor two level (E) Stair cases up to floor two level (K) Vertical and horizontal fins upto floor two level.

1.0. Materials & Workmanship

The relevant specifications of item No. 5.8.1 shall be followed except that the grading of concrete shall be controlled concrete M-200 grades for works 35 specified in item.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No, 5.8.1. shall be followed.

2.2. The rate shall be for one cubic meter.

5.8.3. Providing and laying controlled cement concrete M-250 and curing complete excluding the cost of reinforcement of reinforced concrete work in:

(A) Foundations, footings, bases of columns, and the like and mass concrete (B) Walls from, top of foundation level up to floor two level (C) Slabs, landing, shelves, balconies, beams, girders and cantilever up to floor two level (D) Columns, pillars, struts up to floor two level.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 5.8.1. shall be followed except the grading of concrete shall be controlled concrete M-250 grades for the works as specified in the item.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 5.8.1. shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

5.00.1. Providing and laying ordinary concrete 1:2:4 (1 cement : 2 coarse sand :4 graded stone aggregates 20 mm. nominal size) and finishing smooth with curing etc., complete including the cost of form work but excluding the cost of reinforcement for R.C.C. work in: (I) Slabs up to 8 cms. thickness (II) Slabs having more than 8 cms. and up to (III) Slabs having more than 10 cms. and up to 13 cms. thickness (IV) Slabs having more than 13 cms. and up to 15 cms. thickness.

1.0. Materials & Workmanship

1.1. The relevant specifications for item No. 5.4.1. shall be followed for concrete work and relevant specifications of item No. 9.1. shall be followed for form work and centering. The concrete surface shall be smooth finished with cement mortar 1:3 (1 cement: 3 fine sand) as per item No. 17.59 (I) The thickness shall be as specified in the item.

2.0. Mode of measurement & payment

2.1. The relevant specification for item No. 5.4.1 shall be followed except that item shall include the item providing from work and centering work as directed.

2.2. The rate shall be for a unit of one cubic meter.

5.00.2. Providing and laying controlled cement M-150 and finishing smooth with curing etc. complete including the cost of form work but excluding the cost of reinforcement for R.C.C. work in :
(I) slabs up to 8 cms. thickness (II) Slabs more than 8 cms. 10 cms. (III) Slabs more the 10 cms. and up to 13 cms. (IV) Slabs more than 13 cms. and up to 15 cms.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 5.8.1. shall be followed for concrete work and item No. 9.1. shall be followed for form work and centering. The concrete surface shall be smooth finished with cement mortar 1:3 (1 cement : 3 fine sand) as per No. 17.59 (I) The thickness shall be as specified in the item.

2.0. Mode of Measurement & Payment

2.1. The relevant of item No. 5.8.1. shall be followed except that the item shall include the cost and from work and centering.

2.2. The rate shall be for a unit of one cubic meter.

5.00.3. Providing and laying ordinary cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregates 20 mm. nominal size) exposed work with curing etc. complete. including the cost of work but excluding the cost of reinforcement for R.C.C. work in : (I) Slabs up to 8 cms. thickness (II) Slabs having more than 8 cms.-and up to 10 cms. thickness (HI) Slabs having more than 10 cms. and up to 13 cms. thickness. (IV) Slabs having more than 13 cms. and up to 15 cms. thickness.

1.0. Materials & Workmanship

1.1. There relevant specifications of item No. 5.4.1. shall be followed for concrete work and that of form work and centering work shall be followed as per item No. 9.1. and 9.7. the thickness of the slab shall be as specified in the item.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 5.4.1. shall be followed except that form work and centering work shall be included in the item.

2.2. The rate shall be for a unit of one cubic meter.

5.00.4. Providing any laying controlled cement concrete M-150 exposed work with curing ere., complete including the cost of form work but excluding the cost of reinforcement for R.C.C. work in : (I) Slabs up to 8 cms. thickness (II) Slabs having more than 8 cms. and up to 10 cms. thickness (III) Slabs having more than 10 cms. and up to 13 cms. thickness. (IV) Slabs having more than 13cms. and up to 15 cms. thickness.

1.0. Materials & Workmanship

1.1. The relevant specification of item No 5.4.1. shall be followed for controlled concrete and the relevant specifications of item No. 9.7. and 9.1. shall be followed for exposed concrete form work and centering work. The thickness of the stab shall he as specified in the item.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 5.8.1. shall be followed except that the form work and centering work shall be included in the item.

2.2. The rate shall be for a unit of one cubic meter.

5.00.5. Providing and laying ordinary cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 grades stone aggregate 20 mm. nominal size) for R.C.C. lintel including finishing smooth with curing etc. complete including the cost of form work but excluding the cost of reinforcement.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 581. shall be followed for concrete work, relevant specifications of item No. 17.59.(I) for finishing work and relevant specifications of item No. 9.1. shall be followed form work and centering work The concrete work shall be followed for the form work and centering work for exposed concrete work.

2.0. Mode of measurement & payment

2.1. The relevant specification of item No. 5.3.1. shah be followed except that the item includes the cost form work for exposed concrete work

- 2.2. The rate shall be for a unit of one cubic meter.
- 5.00.6. **Providing and laying cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) and finishing smooth with curing etc., complete, including the cost of form work but excluding reinforcement for R.C.C. work in : (A) Beams : (I) Having cross sectional areas 0.05 to 0.08 Sq. meter. (II) Having cross sectional area more than 0.08 Sq. up to 0.12 Sq. mt (III) Having cross sectional area more than 0.12 Sq. Mt. and up to 0.18 Sq. Mt (B) Column; (I) Having cross sectional area 0.05. to 0.08 Sq. mt. (III) Having cross sectional area more than 0.12 Sq.Mt. and up to 0.18 Sq.mt.**
- 1.0. **Materials & Workmanship**
- 1.1. The relevant specifications of item No. 5.4.1. shall be followed for concrete work and item No. 9.1. shall be followed for form work and centering work. The finishing shall be done in cement mortar 1:3 (1 cement: 3 fine sand) as per item No. 17.59(1). The cross sectional area of beam shall be specified in item.
- 2.0. **Mode of measurement & payment**
- 2.1. The relevant specification of item No. 5.4.1. shall be followed but the form work and centering work shall be included in the item.
- 2.2. The rate shall be for a unit of one cubic meter.
- 5.00.7. **Providing and laying controlled cement concrete M-150 exposed work with curing etc. complete, including the cost of form work but excluding the cost of reinforcement for R.C.C. work in : (A) Beams : (I) Having cross sectional area 0.05 to 0.08 Sq. mt. (II) Having cross sectional area more than 0.08 Sq. mt. up to 0.12 Sq.mt (III) Having cross sectional area more than 0.12 Sq. mt. and up to 0.18 Sq.mt.: (B) Columns; (I) Having cross sectional area of 0.05 to 0.08 Sq.mt (II) Having cross sectional area more than 0.08 sq.mt. and up to 0.12 sq.mt. (III) Having cross sectional area more than 0.12 Sq.Mt and up to 0.18 Sq.mt.**
- 1.0. **Materials & Workmanship**
- 1.1. The relevant specifications of item No. 5.8.1. shall be followed for controlled concrete work as specified in item for M-150 and relevant specifications of item 9.1 shall be followed for the form work centering work for exposed cement work.
- 2.0. **Mode of measurement & payment**
- 2.1. The relevant specifications of item No. 5.8.1 shall be followed except that the form work and centering work shall be included in the item.
- 2.2. The rate shall be for a unit of one cubic meter.
- 5.00.8. **Providing and laying controlled cement concrete M-200 exposed work with curing etc. complete, including the cost of form work but excluding the cost of reinforcement for R.C.C. work in (A) Beams : (I) Having cross section area 0.05 to 0.08 Sq. mt (II) Having cross sectional area 0.08 Sq.mt and up to 0.12 Sq. mt. (III) Having cross sectional area 0.12 Sq. and up to 0.18 Sq. Mt. (B) Columns : (I) Having cross sectional area 0.05 to 0.08 Sq.Mt. (II) Having cross sectional area more than 0.08 Sq.Mt and up to 0.12 Sq.Mt. (III) Having cross sectional area more than 0.12 Sq. mt. and up to 0.18 Sq.Mt.**
- 1.0. **Materials & Workmanship**
- 1.1. The relevant specifications of item No. 5.8.1. shall be followed for controlled concrete work for work as specified in item for M-200 and relevant specifications of item 9.7 and 9.1 shall be followed for the form work and centering work for exposed cement work.
- 2.0. **Mode of measurements & payment**
- 2.1. The relevant specification of item No. 5.8.1. shall be followed except that the item includes the cost of form work and centering work for exposed work.
- 2.2. The rate shall be for a unit one cubic meter.
- 5.00.9. **Providing and laying controlled cement concrete M-250 exposed work with curing etc. complete including the cost of from work but excluding the cost of reinforcement for R.C.C. work in : (A) Beams : (I) Having cross sectional area 0.05 to 0.08 Sq.mt.(II) Having cross sectional areas more than 0.08 Sq.mt. and up to 0.12 Sq. mt (III) Having cross sectional area more than 0.12 Sq.mt. and up to 0.18 Sq. Mt. (5) Columns :(I) Having cross sectional area 0.05 to 0.08. Sq.Mt (II) Having cross sectional area more than 0.08 Sq. mt. and up to 0.12 Sq. mt. (III) Having cross sectional area more than 0.12 Sq.mt. and up to 0.18 Sq.mt.**
- 1.0. **Materials & Workmanship**
- 1.1. The relevant specifications of item No. 5.8.1. shall be followed for controlled concrete work for the work as specified in the item for M-250 and the relevant R.C.C. lintels shall be carried out.
- 2.0. **Mode of measurement & payment**
- 2.1. The relevant specifications of item No. 5.4.1 shall be followed except that the cost of form work finishing and centering shall be included in the item.
- 2.2. The rate shall be for a unit of one cubic meter.

SECTION – 6

Masonry Work

6.12 (A) Brick work using common burnt clay building bricks having crushing strength not less than 35 Kg/Sq. Cm. in foundations and plinth in cement mortar 1:5 (1 cement :5 fine sand) modular bricks.

1.0. Materials

Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Brick shall conform to M-15. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. Proportion:

2.1.1. The proportion of the cement mortar shall be 1:5 (1 cement: 5 fine sand) by volume.

2.2. Wetting of bricks:

2.2.1. The bricks required for masonry shall be thoroughly wetted with clean water for about two hours before use or as directed. The cessation of bubbles, when the bricks are wetted with water is as indication of through wetting of bricks.

2.3. Laying:

2.3.1. Bricks shall be laid in English bond unless directed otherwise. Half or cut bricks shall not be used except when necessary to complete to bond; closures in such case shall be cut to required size and used near the ends of walls.

2.3.2. A layer of mortar shall be spread on full width for suitable length of the lower course. Each brick shall first be properly bedded and set home by gently tapping with handle of trowel or wooden mallet. Its inside face shall be flushed with mortar before the next brick is laid and pressed against it. On completion of course, the vertical joints shall be fully filled from the top with mortar.

2.3.3. The walls shall be taken up truly in plumb. All courses shall be laid truly horizontal and all vertical joint shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. The thickness of brick course shall be kept uniform.

2.3.4. The brick shall be laid with frog up wards. A set of tools comprising of wooden straight edges, man son's spirit level, square half meter rub, and pins, string and plumb shall be kept on the site of work for frequent checking during the progress of work.

2.3.5. Both the faces of walls of thickness greater than 23 cms. shall be kept in proper place. All the connected brick work shall be kept not more than one meter over the rest of the work. Where this is not possible, the work shall be raked back according to bond (and not left toothed) at an angle not steeper than 45 degrees.

2.3.6. All futures, pipes, outlets of water, hold fasts of doors and windows etc. which are required to be built in wall shall be embedded in cement mortar

2.4. Joints:

2.4.1. Bricks shall be so laid that all joints are quite flush with mortar. Thickness of joints shall not exposed 12 mm. The face joints shall be raked out as directed by raking tools daily during the progress of work, when the mortar is still green so as to provide key for plaster or pointing to done.

2.4.2. The face of brick shall be cleaned the very day on which the work is laid and all mortar dropping removed.

2.5. Curing:

2.5.1. Green work shall be protected from rain suitably. Masonry work shall be kept moist on all the faces for a period of seven days. The top of masonry work shall be kept well wetted at the close of the day.

2.6. Preparation of foundation bed:

2.6.1. If the foundation is to be laid directly on the excavated bed, the shall be leveled, cleared of all loose materials, cleaned and wetted before stating masonry, If masonry is to be laid on concrete footing, the top of concrete shall be cleaned and moistened. The contractor shall obtain the engineer's approval for the foundation bed before foundation masonry is started. When pucca flooring is to be provided flush with the top to plinth, the inside plinth offset shall be kept lower than the outside plinth top by the thickness of the flooring.

3.0. Mode measurements & payment

3.1. The measurements of this item shall be taken for the brick masonry fully completed in foundation up to plinth. The limiting dimensions not exceeding those shown on the plinths or as directed shall be final. Battered tapered and curved portions shall be measured net.

3.2. No deduction shall be made from the quantity of brick work, for any extra payment made for embedding in masonry or making holes in respect of following items:

- (1) Ends of joists, beams, posts, girders, purlins, trusses, corbel, steps etc. where cross sectional area does not exceed 500 Sq.Cm.
- (2) Openings not exceeding 1000 Sq.Cm.
- (3) Wall plates and bed plates, bearing of slabs, chajjas and the like whose thickness does not exceed 10 Cms. and the bearing does not extend to the full thickness of wall.
- (4) Drainage holes, and recesses for cement concrete blocks to embed hold fasts for doors, windows etc.
- (5) Iron fixtures, pipes up to 300 mm. dia hold fasts, and doors and windows built into masonry and pipes etc. for concealed wiring.
- (6) Forming chases of section not exceeding 350 -Sq. Cm. in masonry.

3.3. Apertures for fire places shall not be deducted nor shall be paid for separately.

3.4. The rate shall be for a unit of one cubic meter.

6.12. (B) Brick work using common burnt clay building bricks having crushing strength not less than 35 Kg/Sq. Cm. in foundations and plinth in cement mortar 1:5 (1 cement : 5 fine sand) conventional bricks.

1.0. Materials

Cement mortar of proportion 1:5 shall conform to M-11. Conventional bricks shall conform to M-15.

2.0. Workmanship

The relevant specification of item No. 6.12 (A) shall be followed except that the bricks to be used shall be modular bricks and the proportion of cement mortar is 1:6.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 6.12(A) shall be followed.

3.2. The rate shall be a unit of one cubic meter.

6.13.(A) Bricks work using common burnt clay building bricks having crushing strength not less than 35 Kg/Sq. Cm in foundation and plinth in cement mortar 1:6 (1 cement : 6 find sand) with conventional bricks.

1.0. Materials

Water shall conform to M-1. Cement mortar shall conform to M-11. Bricks shall conform to M-15.

2.0. Workmanship

2.1. The relevant specification of item No. 6.12 (A) shall be followed except that the bricks to be used shall be conventional bricks and proportion of cement mortar shall in C.M. 1:6.

3.0. Mode of measurements & payment

3.1. The relevant specification of item No. 6.12(A) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

6.0.0.1(A) Brick work using common burnt clay building bricks having crushing strength not less than 35 Kg/Sq. Cm. in foundation and plinth in cement mortar 1:8 (1 cement :8 find sand), with Modular bricks.

1.0. Materials

Water shall conform to M-1. Brick shall conform to M-15. Cement mortar shall be conform to M-11.

2.0. Workmanship

2.1. The relevant specification of item No. 6.12(A) shall be followed except that the proportion of cement mortar shall be cement mortar 1:8 and bricks used shall be conventional bricks.

3.0. Mode of measurements & payment

3.1. The relevant specification of item No. 6.12(A) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

6.00.1.(B) Brick work using common burnt clay building bricks having crushing strength not less than 35 Kg/Sq. Cm. in foundation and plinth in cement mortar 1:8 (1 cement : 8 fine sand), with conventional bricks.

1.0. Materials

Water shall conform to M-1. Brick shall conform to M-15, cement mortar shall be conform to M-11.

2.0. Workmanship

2.1. There relevant specifications of item No. 6.12(A) shall be followed except that the proportion of cement mortar shall be cement mortar 1:8.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item No. 6.12(A) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

6.0.0.1.(A) Brick work using common burnt clay building bricks having crushing strength not less than 35 Kg./Sq. Cm. in foundation and plinth in time mortar 1:1.5 (1 Lime putty : 1.5 find sand) modular bricks.

1.0. Materials

Lime mortar of proportion (1:1.5) shall conform to M-10. Bricks shall conform to M-15.

2.0. Workmanship

2.1. The relevant specification of item No. 6.12(A) shall be followed except that the proportion of cement mortar shall be cement mortar 1:8 and bricks used shall be conventional bricks.

3.0. Mode of measurements & payment

3.1. The relevant specification of item No. 6.12(A) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

6.001.(B) Brick work using common burnt clay building having crushing strength not less than 35 Kg/Sq. Cm. in foundation and plinth in cement mortar 1:8 (1 cement: 8 fine sand), with conventional bricks.

1.0. Materials

Water shall conform to M-1. Brick shall conform to M-15, Cement mortar shall be conform to M-11.

2.0. Workmanship

2.1. The relevant specifications of item No. 6.12. (A) shall be followed except that the proportion of cement mortar shall be cement mortar 1:8.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 6.12. (A) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

6.0.0.2.(A) Brick work using common burnt clay building bricks having crushing strength not less than 35 Kg./Sq. Cm. in foundation and plinth in lime mortar 1:1.5 (1 Lime putty: 1.5 find sand) modular bricks.

1.0. Materials

Lime mortar of proportion (1:1.5) shall conform to M-10. Bricks shall conform to M-15.

2.0. Workmanship

The relevant specification of item No. 6.12. (A) shall be followed except the masonry work shall be carried out in lime mortar 1:1.5 (1 lime putty 1.5 fine sand) in foundation and plinth.

3.0. Mode of measurements & payment

3.1. The relevant specification of item No. 6.12. (A) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

6.0.0.2.(B) Brick work using common burnt clay building bricks having crushing strength not less than 35 Kg/Sq. Cm. in foundation and plinth in lime mortar 1:1.5 (1 Lime putty : 1.5 find sand) conventional bricks.

1.0. Materials & Workmanship

The relevant specification of item No. 6.12(A) and 6.0.0.2(A) shall be followed except that the masonry work shall be carried out by using conventional bricks in lime mortar 1:1.5 (1 Lime putty: 1.5 fine sand) in foundation and plinth.

2.0. Mode of measurements & payment

2.1. The relevant specification of item No. 6.12(A) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

6.0.0.3.(A) Brick work using common burnt clay building brick having crushing strength not less than 35 Kg. Sq. Cm. in foundation and plinth in lime mortar 1:2 (1 lime putty :2 find sand) modular bricks.

1.0. Materials & workmanship

The relevant specification of item No. 6.12(A) and 6.0.0.2(A) shall be followed except that the masonry work shall be carried out in lime mortar 1:2 (1 Lime putty : fine sand) in foundation and plinth,

2.0. Mode of measurements & payment

2.1. The relevant specification of item No. 6.12 (A) shall be followed.

2.2. The rate shall be for a one cubic meter.

6.0.0.3(3) Brick work using burnt clay building bricks having crushing strength not less than 35 Kg/Sq. Cm. in foundation and plinth in lime mortar 1:2 (1 Lime Putty : 2 find sand) modular bricks.

1.0. Materials & Workmanship

The relevant specifications of item No. 6.12 A and 6.0.03 shall be followed except that the masonry work shall be carried out in lime mortar 1:2 (1 lime : 2 fine sand) using conventional bricks in foundation and plinth.

6.19.(A) Brick work using common burnt clay building brick having crushing strength not less than 35 kg/sq.cm. for super structure above plinth level up to floor two level in cement mortar 1:5 (1 cement: 5 fine sand) modular bricks.**1.0. Materials**

Bricks shall conform to M-15. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. The relevant specification of item No. 6.12 (A) shall be followed except that the masonry work shall be carried out above plinth level to floor two level i.e. for ground floor.

2.2. The frames of doors, windows, cupboards etc. shall be housed into the brick work at the correct location and level as directed. The heavy steel doors, window frames etc. shall be built in with work, but for ordinary steel doors and windows required opening for frames, hold-fasts, etc., shall be in the wall and frame embedded later on in order to avoid damage to the frames.

2.3. Necessary scaffolding shall be provided. The supports of the scaffolding shall be sound and strong tied, together with horizontal pieces over which the scaffolding plunks shall be fixed. Simple scaffolding shall be allowed normally. In this case scaffolding hole shall rest in hole header horizontal course only. Minimum number of holes be left in brick work for supporting horizontal scaffolding poles. The contractor is responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it.

2.4. For the face of brick work, where plastering is to be done, joints shall be raked out to a depth not less than thickness of joints. The face of brick work shall be cleaned and mortar dropping removed on very same day that brick work is laid.

3.0. Mode of measurements & payment

3.1. The masonry work of G.F. i.e. above plinth level to floor two level shall be measured and paid under this item.

3.2. Brick work in parapet shall be included in the corresponding masonry item of store immediately below the floor above which the parapet is built.

3.3. No deduction shall be made from quantity of brick work nor any extra payment made for embedding in masonry of marking holes in respect of following item.

(1) Ends of joints, beams, posts, girders, rafters, purlins trusses corbel, steps, etc. where cross sectional area does not exceed 500 sq.cm.

(2) Opening not exceed in 1000 sq.cm.

(3) Wall plate sand bed plates bearing of slab, chhajjas, and like whose thickness does not exceed 10 cms. and the bearing does not extend the full thickness of wall.

(4) Drainage holes and recesses for cement concrete blocks to embed hold fasts for doors, window etc.

(5) Iron fixtures, pipes up to 300 mm. dia. hold fasts of doors, and window built into masonry and pipes etc. for concealed wiring.

(6) Forming charges of section not exceeding 350 sq.cm. in masonry.

(7) Apparatuses for fire places, shall not be deducted nor shall extra labour required to make splaying of jumps, throating and making trenches over the aperture be paid for separately.

3.4. The rate shall be for a unit of one cubic meter.

6.19.(B) Brick work using common burnt clay building bricks having crushing strength not less than 35 kg/sq. cm. for super structure above plinth up to floor two level in cement mortar 1:5 (1 cement: 5 fine sand) conventional bricks.**1.0. Materials & Workmanship**

The relevant specification of item No. 6.19(A) shall be followed except that brick masonry work shall be carried out with conventional bricks.

2.0. Mode measurement and payment

2.1. The relevant specification of item No. 6.19 (A) Shall be followed.

2.2. The rate shall be for a unit of one cubic meter per meter.

6.20 Extra for brick in super structure above floor two level.**1.0. Materials and workmanship**

The relevant specifications of item masonry work to be earned out shall be followed except that this work is for additional lift of one floor above two level.

2.0. Mode of measurements and payment

2.1. The relevant specification of item No. 6.19 (A) masonry work shall be followed.

2.2. The extra payment shall be made for additional lift above floor two level to each additional floor over and above the rate of masonry work.

2.3. The rate shall be for a unit of cubic meter per floor.

6.30.I(A) Half brick masonry in common burnt clay building having crushing strength not less than 35 kg/sq.cm. in cement mortar 1:4 {1 cement : 4 coarse sand) for super-structure above plinth level up to floor two level with conventional bricks.**1.0. Materials**

Bricks shall conform to M-15. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. Relevant specifications of bricks, wetting and laying of bricks, joints, curing etc shall conform to item no. 6.19.(A) except that the brick work of half shall be carried out.

2.2. Cement mortar used in masonry work shall be in proportion of 1 part of cement and 4 parts of sand by volume.

2.3. AH bricks shall be laid stretcher wise, breaking joints with those in the upper and lower courses. The wall shall be taken truly plumb. All courses shall be said truly horizontal and all vertical joints shall be truly vertical. The bricks shall be laid with frogs upwards. A set of masons tools shall be maintained on work as required for frequent checking.

3.0. Mode of measurement and payment

3.1. The half brick masonry work in foundation and plinth shall be measured under this item the limiting dimensions shall not exceed those shown in the plan or as directed. Any work done extra over the specified dimensions shall be ignored.

3.2. The relevant specifications of item no. 6.12. shall be followed. The length shall be measured nearest to one cm.

3.3. The rate shall be for a unit of one sq. meter.

6.30.I.(B) Half brick masonry in common burnt clay building bricks crushing strength not less than 35 kg/sq. cm. in cement mortar 1:4 (1 cement :4 coarse sand) for super-structure above plinth level up to floor two level with conventional bricks.**1.0. Materials and Workmanship**

1.1. The relevant specifications of Item No. 6.30.1 (A) shall be followed for bricks, wetting, laying of bricks, joints, curing, except that the bricks to be used shall be conventional bricks instead of modular bricks.

2.0. Mode of measurement and payment

2.1. The limiting dimensions shall not exceed those shown in the plan or as directed. Any work done extra over specified dimensions shall be ignored.

6.30.II.(A) Half brick masonry in common burnt clay building bricks having crushing strength not less than 35 kg/sq.cm. in cement mortar 1:5 (1 cement : 5 coarse sand) with modular bricks in foundations and plinth.**1.0. Materials & workmanship**

The relevant specifications of item No. 6.30.I (A) shall be followed except the half brick masonry work shall be carried out in cement mortar 1:5 (1 cement : 5 coarse sand) with modular bricks in foundation and plinth.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item no. f, 30. I (A) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

6.30.II.(B) Half brick masonry on common clay building bricks having crushing strength not less than 35 kg/sq. cm. in cement mortar 1:5 (1 cement : 5 coarse sand) in foundation and plinth using conventional bricks.**1.0. Materials & workmanship**

1.1. The relevant specifications of item No. 6.30.I (A) shall be followed for bricks, wetting, laying of bricks, joints, curing, except that the bricks to be used shall be conventional bricks instead of modular bricks.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 6.30.I (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

6.30 HI.(A) Half brick masonry in common burnt clay building having crushing strength not less than 35 kg/sq. cm. in lime mortar 1:15 (1 lime putty : 1.5 coarse sand) in foundation and plinth with modular bricks.

1.0. Materials & workmanship

The relevant specifications of item No. 6.30 (I)-A shall be followed except that the half bricks work shall be carried out in cement 1:5 (1 cement: 5 coarse sand) in foundation and plinth using conventional bricks.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item no. 6.30 (I)-A shall be followed.

2.2. The rate shall for a unit of one sq. meter.

6.30.III(A) Half brick masonry in common burnt clay building having crushing strength not less than 35 kg/sq. cm. in lime mortar 1 :1.5 (1 lime putty : 1.5 coarse sand) in foundation and plinth with modular bricks.**1.0. Materials**

Modular bricks shall conform to M-15 water shall conform to M-1. Lime mortar or proportion L.M. 1:1.5 (1 Lime putty : 1.5 coarse sand) shall conform to M-10.

2.0. Workmanship

The relevant specifications of item No. 6.30 (I) (A) shall be followed except that the half brick masonry work shall be carried out in lime mortar 1:1.5 (1 Lime putty : 1:1.5 coarse sand) in foundation and plinth using modular bricks.

3.0. Mode of measurements & payment

3.1. The relevant specification of item No. 6.30 (I) A shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

6.30.III(8) Half brick masonry in common burnt clay building bricks having crushing strength not less than 35 kg/sq. cm. in mortar 1: 1.5 (1 Lime putty : 1.5 coarse sand) in foundation and plinth with conventional bricks.**1.0. Materials**

Conventional bricks shall conform to M-15, water shall conform to M.1. Lime mortar or proportion L.M. 1:1.5 (1 Lime putty : 1.5 coarse sand) shall conform to M-10.

2.0. Workmanship

The relevant specifications of item No. 6.30 (I)-A shall be followed except that half brick masonry work shall be carried out in Lime Mortar 1:1.5 (1 Lime putty : 1.5 coarse sand) in foundation and plinth using conventional bricks.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 6.30 (I)-A shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

6.30 II(A) Half brick masonry in common burnt clay building bricks having crushing strength not less than 35 kg/sq. cm. in cement 1:5 (1 cement : coarse sand) with hoop iron 25 mm. x 1.6 mm. or equivalent reinforcement at every third coarse embedded in cement mortar in foundation and plinth with modular bricks.**1.0. Materials**

Bricks shall conform to M-15. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Cement mortar shall conform to M-11. M.S. reinforcement shall conform to M-18.

2.0. Workmanship

2.1. Relevant specifications of bricks, wetting and laying of bricks, joints, curing, scaffolding etc. shall conform to item No. 6.30 (I)-A except the following :

2.2. Cement mortar used in masonry work shall be in proportion to 1 part of cement and 5 parts of sand by volume and shall conform to M-11, and this work is for half brick thickness for partitions walls.

2.3. The hoop iron 25 mm x 1.6 or equivalent reinforcement shall be provided at every third course. The ends of reinforcement shall be fully embedded in main walls on both sides as directed. Reinforcement shall be placed on the top of the bottom most course. Laps shall be of 15 cms. of mild steel bars or hoop iron.

2.4. The joints in the course where reinforcement is placed shall admit of mortar cover to the reinforcement.

3.0. Mode of measurements and payment

- 3.1. The rate shall be for half brick masonry work providing specified reinforcement, the limiting dimensions not exceeding those in the plan or as directed. The length shall be measured nearest to one cm.
- 3.2. Any work done extra over specified dimensions shall be ignored.
- 3.3. The rate shall be for a unit one sq. meter.

6.30.II(B) Half brick masonry in common burnt clay building having crushing strength not less than 35 kg/sq.cm. in cement mortar 1:5 (1 cement : 5 coarse sand) with hoop iron 25 mm. x 1.6 mm. or equivalent reinforcement at every third course embedded in cement mortar in foundation and pith, with conventional bricks.

1.0. Materials & Workmanship

- 1.1. The relevant specifications of item No. 6.30 I (A) shall be followed except that the work is to be carried out with conventional bricks instead of Modular bricks.

2.0. Mode of measurements and payment

- 2.1. The rate shall be for half brick work, including providing specified reinforcement, the limiting dimensions out with conventional bricks instead of Modular bricks.
- 2.2. The work done extra over specified dimensions shall be ignored.
- 2.3. The rate shall be for a unit of one sq. meter.

6.33.(A) Extra for half brick masonry in superstructure above floor two level. Modular bricks.**1.0. Materials & Workmanship**

- 1.1. The relevant specifications for item No. 6.30 A & 6.30. B shall be followed except that this work is for additional lift over and above the payment of work up to floor two level.
- 1.2. The rate shall be for a unit of one sq. meter per floor.

6.33.(B) Extra for half brick masonry work in superstructure above floor two level. Conventional bricks.**1.0. Materials & Workmanship**

- 1.1. The relevant specifications for item No. 6.30 A & 6.30. B shall be followed except that this work is for additional lift of each floor two level using conventional bricks.

2.0. Mode of measurements and payment

- 2.1. The relevant specification of item No. 6.33 (A) shall be followed.
- 2.2. The rate shall be for a unit of one sq. meter per floor

6.55 (1) Half brick thick Honey-comb brick work with burnt work with burnt clay building bricks having crushing strengths not less than 35 kg/sq.cm. in C.M. 1:4 (1 cement : 4 coarse sand)**1.0. Materials**

Bricks shall conform to M-15 Cement mortar of proportion shall conform to M-11.

2.0. Workmanship

The relevant specifications of item No. 6.32(A) shall be followed except that the masonry work shall be carried out Honey-comb in thickness of half bricks in cement mortar 1:4 (1 cement: 4 coarse sand) and as and where directed with all lifts.

3.0. Mode of measurements and payment

- 3.1. The honey-comb work shall be measured in sq. meters. The full area of honey comb work shall be measured without with all lifts.
- 3.2. The rate shall be for a unit of one square meter of wall surface.

SECTION-7**Rubble Masonry Work**

7.6(1) Uncoarsed rubble masonry with hard stone approved quality in foundations and plinth in cement mortar 1:6 (1 cement : 6 coarse sand) including leveling etc. complete.

1.0. Materials:

The cement mortar shall conform to M-11. Stone shall conform to M-16.

2.0. Workmanship

2.1. Dressing of stones:

Stone used for uncoarsed rubble masonry work shall be hammer dressed on the sides, and beds in which such a way as to close with the adjacent stone in the masonry work as strongly as possible. The face stones shall be dressed in such a manner as to give a specified pattern such as polygonal facing etc. The face of the stones shall be so dressed that bushing on the exposed face shall not project by more than 40 mm. from the general wall surface and on the face to be plastered, it shall not project by more than 19 mm., not shall have depressions more than 10 mm. from the average wall surface.

2.2. Laying:

All the stone shall be sufficiently wetted before laying to prevent absorption of water from mortar. The wall shall be built true to plumb (of true to required batter when so specified). All connected walls in a structure shall be raised up informally and regularly. However if for any specific reason, one part of masonry is required to be left behind the wall shall be racked back at an angle not steeper than 45. Vertical toothed joints in masonry shall not be allowed. The work shall be carried out regularly and masonry of any day wall not be raised by more than 1 meter in height.

2.3. The stone shall be laid in an uncoarsed fashion, or random facing etc. However the masonry is required to be brought to level at various stages viz. plinth level window sill level, roof level and any other level specifically shown in the drawings. This may be done first by adjusting the laying of stone to one level and then by providing leveling course of cement concrete 1:6:12 (1 cement: sand : 12 graded stone aggregate 20 mm. nominal size) or as otherwise specified.

2.4. Proper bonding shall be achieved by closely filling in adjacent stones as well as by using bond stones or through stones as described herein below. Face stones shall extend back sufficiently, and bond well with the masonry. The stone shall be carefully set so as to break joints and avoid formation of vertical joints. The depth of stone from the face of wall inwards shall not be less than weight or breadth at the face. The hearing or interior filling of the wall shall consist of rubble stones which may be of any shape. Neither the face stone nor the hearing stone shall be so small to pass through circular ring of 150 mm. internal diameter in any direction nor shall any of them shall have minimum thickness 100 mm.

2.5. All stone shall be carefully laid, hammered down by a wooden mallet into position and solidly embedded in mortar, chips and spawns of stone may be used wherever necessary to avoid thick mortar bends or joints at the same time ensuring that no hollow space is left anywhere in the masonry. The chips used shall not be more than 20% by volume of masonry. The hearting shall be laid nearly level with face stones except that at about one meter intervals vertical bond stone or plumes projecting about 150 to 200 mm. shall be firmly embedded to from vertical bounding in masonry.

2.6. Bond stone:

Bond stones or through stones running right across the thickness of the wall shall be provided in wall up to 600 mm. thick. In thicker walls two stones overlapping each other by at least 150 mm. shall be provided across the thickness of the wall to form bond stones. There shall be at least one bond stone for every 0.5 sq. mt of wall surface. The bond stone shall be marked by a distinguishing letter during construction for subsequent verification and shall be laid staggered in subsequent layers.

2.7. Quoins:

The quoins or corners stones shall be selected stone neatly dressed with hammer and/or chisel to form the required corner angle and laid header and stretcher alternatively, The bed top surface of quoins shall be chiseled dressed to give horizontal joints. The quoins shall have a uniform chisel draft of at least 25 mm. width at four edges of each exposed face, all the edges of the same face being in one plane. No quoins stone shall be smaller than 0.025 cum. in volume.

2.8. Jamb Stones:

The jamb stone shall be made with stone specified for quoins, that the stone provided on the jambs shall have their length equal to thickness of wall up to 600 mm. and a line of headers shall be provided for walls thicker than 600 mm. as specified for bond.

2.9. Joints:

All the joints shall be completely filled with mortar and width shall not exceed 25 mm. when plastering or pointing is not required to be done, the joints shall be struck flush and finished simultaneously while laying the stone. Otherwise the joints shall be raked to a minimum depth of 20 mm. by a racking tools, during progress of laying while the mortar is still green.

2.10. Scaffolding:

Single or double scaffolding shall be used. The scaffolding shall be strong and sound. The holes left in masonry for supporting scaffolding shall be filled and made good before plastering.

2.11. Curing:

Green work shall be protected from rains by covering the same. Masonry shall be kept constantly moist on all the faces for a period of at least 7 days. The top of masonry shall be flooded at close of the day.

3.0. Mode of measurements and payment

3.1. All work shall be measured on the basis of finished dimensions and measured net except where otherwise specified. Only specified dimensions shall be allowed. Anything extra shall be ignored. The masonry work in foundation and plinth shall be measured under this item. No deduction shall be made, not extra payment made for the following:

- (a) Ends of joints, beams, spots, girders, rafters, purloins, trusses, corbles, etc. each up to 500 sq. cm. in section.
- (b) Opening each up to 0.1 sq.m.
- (c) Wall plates and bed plates, bearing of chhaja and like up to 10 cm. depth (bearing of floor and roof slabs shall be deducted from masonry).
- (d) Drain holes and recesses for cement concrete blocks to embed hold fasts for doors windows.
- (e) Building in the masonry iron fixtures pipes up to 300 mm. dia. hole fasts of doors and windows.
- (f) Forming theses in masonry up to section of 350 sq.cm.

3.2. The rate shall be for a unit of one cubic meter.

7.6.(II) Uncoursed rubble masonry with hard stone of approved quality in foundation and plinth in cement mortar 1:5 (1 cement : 5 coarse sand) including leveling up etc. complete.**1.0. Materials and workmanship**

The relevant specification of item No. 7.6(1) shall be followed except that the proportion of cement mortar shall 'be in C.M. 1.5 (1 cement : 5 coarse sand)

2.0. Mode of measurements and payments

2.1. The relevant specifications of item No. 7.6(1) shall followed.

2.2. The rate shall be a unit of one cubic meter.

7.6.(III) Uncoursed rubble masonry with hard stone of approved quality in foundation and plinth in lime mortar 1:1.5 (1 lime putty : 1.5 coarse sand) including leveling etc. complete.**1.0. Materials:**

Lime mortar shall conform to M-10. The rubble shall conform to M-16.

2.0. Workmanship

The relevant specifications of item No. 7.6 (I) shall be followed.

3.0. Mode of measurement and payment

3.1. The relevant specifications of item No. 7.6 (I) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

7.17(A) Coursed rubble masonry with hard stone of approved quality in foundation and plinth in cement mortar 1:6 (1 cement : 6 coarse sang) etc. complete.**1.0. Materials**

Cement mortar shall conform to M-11. The stone shall conform to M-16.

2.0. Workmanship**2.1. Dressing of stones:**

The face stone shall be hammer dressed so as to give approximately rectangular blocks. They shall be squared on bed and side joints. The bed joints shall be rough chisel dressed for a depth of at least 50 mm. back from the faces and the side joints shall be so dressed to a depth of at least 40 mm. back from the face, such that no portion of the dressed surface is more than 10 mm. from a straight edge held against the surface. The remaining portions of surface shall not project above the chisel dressed bed and side joints. The bushing on the face shall not project by more than 40 mm. on an exposed face and 10 mm. on a face to be plastered. The hammer dressed stone shall also have a rough tooling for a minimum with of 25 mm. along the four edges of the face of the stone.

2.2. Laying:

2.2.1. All stones shall be wetted before laying. The wall shall be built up truly plumb (or to required better where so specified.)

All connected masonry in a structure shall normally be raised up uniformly and regularly. However, if for any specific reasons one part of wall is required to be left behind, such wall shall be raked back at an angle not steeper than 45°. vertical toothed joints in masonry shall not be allowed. The work shall be carried up regularly and masonry on any day shall not be raised by more than 1 meter in height.

2.2.2. All the courses shall be laid truly horizontal. The height of course shall not be less than 150 mm. nor more than 300 mm. Face stone shall be laid in alternate header and stretcher fashion. They shall be so arranged as to break joints by at least 75 mm. Stones shall be laid with grains horizontal so that the load is transmitted along the direction of their maximum crushing strength. The depth of stone shall not be less than the height or breadth. The breadth of a face stone shall also be not less than the breadth. The breadth of a face stone shall also be not less than 150 mm. Each face stone shall be of the same height in any give course. The courses shall be not less than 150 mm. Each face stone shall be of the same height in any give course. The courses shall be built in perpendicular to the pressure which the masonry will bear. In case of battered walls (such as retaining walls) the beds of the stone and the plate of courses shall be laid with their bed perpendicular to the battered face.

2.2.3. The hearting or the interior filling of the wall shall consist of flat bedded stones carefully laid on their proper beds in mortar, chips and spawns of stone being used where necessary to avoid excessive use of mortar, care being taken to see that no hollow space is left anywhere in the masonry. Chips shall not be used below the hearting stone to bring these up to the level of stones. The use of chips shall be restricted to be filling of interstices between the hear tiling stone but the volume of chips shall be limited to 15% of the total volume of the masonry.

2.3. Bond Stones:

The relevant specification of item No. 7.6 (I) Para 2.6 shall be followed except that the bond stone shall be provided for at least 1.8. m. length of every courses.

2.2.4. Quoins:

The quoins, which shall be of the same height as the course to which it belongs shall be formed from selected stone of at least 400 mm. length. They shall be laid square or beds on stretchers and headers alternatively. The beds shall be rough, chisel dressed to a depth of at least 100 mm. These stones shall have a minimum uniform chisel draft of 25 mm. width at four edges being in the same plane, quoin stone shall not be smaller than 0.025 cum. in volume and it shall also be not less than 300 mm. in length, 25 % of them being not less 500 mm. in length.

2.5. Joints:

All the bed joints shall be horizontal and all shall be vertical. Face joints shall not be more than 10 mm. thick. All joints shall be properly and completely filled with mortar. On faces where no plastering or pointing is required to be done the joint shall be flush and finished simultaneously while laying stones. In other cases the joints shall be raked to a minimum depth of 20 mm. by raking tools during the progress of work while the mortar is still green.

2.6. Curing:

The relevant specification of item No. 7.6 (I) area Para 2.9 shall be followed

3.0. Mode of measurements & payment

3.1. The relevant specification of item No. 7.6 (I) shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

7.17.(B) Coursed rubble masonry with stone of approved quality in foundation and plinth in cement mortar 1:5 (1 cement : 5 coarse sand) etc. complete.**1.0. Materials & Workmanship**

The relevant specifications of item No. 1.17 (A) shall be followed except that the proportion of cement mortar shall be C.M. 1:4 (1 cement : 5 coarse sand)

2.0. Mode of measurement & payment

2.1. The relevant specification of item No. 7.17 (A) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

7.17 (C) Coursed rubble masonry with stone of approved quality in foundation and plinth in C.M. 1:4 (1 cement : 4 coarse sand) etc. complete)**1.0. Materials & workmanship**

The relevant specifications of item No. 7.17 (A) shall be followed except that the proportion of mortar shall be C.M. 1:4 (1 cement : 4 coarse sand)

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 7.17 (A) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

7.17(D) Coarsed rubble masonry with stone of approved quality in foundation and plinth in c.m. 1:3 (1 cement : 3 coarse sand) etc. complete.

1.0. Materials and Workmanship

1.1. The relevant specification of item No. 7.17 (A) shall be followed except that the proportion of mortar shall be C.M. 1:3 (1 cement : 3 coarse sand)

2.0. Mode of measurement & payment

2.1. The relevant specification of item No. 7.17 (A) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

7.19(A) Coarsed rubble masonry with stone of approved quality for structure above plinth level up to floor two level in C.M. 1:6 (1 cement : 6 coarse sand) etc. complete.

1.0. Materials & Workmanship

1.1. The relevant specification of item No. 7.17 (A) shall be followed except that the coursed rubble masonry work shall be carried out for superstructure above plinth level up to floor two level.

1.2. Single or double scaffolding may be used. The scaffolding shall be strong and sound. In case single scaffolding is used, the holes shall be carefully made good as directed.

2.0 Mode of measurement & payment

2.1. The relevant specifications of item No. 7.17 (A) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

7.75. Precast concrete block masonry (including quoin block, jamb blocks, closer etc.) with solid concrete blocks of approved size made of cement concrete 1:3:6 Mix. (1 cement : 3 coarse sand : 6 graded stone aggregate of 20 mm. and down gauge) in foundation and plinth in cement mortar 1:6.

1.0. Materials

(a) Aggregate shall conform to M-12. (b) Sand shall conform to M-6. (c) Cement shall conform to M-3.

1.1. The solid cement concrete blocks shall be precast with concrete of 1:3:6 mix (1 cement: 3 coarse sand : 6 graded stone aggregate)

1.2. A block shall be deemed to be solid if the solid materials is not less than 75% of the total volume of the blocks calculated from overall dimensions.

1.3. The concrete mix used for block shall be one of the following:

1.4. The actual size of the block shall be one of the following:

Size : A. 39 x 30 x 19 cms. Size-B 39 x 20 x 19 cms. Size C 39 x 10 x 19 cms.

The size other than those specified above may be used with the approval of Engineer-in-charge.

1.5. The blocks may be either machine made or hand made. The concrete mix, the mixing of concrete the manufacture of blocks, curing and drying shall be in accordance with para-6 to 10 under I.S. : 2185-1967.

1.6. Faces of blocks shall be flat and rectangular Surface finish shall be rendered smooth or plastered with cement mortar 1:3 coarse sand)

1.7. The average compressive strength of eight blocks when determined in the manner described-in I.S. 2185 - 1967 shall not be less than 50 Kg/Sq. Cm. of gross area. The strength of lowest individual block shall not be less than 75 percent of average compressive strength of eight blocks.

1.8. Concrete blocks shall be stored and stacked properly in such a way as to avoid any contact with moisture at site. They shall be stock plied on planks or other supports free from contact with ground and covered to protect against wetting. Cement mortar of proportion 1:6 shall conform to M-11.

2.0. Workmanship

2.1. The blocks need not wetted before of during laying in the walls. In case climatic conditions so required, the top and the sides of block may only be slightly moistures so as to prevent absorption of water from the mortar and ensure the development of required bond with mortar.

2.2. Operations of laying precast cement concrete block masonry shall be carried out in accordance with instructions detailed in I.S. : 6042 -1952. The mortar shall not be spread so much ahead of the actual laying of the units that it tends to stiffen and loose, its plasticity, thereby resulting in poor bond. For most of the work, the joints, both horizontal and vertical shall be 10 mm. thick except in the case of extended joint, construction, the mortar joints shall be struck off flush with wall surface and when the mortar has stated stiffening, it shall be compressed with rounded or U-shaped tool. The mortar shall be pressed against the units with a jointing tool after the mortar has stiffened in effect intimate contact between the mortar and the masonry unit and obtained a weather tight joint.

2.3. Quoins and closures:

Special quoins blocks (with a return face equal to half the length of normal face) shall be cast for all building blocks and slabs for external work. Proper half closures shall be cast and not cut from full size blocks. The returned ends of blocks for door windows reveals and quoins shall be finished with a fair face in the mould.

2.4. Only double scaffolding shall be used. The scaffolding be strong and sound. No holes in the masonry for supporting shall be allowed.

2.5. Curing : The curing of concrete block masonry shall be carried out for 7 days.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 7.6 (I) shall be followed.

3.2. The work of concrete block masonry in foundation and plinth shall be measured under this item.

3.3. The rate shall be for a unit of one cubic meter.

7.82 (A) Precast concrete block masonry in partition walls 10 cms. thick with solid block of approved size (including quoins, blocks, jamb blocks closer etc) made of C.C. 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregates 20 mm. and down gauge) in C.M. 1:4.

1.0. Materials:

1.1. The relevant specification of item No. 7.75 shall be followed except that the precast concrete blocks shall be of size suitable for 10 cms. size partition wall i.e. size c and the proportions of cement mortar shall be in cement mortar 1:4 (1 cement : 4 coarse sand).

2.0. Workmanship

The relevant specifications of item No. 7.75 shall be followed except that the work shall be for precast concrete block partition walls of 10 cms. thickness.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item No. 7.75 shall be followed.

3.2. The rate shall be for a unit of one cubic meter.

7.0.0.1. White stone masonry block in coarse in superstructure with stone of approved quality in lime mortar 1:1.5 (1 Lime putty 1:5 fine sand) including raking out joints etc. complete.

1.0. Materials:

1.1. The stone or bela shall be white hard sand stone or block. The stone shall be sound hard rough and durable. It shall be free from skin. The thickness of bela or block shall not be less than 15 cms. or as directed. The mortar used shall consist. One part of lime putty and 1.50 parts of fine sand. Lime mortar shall conform to M-10.

2.0. Workmanship**2.1. Dressing of stone:**

Stone shall be chiseled on all the sides so that all six sides shall be in a rectangular shape and all the stones shall be so dressed that the bushing of the exposed face shall not project nor depressions for the general wall surfaces. The size of bela or block shall be as per thickness of the wall to be constructed or as directed.

2.3. Laying:

All the stone shall be sufficiently wetted before laying to prevent absorption of water from mortar. All connected Walls in a structure shall normally be raised up uniformly and regularly. The vertical joint shall not be allowed and also it shall not be more than 12 mm. in thickness.

2.3. Proper bonding shall be made by laying bela or block side by side each other with lime mortar on bed as well as in between two bela or block vertically.

2.4. Bond stones:

Bond stones or through stones running right across the thickness of the wall shall be provided in walls up to 450 mm. thick. In thicker walls two bela or blocks or laying each other by at least 150 mm. each other shall be provided across the thickness of the wall to bond stone. Such bond stone shall be at least one for every 1.0 sq. mt. area of the wall surface.

2.5. Joints:

All the joints shall be completely filled up with mortar and their thickness shall not exceed by 12 mm. When plastering or pointing is not required to be done, the joints shall be struck flush and finished, simultaneously while laying the stone. Otherwise the joints shall be raked to a minimum depth of 20 mm. during process of laying while mortar is still green.

2.6. Scaffolding:

Single or double scaffolding shall be used. It shall be strong and sound. The holes left in masonry for supporting shall be made good before plastering.

2.7. Curing:

Green work shall be cured for a period of 7 days continuously.

3.0. Mode of measurements & payment

3.1. The work shall be measured on the basis of finished dimensions. No deduction shall be made nor extra payment shall be made for the following:

(a) Ends of joint, beams, posts, girders, rafters, purlins, corbels etc., each up to 500 sq.cms. in section (b) Opening each up to 0.10 Sq.m.(c) Small plates and bed plates, bearing of chhajas and like up to 10 cms. depth (bearing or floor and roof shall be deducted from masonry), (d) Drain holes and recesses for cement concrete blocks to embedded hold fasts of one cubic meter.

7.0.0.2. White stone bela masonry work in partition walls up to 15 cms. thickness in C.M. 1:4 (1 cement : 4 coarse sand.)

1.0. Materials and workmanship

The relevant specifications of item No. 7.0.0.1 as above shall be followed except that the proportion of mortar shall be in C.M. 1:4 (1 cement : 4 coarse sand.)

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 7.6 (I) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

7.0.0.3. White stone bela masonry block in coarse in superstructure with stone of approved quality in C.M. 1:5 (1 cement: 5 coarse sand) including raking the joints etc. complete.

1.0. Materials and Workmanship

The relevant specifications of item No. 7.0.0.1. as above, except that the proportion of cement mortar shall be in C.M. 1:5 (1 cement : 5 coarse sand)

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 7:6 (I) shall be followed

2.2. The rate shall be for a unit of one cubic meter.

7.0.0.4. White stone bela masonry block in coarse in superstructure with stone of approved quality in C.M. 1:6 (1 cement : 6 coarse sand) including raking the joints etc. complete.

1.0. Materials and Workmanship

The relevant specifications of item No. 7.0.0.1 shall be followed except that the proportion of cement mortar shall be 1:6 (1 cement : 6 coarse sand)

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 7.6. (I) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

SECTION -9**Centering & Form Work**

9.1.(A) Providing form work of ordinary timber planking so as to give a rough finish including centering strutting and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced concrete and plain concrete work in foundation, footings, bases of columns, and mass concrete.

1.0. Materials

1.1. The shuttering to be provided shall be of ordinary timber plank and shall conform to M-26.

1.2. The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

2.0. Workmanship

2.1. The form work shall conform to the shape lines and dimensions as shown on the plans and be constructed as to remain sufficiently rigid during the placing and compacting of the concrete. Adequate arrangements shall be made by the contractor to safe-guard against any settlement of the form-work during the course of concreting and after concreting. The form work of shuttering, centering, scaffolding, bracing etc. shall be as per design.

2.2. Clearing and Treatment of forms:

2.2.1. All rubbish, particularly chipping shaving and saw dust shall be removed from the interior of the form before the concrete work is placed and the form in contact with concrete shall be cleaned and thoroughly wetted or treated. The surface shall be then coated with soap solution applied before concreting is done. Soap solution for the purpose shall be prepared by dissolving yellow soap in water to get consistency of paint. Alternatively a coat of raw linseed oil shall be applied after thoroughly cleaning the surface. Care shall be taken that the coating does not get on construction joint surface and reinforced bars.

2.3. Stripping time:

2.3.1. In normal circumstances and where ordinary cement is used forms may be struck after expiry of following periods.

- | | | |
|------|---|-----------------|
| (a) | Sides of walls columns and vertical faces of beams..... | 24 to 48 hours. |
| (b) | Beam soffits, (props, left under)..... | 7 days. |
| (c) | Removal of props slabs: | |
| (i) | Slabs spanning up to 4.5. m..... | 7 days. |
| (ii) | Spanning over 4.5 mm..... | 14 days. |
| (d) | Removal of props t beams and Arches: | |
| (i) | Spanning up to 6 mm..... | 14 days. |
| (ii) | Spanning over 6 m..... | 21 days. |

2.4. Procedure when removing the form work:

2.4.1. All form work shall be removed without such shock or vibrations as would damage the reinforced concrete surface. Before the soffits form work and struts are removed, the soffits and the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened

2.5. Centering:

2.5.1. The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during and after pouring concrete. Watch should be kept to see that behavior or centering and form work is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.

2.5.2. The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads without any settlement.

2.5.3. The centering and form work shall, be inspected and approved by the Engineer-in-charge before concreting. But this will not relieve the contractor of his responsibility for strength, adequacy and safety of form work and centering. If there is a failure of form work or centering, contractor shall be responsible for the damages to property.

2.6. Scaffolding:

2.6.1. All scaffolding, hoisting arrangements and ladders etc., required for the facilitating of concreting shall be provided and removed on completion of work by contractor at his own expense. The scaffolding, hoisting

arrangements and ladders etc. shall be strong enough to with stand all live, dead and impact loads expected to act and shall be subject to the approval of the Engineer-in-charge. However contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workman etc. 2.6.2. The scaffolding, hoisting arrangements and ladder shall allow easy approach to the work spot and afford easy inspection.

2.6.3. The rate is applicable to all condition of working and height up to 4 mts. The rate shall include the cost of materials and labour for various operations involved such as:

- (a) Splayed edges, notching, allowance for overlaps and passing at angles, battens centering, shuttering propping, bolting, wedging easing, striking and removal.
- (b) Filleting to form stop chamfered edges or splayed external angles not exceeding 20 mm: width to beams, columns and the like.
- (c) Temporary openings in the forms for pouring concrete, if required removing rubbish etc.
- (d) Dressing with oil to prevent adhesion of concrete with shuttering and.
- (e) Raking or circular cutting.

2.7. Re-Use:

2.7.1. Before re-use, all form shall be inspected by Engineer-in-charge and their suitability ascertained. The forms shall be scarred, cleaned and joints are gone over, repaired where required. Inside surface shall be retreated to prevent adhesion of concrete.

3.0. Mode of Measurements & Payment

3.1. Form work shall be measured as the area in square meters to shuttering in contract with concrete except in the case of inclined member and portion of curved profile and upper side in which case on area of underside shall be measured for payment.

3.4. Form work to secondary beams shall be measured up to the sides of main beams but no deduction shall be made from the form work of the main beam at the inter section point. No deduction shall be made from the form work of a column at inter section of beams.

3.5. The rate is for the completed item

3.6. The rate shall be for a unit of one sq. meter.

9.1.(A) (i) **Extra for providing from work of ordinary timber planking so as to give a rough finish including centering, shuttering and propping etc., height of propping and centering below supporting floor to ceiling is between 4 to 5 m. and removal of the same for in situ reinforce or plain concrete work in foundations, footings, bases of columns etc. and mass concrete.**

1.0. Materials workmanship

1.1. The relevant specification of item No. 9.1. (A) shall be followed except they the height of propping and centering below supporting floor to ceiling exceeding 4 m. but not exceeding 5 m.

2.0. Mode of measurements and payment

2.1. The payment shall be made extra over and above the payment made up to 4 m. height. The relevant specifications of item No. 9.1.(A) shall be followed. The rate shall be for a unit of one sq. meter.

9.1.(B)(i) **Providing from work of ordinary timber planking so as to give a rough finish including centering, below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced and plain concrete work in flat surface such as soffits of slabs, landing and the like floors etc. up to 200 mm. in thickness.**

1.0. Materials & Workmanship

1.1. Relevant specifications of item 9.1. (A) shall be followed except that work is to be carried out for flat surfaces such as soffits of slabs, landings, and the like for floors etc. up to 200 mm, in thickness.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 9.1 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

9.1.(B)(ii) **Providing form work of ordinary timber planking so as give a rough finish including centering shuttering, strutting and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced and plain concrete work in flat surface such as soffits of slabs, landings, and the like floors etc. above 200 mm. in thickness.**

1.0. Materials and Workmanship

1.1. Relevant specifications of item No. 9.1 (A) shall be followed except that the work is to be carried out for flat surfaces such as soffits of slabs, landings, and the like for floors etc. up to 200 mm. in thickness.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 9.1 (A) shall be followed.

2.2. The rate shall be for a unit of sq. meter.

9.1.(C) Providing form work of ordinary timber planking so as to give a rough finish including centering, shuttering, strutting and propping etc. height of propping and centering below supporting floor to ceiling not excluding 4 m. and removal of the same for in situ reinforced concrete and plain concrete work in vertical surface such as walls (any thickness) partitions.

1.0. Materials and Workmanship

The relevant specifications of item 9.1 (A) shall be followed except that the form work shall be carried out for vertical surfaces such as walls of any thickness, partitions etc.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 9.1 (A) shall be followed"

2.2. The rate shall be for a unit of sq. meter.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No.9.1 (A) shall be followed.

1.2. The rate shall be for a unit on one sq. meter.

9.1.(G)(i) Providing form work of ordinary timber planking so as to give a rough finish including centering, shuttering and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced and plain concrete work columns, pillars, posts, and struts, square rectangular, polygonal in plan.

1.0. Materials and Workmanship

1.1. The relevant specification of item No. 9.1. (A) shall be followed except that the work is for columns, pillars, posts and struts, square, rectangular, polygonal in plan.

2.0. Mode of measurement and payment

2.1. The relevant specification of item No. 9.1. (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

9.1.(H)(i) Providing form work of ordinary timber planking so as to give a rough finish including centering, shuttering, strutting and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced and plain concrete work in side and soffits of beam haunchings, cantilevers, girders, bressumers, and lintels not exceeding 1 m. depth.

1.0. Materials and Workmanship

1.1. The relevant specification of item No. 9.1 (A) shall be followed except that the work is for sides and soffits of beams, haunching cantilevers girders, bressumers and lintels not exceeding 1 M. in depth.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 9.1 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

9.1.(H)(2) Providing form work of ordinary timber Planking so as to give a rough finish including centering, shuttering, strutting and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced and plain concrete work in sides and soffits of beams, haunchings, cantilevers, girders, bressumers and lintels exceeding 1 m. in depth.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 9.1.(A) shall be followed except that the work is for side and soffits of beam hunchings, girders, bressumers and lintels, exceeding 1 m. in depth.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No 9.1.(A) shall be followed except that the work is for side and soffits of beams haunching cantilevers, girder bressumers and lintels, exceeding 1 m. in depth.

2.2. The rate shall for a unit of one sq. meter.

9.1.(i) Providing form work of ordinary timber planking so as to give a rough finish including centering, shuttering and propping etc. height of propping and centering below supporting floor toe ceiling not exceeding 4 m. and removal of the same for situ reinforced and plain concrete work in edges of slabs and breaks in floor and walls.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 9.1. (A) shall be followed except that the work is for edges of breaks in floors and walls.

2.0. Mode of measurements and payment

2.1. The length and breadth shall be measured nearest to one Cm.

2.2. The rate shall be for a unit of one Sq. meter.

9.1.(K) Providing form work of ordinary timber planking so as to give a rough finish including centering shuttering, strutting and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same in situ reinforced and plain concrete in small surface such as cantilevers ends, brackets and ends of the steps., caps and bases to pilasters and columns and the like.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 9.1.(A) shall be followed except that work is for small as cantilever ends, brackets and ends of steps, caps and bases to pilasters and columns and the like.

2.0. Mode of measurement and payment

2.1. The relevant specification of item No. 9.1.(A) shall be followed.

2.2. The rate shall be unit of one sq. meter.

9.1.(I) Providing form work of ordinary timber planking so as to give a rough finish including centering, shuttering, strutting and propping .etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced and plain concrete in chullah hoods, weather sheds, chhajjas, corbels etc. including edges.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 9.1 (A) shall be followed except that the work is for chullah hoods, weather-sheds, chhajjas, corbels, etc. including edges of the same.

2.0. Mode of measurements and payment

2.1. The relevant specification of item No. 9.1. (A) shall be followed.

2.2. The rate shall be for a unit of one square meter.

9.1.(M) Providing from work of ordinary timber planking so as to give a rough finish including centering, shuttering and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for in situ reinforced and plain concrete work in staircase with slopping or stepped soffits including risers and stringers excluding landing.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 9.1.(A) shall be followed except that the work is for staircases, with slopping or stepped including risers and stringers excluding landing.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 9.1. (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

9.1.(Q) Providing form work of ordinary timber planking so as to give a rough finish including centering shuttering, strutting and propping etc. height of propping and centering below supporting floor to ceiling not exceeding 4 m. and removal of the same for In situ reinforced and plain concrete work in vertical fins and vertical sun-breakers.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 9.1. (A) shall be followed except that the work is for vertical fins and vertical sun breakers.

1.2. The rate shall be for a unit of one sq. meter.

9.7. Extra for providing form work with sweating of steel sheets so as to give a fair finish in :

(A) Foundation, footings, base of columns etc. mass concrete.

(B) Flat surfaces such as soffits, of slab landing and the like.

(i) Floors etc. up to 200 mm. in thickness.

(ii) Floors etc. above 200 mm. in thickness.

(C) Vertical surfaces such as walls (Any thickness) partitions.

(D) Columns, pillars posts and struts.

1. Square, rectangular, bressumers, and lintels not exceeding 1 mm. depth.
2. Sides and soffits and beams, beam haunchings, cantilevers, girders, breassumers and lintels exceeding 1 mm. in depth.
 - (I) Edges of slabs, and breaks in floors and walls.
 - (K) Small surfaces such as cantilever ends, brackets, and ends of steps, caps and bases to pillars and columns including edges.
 - (L) Chollar woods, weather sheds, chhajjas, corrodes etc. and the like.
 - (M) Stair cases sloping or stepped soffits, including risers, skidders excluding landing.
 - (Q) Vertical fine and vertical sun breakers.

1.0. Materials and Workmanship

1.1. The relevant specification of item No. 9.1 .(A) to (Q) shall be followed except that the extra rate shall be paid for using sheathing of steel sheets, and plates of steel or plywood instead of ordinary timber plank, to obtain a desired smooth exposed finish of surface. The surface shall be presentable without further treatment.

2.0. Mode of measurements and payment

2.1. The measurement of form work shall be taken for the work done with steel sheathing, extra over and above the rate of form work of respective item ' from work done. The relevant specification of respective item No. 9.1. (A) to (Q) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

SECTION 10

Wood Work, Doors & Windows

10.1.(A) Providing wood work in frames of doors, windows, clerestory windows and other similar work, Wright, framed and fixed in position, Indian Teak wood.

1.0. Materials

Wooded in frames shall conform to M-29.

2.0. Workmanship

2.1. The item covers the requirement of frames for doors, windows, clerestory windows, their supply and fixing.

2.2. Frames:

2.2.1. All members of frames shall be exactly at right angles. The right angle shall be checked from inside surfaces of the-frames of the respective members.

2.2.2. All members of frames shall be straight without any warp of bow and shall have smooth surfaces well planed on the three sides exposed at right angles to each other. The surfaces touching the wall may not be planed unless it is required in order to straighten up the member or to obtain the overall sizes within the tolerances as specified.

2.2.3. Frame shall have dovetail joints. When clerestory windows in included, it shall be provided by having full length one piece post for door or windows and clerestory window extending the frame on top at the head to the required extent. Horns shall not be provided in the head of the frame. When no sills are provided, the vertical posts of the frame in the ground floor shall be embedded in the sill masonry for 10 cm. on upper floors, the vertical posts shall be fixed in the floor or masonry by forming notches 10 mm. deep. Slight adjustment of spacing as necessary shall be done to have the hold fasts in the joints of masonry; course. The frame shall be erected in position and held plumb with strong support form north sides and built in masonry as it is being built. The transom shall be through tenoned into the mortises of the jamb pot to the full width of the jamb post and the thickness of the tenon shall be not less than 15 mm.

2.3. Tolerance:

Unless specially mentioned otherwise tolerance of + 1.5. mm shall be allowed for each wrought face.

2.4. The tenons shall be closely fitting into the mortises and suitably pinned with wood dowels not less than 10 mm. dia. meter. The depth of rebates for housing the shutter shall be as shown in the detailed drawing or as directed.

2.5. The concrete surface of tenon and mortise shall be treated before putting together with an adhesive of approved make.

2.6. Minimum number of three hold-fasts shall be fixed on each side of door and windows frames, one at the center point and the other two at 30 mm. from the top and bottom of the frames. In case of windows and ventilators frames. The size c. each hold-fast shall be 300 x 25 x 6 mm. and of mild-steel with split end. The hold fasts shall be fixed with screws to frames.

2.7. Mild steel hold fasts shall be protected with a coating of coal asphalt tar. The surface of frame abutting the masonry or concrete faces shall be properly treated by applying a coat of approved coating.

3.0. Mode of Measurements and payment

3.1. The linear dimensions shall be measured correct up to 1 cm. The quantity shall be worked out correct to places of decimals of cu. m.

3.2. The rate shall be for a unit of 10 cu. diameter.

10.4.(A) Providing work in trusses, purloins, falters, posts, post plates, wall plates, and like wrought, framed, hoisted and fixed in position, Indian teak wood.

1.0. Materials

The teak wood shall conform M-29.

2.0. Workmanship

2.1. The relevant specifications of item No. 10.1.(A) shall be followed except that wood work shall be carried mi* in trusses, purloins, falters, posts, plates, wall plates and like wrought framed.

2.2. The work shall be carried out as per detailed drawings supplied by the Department as directed;

2.3. The length of the each member shall be in one piece or as directed.

3.0. Mode of measurement and payment

The length, breadth and depth shall be measured nearest to 1 cm. of unfinished member. The rate shall be for a unit of 10 cubic Decimeter.

10.5. (A) Providing wood work in frames of false ceiling partition etc. swan and put up in position, Indian teak wood.

1.0. Materials

The teak wood shall conform to M-29.

2.0. Workmanship

The relevant specification of item No. 10.1.(A) shall be followed except that the wood work shall be for false, ceiling, partitions, etc. swan and put in position.

3.0. Mode of measurement and payment

3.1. The relevant specifications of item No. 10.1.(A) shall be followed.

3.2. The rate shall be for a unit of Ten cubic Decimeter.

10.12.(A)(i) Providing and fixing 35 mm. thick fully paneled shutters for doors, windows and clerestory windows including anodised aluminum butt hinges with necessary screws. Indian Teak Wood.

1.0. Materials.

1.1. Wood for shutter shall conform to M-29. 2. Glass shall conform to M-38. 3. Anodised aluminum butt hinges shall conform to M-43.

2.0. Workmanship

2.1. The item covers the requirement of preparation of shutters for doors, windows, clerestory windows, their supply and fixing.

2.2. Shutters:

2.2.1. Paneled shutters shall be constructed in the form of timber frame work of styles and rails with panel inserted of type as specified in the detailed drawings. Panel shall be fixed by providing grooves in the style and rails. The styles and rails shall be joined to each other by mortise and tenon joints at right angles.

2.2.2. All members of the shutters shall be straight without any warp or bow and shall have smooth, well planed faces at right angles to each other.

2.2.3. The size of styles and rails shall be as per drawings or as directed. Styles and rails of shutters shall be made of one piece only.

2.3. Timber paneling:

2.3.1. Thickness of the panel shall be as specified in the item as shown in the drawing or as directed. If the panel is made from more than one piece the pieces shall be finished as shown in the detailed drawings and shall be joined with continuous groove with specified size. The end pieces of the panel and the top and bottom of the panel shall be provided with continuous tongue to frame into groove of the frame shutter. An air space of 1.5 mm. shall be left in the groove of frame of shutter while framing the panels in it.

2.3.2. The faces of the panel as well as various pieces of the panel shall be- closely fitted to the sizes of the grooves.

2.3.3. Finishing of the corners of raised panel edges shall be done as shown in drawings or as directed.

2.3.4. The thickness specified shall be finished thickness and no tolerance will be permitted.

2.5. Fixtures and Fastenings:

2.5.1. The rate shall include anodised butt hinges including fixing with iron screws. The size and number of hinges shall be as per table given in annexure-1.

3.0. Mode of measurement and payment

3.1. The rate for shutter includes cost of providing block and cleat for keeping the shutter in open position if directed.

3.2. The dimension of the shutter shall be measured clear size of the shutter in close position between the grooves of the frame.

3.3. The rate shall be for a unit of one sq. meter.

19.12.(A)(II) Providing and fixing 35 mm. thick fully shutters for doors, windows and clear story windows including anodised aluminum but hinges with necessary screws, Indian teak wood.

1.0. Materials

Teak wood shall conform to M-29 Glass shall conform to M-38. Anodised aluminum butt hinges shall conform to M-43.

2.0. Workmanship

2.1. The relevant specifications of item No. 10.12 (A) I shall be followed except that the 35 mm. thick shutters full glazed for doors, windows and clear story windows including anodised aluminum butt hinges with necessary screws.

2.2. Glazing:

2.2.1. The glass panels shall be embedded in putty and secured to the rebate by wooden beads, or moulding shape and size as approved with counter sunk screws of suitable size.

2.2.2. The glass panels shall be properly cut to fit the rebates of the frames and sashes fully with a slight minus margin of about 1.5. mm. on all sides. Before blazing, the frame shall be primed and prepared for painting so that wood may not draw oil out of putty. The rebate shall be putted to an extent to provide bedding all round the glass.

2.2.3. The glass shall then be bedded in putty and fitted to frames with wooden heads or moulding as directed and secured with counter sunk screws. The screws shall be spaced not more than 100 mm. from each corner and not more than 200 mm. apart.

2.2.4. The size of the rebate in the frame and size and shape of beads of moulding shall be as per detailed drawings or as directed. The beads or mouldings shall have mitered corners.

3.0. Mode of measurement and payment

3.1. The relevant specifications of item No. 10.12 (A) (I) shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

10.12(A)(III) Providing and fixing 35 mm. thick partly paneled and party glazed shutters, or doors, windows, including anodized aluminum butt hinges with necessary screws, Indian teak wood.

1.0. Materials

Teak wood shall conform to M-29. Glass shall conform to M-38. Anodised aluminum but hinges shall conform to M-43.

2.0. Workmanship

The relevant specifications of item No. 10.12.(A) (II) shall be followed except that the 35 mm. thick shutter shall be partly paneled and partly glazed for doors, windows, clear story windows etc. as per drawings.

3.0. Mode of measurement and payment

3.1. The relevant specifications of item No. 10.12 (A) (I) shall be followed.

3.2. The rate shall be for a unit of one sq, meter,

10.13.(A)(I) Providing and fixing 35 mm. thick full paneled, shutters for doors, windows and clear story windows including black enameled M.S. Butt, hinges with necessary screws, Indian Teak Wood.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 10.12 (A) (II) shall be followed except that the hinges shall be of black enameled M.S. Butt hinges. The hinges, bolts and other items of iron mongery with moving parts shall be properly oiled by the contractor before handing over the building.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 10.12 (A) (I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

10.13.(A)(II) Providing and fixing 35 mm. thick full glazed shutters for doors, windows and clear story windows including black enameled M.S. Butt, hinges with necessary screws, Indian Teak Wood.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 10.12 (A) (II) shall be followed except that the hinges shall be of black enameled M.S. Butt hinges. The hinges bolts and other items of iron mongery with moving parts shall be properly oiled by the contractor before handing over the building.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 10.12 (A) (I) shall be followed:

2.2. The rate shall be for a unit of one sq. meter.

10.13(A)(III) Providing and fixing 35 mm. thick partly paneled and partly glassed shutters for doors, windows, and clearstory windows including black enameled M.S. Butt hinges with necessary screws, Indian Teak Wood.

1.0. Materials & Workmanship

The relevant specification of item No. 10.12 (A) (III) shall be followed except that the hinges shall be of black enameled M.S. butt hinges, bolts and other items of ironmongery with moving parts shall be properly oiled by the contractor before handing over the building.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 10.12. (A) (I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

10.15.(A)(I) Providing and fixing 25 mm. thick paneled, shutters for cup-boards etc. including anodised aluminum butt hinges with necessary screws, Indian Teak Wood.

1.0. Materials

First class Indian teak wood for shutters shall conform to M-29. Glass shall conform to M-38. Anodised aluminum butt hinges shall conform to M.43.

2.0. Workmanship

2.1. The relevant specification of item No. 10.12. (A) (I) shall apply except that the thickness of shutter shall be 25 mm. for cup-boards.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item No. 10.12 (A) (I) shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

10.15.(A)(H) Providing and fixing 25 mm. thick fully glazed shutters for cup-boards etc. including anodised aluminum butt hinges with necessary screws, Indian teak wood.

1.0. Materials & Workmanship

The relevant specifications of item No. 10.12.(A) (I) and 10.12 (A) (II) shall be followed except that the thickness of shutters shall be 25 mm. thick and partly paneled and partly glazed shutters as per drawings for cup-boards.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 10.12 (A)(I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

10.15.(A)(IH) Providing and fixing 25 mm. thick partly paneled and partly shutters for cub-boards etc. including anodised aluminum butt hinges with necessary screws, Indian teak wood.

1.0. Materials & Workmanship

The relevant specifications of item No. 10.12.(A) (I) and 10.12 (A) (II) shall be followed except that the thickness of shutters shall be 25 mm. thick and partly paneled and partly glazed shutters as per drawings for cupboards.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 10.12 (A)(I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

10.16.(A)(I) Providing and fixing 25 mm. thick fully paneled, shutters for cup-boards etc., including black enameled M.S. butt hinges with necessary screws, Indian Teak Wood.

1.0. Materials & workmanship

1.1. The relevant specifications of item No. 10.12 (A) (I) shall apply except that the wood for shutters shall be Indian teak wood and black enameled M.S. Butt hinges are to be used instead of anodised aluminum butt hinges and thickness of shutter shall be 25 mm.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 10.12. (A) (I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

10.16.(A)(H) Providing and fixing 25 mm. thick fully glazed shutters for a cup-boards etc., including black enameled M.S. Butt hinges with necessary screws, Indian Teak Wood.

1.0. Materials & Workmanship

The relevant specifications of item No. 10.15.(A) (I) shall be followed except that the fully glazed shutters of 25 mm. thickness shall be of India Teak Wood fixed in position with black enameled butt hinges for cup-boards.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 10.12 (A) (I) shall followed.

2.2. The rate shall be for a unit of one sq. meter.

10.16.(A)(III) Providing and fixing 25 mm. thick partly paneled and partly glazed shutters for cupboards etc., including black enameled M.S. butt hangs with -necessary screws. Indian Teak Wood.

1.0. Materials

The relevant specifications of item No. 10.15 (A) (I) & 10.15 (A) (II) shall be followed except that the shutters shall partly paneled and partly glazed of 25 mm. thickness of Indian Teak Wood fixed with black enameled butt hinges for cup-boards.

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 10.12 (A)-shall be followed. **12.** The rate shall be for a unit of one sq. meter.

10.23. Providing and fixing 35 mm. thick paneled glazed or paneled and glazed shutters for doors, windows, and clearstory windows including anodised aluminum butt hinges with necessary screws. Indian Teak Wood shutters with (A) Plywood,(B) Particle, (C) Hard Board, (D) Asbestos Sheet panels.

1.0. Materials

Indian teak wood for shutters shall conform to M-29. Glass shall conform to M-38.

- (A) Plywood shall conform to M-37.
- (B) Particle board shall conform to M-40. Anodised aluminum butt hinges shall conform to M-43.
- (C) Hard board shall of best quality and shall be as approved by Engineer-in charge.
- (D) A.C. sheet shall conform to M-24.

2.0. Workmanship

2.1. The relevant specifications of item No. 10.12 (A) (I) shall apply to this item except that the work is shuttered with (A) plywood (B) particle board (C) hard board panels (D) A.C. sheets panels as specified in item.

2.2. The shutter shall be prepared by fittings styles and rails (top, bottom, lock and frieze) as for paneled leaves with simple chamfer on edge only. The styles and rails shall be grooved with just sufficient width for receiving panels and plain panels of specified type panels shall be fitted into the grooves.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 10.12 (A) (I) shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

10.24. Providing and fixing 35 mm. thick paneled, glazed or paneled and glazed shutters for doors, windows and clearstory windows including black enameled M.S., butt hinges with necessary screws. Indian Teak Wood shutters with (A) Plywood (B) Particle board (C) Hard Board (D) Asbestos panels.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 10.23 shall be followed except that the hinges shall be of back enameled M.S. Butt hinges instead of anodised aluminum butt hinges and shutter with (A) Plywood (B) Particle board (D) Hard Board (D) Asbestos sheet panels as specified in item.

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 10.12 (A) (I) shall-be followed.

2.2. The rate shall be for a unit of one sq. meter.

10.30. Providing & fixing flush door shutters, solid core construction with frame of 1st class hard wood with cross band and face veneer or plywood face panels including anodised aluminum butt hinges with necessary screws (B) Non-decorative type and block board core. (2) 35 mm. thick.

1.0. Materials

Flush door shall conform to M-30. Plywood shall conform to M-37. Anodised aluminum butt hinges shall conform to M-43.

2.0. Workmanship

2.1. The relevant specifications of item No. 10.23 shall be followed except that the shutters be non decorative type and block board core with face veneer or plywood with 35 mm. thickness.

2.2. Ready made shutters shall be of correct size and shall fit into the door or other openings without excessive scraping of edges. Adding of battens etc., to make up to the size shall not be allowed.

3.0. Mode of measurement & payment

3.1. The relevant specification of item No. 10.12 A (I) shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

10.37. Extra for using bright finished M.S. Piano hinges instead of anodised aluminum butt hinges in flush door shutter (A) Nickel Plated Piano hinges.

1.0. Materials and workmanship

1.1. The relevant specification of item No. 10.30 shall be followed except that the nickel plated piano hinges shall be provided and fixed. It shall conform to the latest Indian Standards and shall be got approved by the Engineer-in-charge.

2.0. Mode of measurement & payment

2.1. The extra payment shall be made on sq. M. basis of door over and above item No. 10.30 for providing finish M.S. planed hinges instead of anodised aluminum butt hangs.

2.2. The rate shall be for a unit of one sq. meter.

10.39. Extra for providing vision panel not exceeding 0.1 sq. m. in all types of flush doors. (A) Rectangular square.

1.0. Materials and workmanship

1.1. The relevant specification of item No. 10.30 shall be followed except that the vision panel not exceeding 0.1 sq. m. shall be provided.

1.2. The glass panels shall conform to M-38 and this item is extra work of providing vision panel rectangular or square not exceeding 0.1 sq. in all types of flush doors.

2.0. Mode of measurements & payment

2.1. The payment shall be made over of item No. 10.30 for this extra work on shutter in which visions panels are provided.

2.2. The rate shall be for a unit of one sq. meter of door area.

10.51. Providing and fixing 30 mm. thick wire gauze shutters using galvanised M.S. Wire of I.S. gauze designation 85-G with wire of 0.56 mm. dia butt hinges with necessary screws : Indian Teak Wood.

1.0. Materials

Wire gauze ail shall conform to M-36. The teak shall conform to M-29. Anodised aluminum butt hinges shall conform to M-43.

2.0. Workmanship

2.1. Specification for item No. 10.12 A(l) shall be adopted for shutter and fixtures and fastenings except thru 30. mm. thick wire gauze shutter shall be provided.

2.2. Wire gauze shuttering:

2.2.1. The finished sizes of the wooden components like styles, rails, mountings, shall be as per the paneled doors. Each leaf shall have 2 panels of wire gauze as per drawings or as directed.

2.2.2. The styles, rails etc. shall be rebated 12 mm. along the side where they receive the gauze The galvanised iron webbing of 0.56 mm. dia mesh shall be used unless otherwise specified. The webbing shall be at 90 to 12 mm. along both sides of the rebate and fixed securely to the styles and rails and fillets of the size 10 mm x 10 mm, shall be securely and neatly fixed with small screws, spaced about 7.5. cm. centers round the rebate for each panel of webbing,- After the fillets are pressed well into the angle io hole the gauze hi two faces, the exposed edge of fillets shall be neatly rounded. The gauze shall be tightly stretched during fixing The space between the fillet and the rebate where the webbing is bent shall be neatly finished with putty, so that cut end of webbing may not be visible. Each shutter shall be fitted with a pair of anodised aluminum but! hinges with necessary iron screws.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item No. 10.12 shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

10.53. Providing and fixing 30 mm. thick wire gauze shutters using galvanised M.S. wire of wire gauze designation 85 G with wire of 0.56 mm. dia. for doors, windows, and clerestory windows including bright finished or/and black enameled M.S. butt hinges with necessary screws. Mango wood or equivalent quality.

1.0. Materials & workmanship

The relevant specification of item No. 10.51 shall be followed except that the hinges to be used shall be bright finish or/and black enameled M.S. butt hinges with screws and the wood shall be used of Mango wood or equivalent quality of non teak wood.

2.0. Mode of measurement and payment

2.1. The relevant specification of item No. 10.12 shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

10.54. Extra for providing and fixing galvanised M.S. gauze of I.S. gauge designation 140 G. to doors windows and clerestory windows with wire of dia 0.71 mm. instead of I.S. gauge designation 85 G. with wire of dia. 0.56 mm.

1.0. Materials & workmanship

1.1. The relevant specification for item no. 10,51 & 10.53 shall be followed for this item except that the diameter of wire shall be 0.71 mm. of I.S. gauge designation 140 G. instead of 596 G. diameter I.S. gauge designation 85 G.

2.0. Mode of measurements and payment

2.1. The payment shall be made extra over and above the payment for galvanised M S wire gauge.

2.2. The rate I.S. gauge designation 85 G. shall of one sq. mt of size of doors and windows shuttles

10.74. Providing and fixing 12 mm. thick and 100 mm. wide pellet of flat pressed 3 layer veneered particle board solid core with 25 mm. diameter aluminum curtain rod brackets including fixing with 25 mm. x 3 m. M.S. flat 10 long and plug etc. comp.

1.0. Materials

(1) 3 layers veneered particle board solid core snail-conform to M-40 25. mm. diameter aluminum curtain rod and 25 mm. x 3 mm. x 10 cms. long M.S. flat and plugs shall of best approved quality as directed.

2.0. Workmanship

The work shall be done as per drawing and description given in the item of work. The wooden planks shall be planed smooth and oven on the exposed surface.

The pellet shall be fixed Jo level by means of 10 cms. long x 25 mm. x 3 mm. M.S. flat brackets lent in the form of angle and wooden plug fixed in the walls using wood screws. For pelmet up to 1.5 meter long two such brackets shall be used and additional bracket provided for longer pelmet at the rate of one per meter length extra. The curtain rods be fixed by suitable brackets at the ends to the pelmet as directed.

3.0. Mode of measurement and payment

3.1. Pelmet shall be measured in running meters along the sides and face.

3.2. The rate shall be for a unit of one running meter.

10.84. Providing and fixing 40 mm. paneled, glazed or paneled and glazed partitions fixed to frames with iron screws etc., complete with India teak wood (Frames to be paid separately)

1.0. Materials

Indian Teak wood shall conform to M-29. Glass shall conform to M-38. Iron screws on shall of best approved quality. Plywood asbestos shall conform to relevant specification of materials.

2.0. Workmanship

The work shall be done as per detailed drawing or as directed. The wooden frames shall be of sizes as indicated in the drawing and description of item. They shall be planed and finished smooth and even. The vertical styles and rails shall be framed by tenon and mortise joints.

The panels which may be of planks, asbestos, plywood, glass or any other materials specified shall be fixed in the grooves made in styles and rails or by means of rebate and beading fixed by suitable screws. When glazing is used as panels the glass shall be fixed by using putty in addition to beading, (he putty shall be used before applying material.

3.0. Mode of measurement and payment

Partitions shall be measured in square meters of the net area of the tiller materials provided. The rate shad be for a unit of one sq. meter.

10.85. Providing and fixing decorative plywood 4 mm. thick in portions including fixing to frames with screws etc., complete with 50 mm. x 12 mm. teak wood beading (Frames to be paid separately)

1.0. Materials

4 mm. thick decorative plywood shall be of best approved quality. Teakwood beading and screws shall of best approved quality as directed.

2.0. Workmanship

The relevant specifications shall be same, as per that of item No. 10.84 expect that partitions shall be with 4 rnm. thick decorative plywood and with teakwood beading.

3.0. Mode of measurements and payment

The specifications shall be same as that of item No. 10.84. The rate shall be for a unit of one square meter.

10.86. Providing an fixing plain Asbestos cement sheet 6 mm. thick in partition including fixing to frames with screws etc., complete with 50 mm. x 12 mm. deodar wood beading (Frames to be paid separate)

1.0. Materials

Plain A.C. Sheets shall conform to M-24. Deodar wood beading shall conform to M-29. A.

2.0. Workmanship

The relevant specification of item No. 10.84 shall be followed same except that plain asbestos cement sheet 6 mm. thick shall be used in partition and Deodar wood beading of size 50 x 12 mm. size shall be used.

3.0. Mode of measurement and payment

3.1. The relevant specifications of item No. 10.84 shrill pp followed except that the rate excludes cost of frame work.

3.2. The rate shall be for a unit of one square meter.

10.88. Providing and fixing in partition 4 mm. thick medium hard board approved quality including fixing to frames with screws etc., complete with 50 x 12 mm. Teak wood beading (Frame to paid separated)

1.0. Materials

The hard board shall be 4 mm. thick and of best quality and made as approved. Teak wood beading shall conform to M-29.

2.0. Workmanship

The relevant specifications of item No. 18.84 shall be followed except that the hard board of 4 mm. thickness shall be used in partition and teak wood beading 50 x 12 mm. size shall be used.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 10.84 shall be followed except that the rate excludes cost of frame work.

3.2. The rate shall be for a unit of one square meter.

10.96. 26 mm. thick wooden shelves supported on 40 x 40 x 6 mm. T or Iron brackets fixed at suitable distances not exceeding 75 cms. apart with Mango wood or equivalent quality.

1.0. Materials

The mango wood shall conform to M-29-A. Structural steel shall conform to M-22

2.0. Workmanship

The mango wood or equivalent quality (not teak wood shelves shall be prepared from 25 mm. thick planks. The planks shall be planed smooth. The planks shall be used in single piece up to 30 cms. width. The shelves shall be fitted in position by fixing 40 x 40 x 6 mm. T or L Iron brackets. The spacing of brackets shall not be more than 75 cms. The 40 x 40 x 6 mm. T or L Iron brackets shall be fixed firmly in position by imbedding the same in concrete. The shelves shall be fixed as directed. The season teak wood buttons of size 35 x 12 mm. shall be fixed on open side as directed.

3.0. Mode of measurements and payment

3.1. The shelves shall be measured in Sq. meter. The length and breadth of shelves shall be measured net.

3.2. The rate is inclusive of button provided:

3.3. The rate shall be for a unit of one sq. meter.

10.97. 40 mm. thick wood shelves supported on 40 x 40 x 6 mm. T or L Iron brackets fixed at suitable distance but not exceeding 75 cms. apart with mango wood or equivalent quality.

1.0. Materials & Workmanship

The relevant specifications of item No. 10.96 shall be followed except that the thickness of shelves shall be 40 mm. Thick teak wood buttons shall be provided of 50 x 12 mm. on all open sides.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item NO. 10.96 shall be followed.

2.2. The rate shall be for a unit of one square meter.

10.99. Providing and fixing M.S. round or square bars with M.S. flats at required spacing in wooden frames of windows and clerestory windows.

1.0. Materials

M.S. bars and flats shall conform to M-18 and M-22 respectively.

2.0. Workmanship

2.1. The M.S. bars shall be fabricated as shown in the drawing or as directed. It shall conform to I.S. 226-1975 and I.S. 96 and I.S. 1977-1975. The M.S. bars shall be fixed at the required spacing in mild steel flats, after drilling holes in the latter. The diameter and spacing of these bars shall be as mentioned in the drawing or as directed. The bars shall be passed through drill holes drilled into the mild steel flats, fixed in the recess in frames. The flats shall be fixed with iron screws.

3.0. Mode of measurements & payment

3.1. The rate shall be for the M.S. round or square bars with M.S. flats provided and fixed in position as per the specifications for the completed item.

3.2. The rate shall be for a unit of one Kg

10.100.(A) Providing and fixing M.S. Grills of required pattern to wooden frames of windows etc., with M.S. flats at required spacing and frame around, square, or round bars with round headed bolts and nuts or by screws : plain Grill.

1.0. Materials

The structural steel shall conform to M-22

2.0. Workmanship

2.1. The M.S. Grill shall be prepared as per the drawing or as directed for fixing to wooden frames of windows etc.

2.2. The grill shall be fabricated to the designs and patterns shown in the drawings and the weight shall be as directed, and the joints shall be reverted or welded as shown in the plan or as directed. The grill so formed shall be fixed into the frames of the windows etc. before they are erected in position. The outside strip frame of the grill shall be housed to its full thickness into the recess cut into the frame of the windows etc. The grill shall be fixed to the frame with number of bolts and nuts or screws viz. bolt nut/screw per 30 cm. of the length of outer strip subject to minimum of 2 Nos. on each side of the frame or as indicated in the drawing or as directed.

2.3. The bolts and nuts or screws shall be counter sunk and shall be fixed with the top of their heads flush with the face of the frame strips.

3.0. Mode of measurements & payment

3.1. No payment shall be made for weight of screws, bolts nuts etc. only weight of grill shall be paid.

3.2. The rate shall be for a unit of one kg.

10.100.(B) Providing and fixing M.S. Grill of required pattern to wooden frames of windows etc. with M.S. plates, at required spacing and frame around, square or round bars with round headed bolts and nuts or by screws and with ornamental grill.

1.0. Materials & Workmanship

1.1. The relevant specification of item no. 10.100 (A) shall be followed except that the work is for of ornamental grill.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 10.100 (A) shall be followed.

2.2. The rate shall be for a unit of one Kg.

10.102. Providing and fixing hard drawn steel wire fabric 75 x 25 mm. mesh of weight not less than 7.75 kg. per sq.M to window frames etc, including 60 x 20 mm. beading of teak wood.

1.0. Materials

Hard drawn steel wire of 75 x 25 mm. mesh shall conform to M-34. Teak wood beading shall conform to M-29.

2.0. The steel wire fabric 75 x 25 mm. mesh of weight of not less than 7.75 kg per Sq.M. to windows frames etc. shall be fabricated as per detail drawings. The wire fabric shall be fixed to windows frame by teak wood beading of 60 x 20 mm. size be by means of screws.

3.0. Mode of measurements & payment

3.1. The wire mesh (Hard drawn) shall be measured net clear opening of frame of windows in which mesh is fitted. Nothing shall be paid extra for fixing mesh in groove below teak woods-beading.

3.2. The rate shall be for a unit of one sq. meter.

10.103. Providing and fixing fly proof galvanised M.S. Wire gauge of I.S, Gauge designation 85 G. with wire of dia. 0.56 mm. to windows and clerestory windows including 60 x 20 mm. beading of Indian Teak Wood.

1.0. Materials

The fly proof galvanised M.S. wire gauge shall conform to M-36. Teak wood .beading shall conform to M-29. **2.0. Workmanship**

The relevant specifications of item No. 10.102 Shall be followed except that fly proof galvanised M.S. wire gauge of I.S. gauge designation 85-G with wire of 0.56 mm. shall be provided.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item No. 10.102 shall be followed.

3.2. The rate shall be for a unit of one square meter.

10.120. Providing and fixing first class Indian teak wood, 75 x 60 mm. moulded hand rails in , straight lengths completed.

1.0. Materials

First class Indian teak wood shall conform to M-29.

2.0. Workmanship

The teak wood hand rail shall be of size 75 x 60 mm. The hand rail shall be prepared from first class Indian teak wood. The hand rail shall be moulded as per detail drawings. The hand rail shall be fixed in straight length as per detail drawings with screws. The relevant specifications of item No. 10.4 shall be followed except that the teak wood work shall be for a railing of specified size.

3.0. Mode of measurements & payment

3.1. The hand rail shall be measured in running meter.

3.2. The rate shall be for a unit of one running meter.

10.0.0.(I) Providing and fixing glazed louvered Glass windows and ventilators with teak wood frame 10 x 75 mm. size including 3 coats of oil painting to wood work etc. complete,**1.0. Materials**

Indian teak wood shall conform to M-29. Glass shall conform to M-38.

2.0. Workmanship

The relevant specifications of item No. 10.1 (A) shall be followed for frame work except that the frame work of 10 x7 cms. size of required size ventilators shall be provided with glazed glass louvers. The glass louvers shall be provided as directed. In the groove of 1.25 cms. depth made in frames, the thickness of glass shall be 5 mm. and glass shall be glass of best quality. The ventilation blades shall slope done towards the outside at an angle of 450.

3.0. Mode of measurements and payment

3.1. The area of opening within the frame in which louvers are fixed shall be measured in sq. meters.

3.2. The rate included painting 3 coats to wood work with ready mix paint.

3.3. The rate shall be for a unit of one square meter.

10.0.0.(II) Providing & fixing with wooden louvers plank 12 mm. thick windows and ventilators with teak wood frame 10x7 cms. size including 3 coats of oil painting to wood etc complete.**1.0. Materials & Workmanship**

The relevant specifications of item No. 10.00 (I) shall be followed except that the teak wood planks 12.00 thick louvers shall be provided.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 10.00 (I) shall be followed.

2.2. The rate shall be for a unit of one square meter

SECTION-11**Steel Shutters, Windows, Ventilators**

- 11.2. (A) Steel work riveted, in built up sections, framed work including cutting, hosting fixing in position and applying a priming coat of red lead paint. In beam and joints, channels, angles tees, flats, with connecting plates or Angle cleats as in main & cross beams, Hop and jack falters, pralines connected to common rafters and the like.**

1.0. Materials

The structured steel work shall conform to M-22. Red lead paint shall conform to I.S : 102-1962.

2.0. Workmanship

2.1. The steel sections as specified or required, shall be cut, square and to correct lengths, as per drawings and design. The .cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member, except as indicated in the drawing or as directed. All straightening and shaping to form shall be done by application of pressure and not by hammering. Any bending or cutting shall be carried out in suet] a manner as not to impair the strength of the metal. All operations shall be done in cold state unless otherwise directed/permittted.

2.2. Steel riveted or bolted in built up sections, frame work.

2.2.1. The steel structure as shown in the drawings or as per direction of the Engineer-in-charge shall be laid out on a level platform to full scale and to full size in parts. A steel tape shall be used for measurements to ensure maximum accuracy.

2.2.2. Wooden templates 12 mm. to 19 mm. thick or metal sheet template shall be made to correspond to each connecting gussets plate and rivet holes shall be accurately marked on them and drilled. The templates shall be laid on the steel members and holes of the steel members shall also be marked for curing. The base of steel column and the .position of Anchor bolts shall be carefully set out

2.2.3. Ail stiffeners shall be formed by pressure and where practicable the metal shall not to be cut and welded in making these. In major work', or whore so specified, shop drawings giving complete details and information for the fabrication of the component parts of the structure including location, type, size, (origin and details or rivets, bolts or weld shall be prepared in advance of the actual fabrication and as distinctly marked or stenciled with paint with the identification mark as given in the stop drawings. The bars shall be thickened at the ends, so as to provide for screwed threads and gradually tapered off to meet their normal section.

Great accuracy shall be observed in fabrication of various member, so that these can be assembled without being unduly packed, stained, or forced into position and when build up, shall be true and tree from twists, brinks, buckles, or open joints.

Before making holes in individual members for fabrication the steel work intended to be riveted or belted together shall be as ambled or clamped properly and tightly so as to ensure close abutting or lapping or the surfaces of the different members. All softeners shall bear tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or crossed true and straight and fitted close together. Web splice plates and tillers under stiffened shall be cut to fit within 3 mm. or flange Angles Web plates of Girders shall have no cover. Plates, shall have their ends flush with the top of angles forming the flanges unless otherwise required. The web plates when spiced ^,hall have clearance of not more than 6 mm. The erection, clearance for created ends of members connecting steel shall preferably be not greater than i.5 mm. The erection clearance at the ends o' beams without web cleats shall not be more than 3 mm. at each end but where for a practical reason greater clearance is necessary, suitably designed seating shall be provided.

Pains and rollers shall be accurately tuned to gauge. These straight and smooth and free from flows. The roller bearing shall be provided with adequate arraignment fur holding the girders or truss resting on it. In columns caps and bases, the ends of shifts together with the attached gussets Angles, channels etc after riveting together shah be accurately mechanized so that the parts connected Butt against each other over the entire surfaces of contact connecting angles or channels shall he fabricated and placed in position with greater accuracy so that they are nut unduly reduced in thickness by machining. The ends of bearing stiffeners shall be mechanized or ground to tit tightly both at the top and bottom, Alt holes shall generally be drilled to the required size and at required, position. Sub punching shall be permitted provided it is done 3 mm. or less in diameter and reamer thereafter to the require size. The holes for rivets and bolts shall be larger by 0 4. to 6 mm. than the nominal diameter of rivets or black bolts depending upon me diameter of rivets.

Holes shall have their axis perpendicular to the surface bored through. The drilling or remarrying shall be free from burrs, and the holes should be clean and accurate holes for counter sunk bolts shall be made in such a mariner that their heads fit flush with the surface after fixing.

The fabrication work shall be completed in workshop as far as it is practicable to do so. Site joints shall be done with rivets and fitted bolts or black bolts, as shown in the drawings or as directed. Generally the following principles shall govern the use of rivets turned and fitted bolts, and black bolts.

- (i) Rivets and turned and fitted bolts shall be used where the connections is such that slip under load has to be avoided.
- (ii) Black bolts may be used very sparingly where a force is carried through a connection without impact, vibration or reversal or stresses.

2.2.4. Riveting:

The parts assembled for riveting shall be in close contact with each other and the bearing stiffeners shall bear tightly both at top and bottom without being drawn or caulked. Members to be riveted shall be properly pinned or bolted and rigidly held to gather while riveting. Drifting of holes shall not be permitted Except to draw the parts together and the drifting tools so used shall have maximum diameter not exceeding, the nominal diameter of rivets or bolts. Drifting done during assembling shall not distort the metal or enlarge the holes.

The shanks of rivets shall project beyond the plate-surface sufficiently so as to fill hole thoroughly and form the required head after riveting.

The riveting shall be done by hydraulic or pneumatic process. However, where such facilities are not available, hand riveting may be permitted. The rivet shall be heated red hot, care being taken to control the temperature of heating so as not to burn the steel. Rivets of diameter less than 10 mm. may be fitted cold. Rivets shall be of heat finish with heads full and of equal size. All loose, burnt or badly formed rivets with concentric or deficient heads shall be cut out and replaced. The heads of rivets shall be central to shanks and shall grip the assembled member firmly. In cutting out rivets, care shall be taken so as not to injure assembled members, caulking or reequipping shall not be permitted.

For testing rivets, a hammer weighing approximately 0.25 kg shall be used. Both heads of the rivets shall be tapped, slack rivets will give a hollow sound and a jar.

All rivet heads shall be painted with red lead paint within a week of their fixing.

2.2.5. All bolt heads and nuts shall be hexagonal and of equal size unless specified otherwise. The screwed heads shall conform to I.S. 1363-1960 and the threaded surface shall not be tapered. The bolts shall be of such length so as to project two clear threads beyond the nuts when fixed in position and these shall fit in the holes without any shakes. The nut shall be fit in the threaded ends of bolts properly.

Where turned and fitted bolts are required to be used in place of rivets shall be provided with washers not less than 6 mm. thick so that the nut when tightened shall not bear on the unthreaded body of the bolt Tapered washers shall be provided for all heads and nuts bearing on leveled surfaces. The threaded portion of the bolt shall not be within the thickness of the parts bolted together, the faces of the bolt heads and nuts abutting against steel members shall be machine finished. Where there is a risk of the nut being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from slackening by the use of locknuts, spring washers, cross-cutting or hammering down of threads as directed.

Bolts, nuts, and-washers shall be thoroughly cleaned and dipped in double boiled linseed oil before use. The whole steel work shall be painted with a coat of priming coat of red lead, as per relevant specification of painting.

3.0 Mode of measurements & payment

3.1. The steel work shall be measured in general as under:

- (a) All work shall be measured on the basis of finished dimensions as fixed at site and measured net unless specified otherwise.
- (b) The weight of steel sections, steel rods, and steel strips in finished work shall be calculated from standard weight on the same basis on which steel is supplied to Contractor by department or those given in relevant I S : if steel is arranged by the contractor.
- (c) The weight of steel plates and strips shall be taken from relevant I.S. based on 7.35 kg./ sq. meter for every millimeter sheet thickness if steel is supplied to the contractor by department.
- (d) Unless otherwise specified, weight of cleats, brackets, packing pieces, bolts, nuts, washer, distance pieces, separators, diaphragm gusset (taking overall square dimensions) fish plates etc. shall be added to the weight of respective items.
- (e) In riveted work allowance is to be made for weight of rivet heads. No deductions shall be made for rivet or bolts holes excluding holes for anchor or holding down bolts.
- (f) For forged steel and steel castings, weight shall be calculated on the basis of 7850 kg./cum.
- (g) Unless otherwise specified, no allowance shall be made for the weld metal in case of welded steel structure.

- (i) Dimensions other than cross sections and thickness of plates shall be measured to nearest 0.001m
- (j) Mill tolerance shall be ignored when weight is determined by calculation.
- 3.2.** The rate includes cost of all material, labour, erection, hoisting scaffolding, protective measure, required for proper completion of the item of work. This shall also include conveyance and delivery handling, loading, unloading and storing etc. required for completing the item described above including necessary wastage involved.
- 3.3.** The rate shall be for a unit of one quintal.
- 11.2.(D) Steel work riveted in built up section, framed work including cutting, hoisting, fixing in position and applying a priming coat of red lead paint in trusses, and trussed, purlins, upto 25 m. span and 15 m. overall height.**
- 1.0. Materials & Workmanship**
The relevant specifications of item No. 11.2 (A) shall be followed except that the work shall be for trusses and trussed purlins up to 25 m. span and 15 m. overall height.
- 2.0. Mode of measurement & payment**
- 2.1.** The relevant specifications of item No. 11.2. (A) shall be followed.
- 2.2.** The rate shall be for a unit of one quintal.
- 14.4.(A) Steel work welded, in built up sections frame work including, cutting, hoisting, fixing in position and applying a priming coat of red lead paint. In beams and joints, channels, angles tees, flats, with connecting plates or angle cleats as in main and cross beams. Hip and jack rafters, purlins, connected to common fallers and the like.**
- 1.0 Materials & Workmanship**
- 1.1.** The relevant specification of item No. 11.2 (A) shall be followed except that the steel work shall be done by welding.
- 1.2.** Welding shall generally be done by electric process. Gas welding shall be resorted to, using oxyacetylene flame with specific prior approval. Gas welding shall not be permitted for structural steel work.
- 1.3.** The work shall be done as shown in the shop drawings which should clearly indicate various details of the joints to be welded, shop and site welded as well as type of electrodes to be used, symbol for welding on plans and shop drawings shall be according to I.S. 813-1961. As far as possible every effort shall be made to limit the welding that must be done after improper welding that is likely to be done due to heights and difficult positions on scaffoldings etc. The welding work shall conform to I.S. 816-1969.
- 1.4.** Preparation of surfaces : Surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.
- 1.5.** Assembly for welding : Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the plates accurately in place without displacement.
- 1.6.** Precautions : All operations connected with welding and cutting equipment shall conform to safety requirement given in I.S. 818-1968.
- The following points shall be borne in mind during the process of welding:
- (b) Arc length voltage and amperage shall be suited to the thickness of material type of groove and other circumstances of the work.
- (c) The segments of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.
- 1.7.** The defective welds which shall be considered harmful to the structural strength shall be cut out and reworked.
- 1.8.** Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed. Welds and adjacent parts shall not be painted after the same are approved.
- 1.9.** All the members shall be thoroughly cleaned of rust-scales, dust etc. and given a priming coat of red lead paint before fixing them in position.
- Testing of welding to be added in the specification I.N. 12.2.2.12-(i) to (viii)
- 2.0. Mode of measurements & payment**
- 2.1.** The relevant, specification of item No. 11.2 (I) shall be followed.
- 2.2.** The rate shall be for unit of one quintal.
- 11.4.(D) Steel work welded in built up section framed work, cutting, hoisting, fixing in position and applying a priming coat a red lead paint in trusses and trusses purlins up to 25 m. span and 15 m. overall height.**
- 1.0. Materials & Workmanship**
The relevant specification of item No. 11.4.(A) shall be followed except that the work shall be for trusses and trussed purlins up to 25 m. span and 15 m. overall height.

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 11.4 (A) shall be followed.

2.2. The rate shall be for unit for one quintal.

11.6. Providing and fixing in position collapsible steel shutters with vertical channels 20 x 10x2 mm. braced with flat iron diagonals 20 x 5 mm. size with top and bottom rails of T Iron 40 x 40 x 6 mm. with 38 mm. dia steel pulleys complete with bolts, nuts, locking arrangements, stoppers, handles, including applying a priming coat red lead paint.

1.0. Materials

The collapsible steel gate shall conform to M-33.

2.0. Workmanship

J-rails shall be fixed to the floor and to the lintel at top by means of Anchor bolts, embedded in cement concrete-of floor and lintel. The anchor bolts shall be placed approximately at 45 mm. centers alternatively in groove shall be formed along the runner for the purpose. The collapsible gate shall fixed at the sites by fixing the double channels in the T-iron rail and also by hold fasts bolted to the end double channel and fixed in the masonry of the side walls or the otherwise.

In case where the collapsible gate is not required to the lintel beams or slop above, a toe iron suitably designed may be fixed at the top embedded in masonry and provided with necessary clamps and roller arrangement at the top.

All the adjoining work damaged while fixing of gate shall be made good to match the existing work without any extra payment.

All the members of the collapsible gate including T-iron shall be thoroughly cleaned of rust, scales dust etc., and given a priming coat of red lead, before fixing them in position.

3.0. Mode of measurement and payment

3.1. The collapsible gate shall be measured in sq. meter. The height of the gate shall be measured as the length of double channels and breadth from outside to outside of the end fixed double channels in open position of the gate. The rate includes providing handles, arrangements stoppers etc.

3.2. The rate -shall be for a unit of one sq. meter.

11.7. Providing and fixing 1 mm. thick M.S. sheet sliding shutters both frame and diagonal braces of 40 x 40 x 6 mm. Angle iron 3.15. M.S.S. gusset plates at junctions and comers, 25 mm. dia. pulley 40 x 40 x 6 mm. angle and T-iron guide rail at top and bottom respectively with handles, stoppers and locking arraignments etc. including applying priming coat of red lead paint.

1.0. Materials

M.S. sliding shutters shall be fabricated of M.S. component as given in the description of item M.S. sheets 1 mm. thick shall be fixed to the frame with rivets of weld as approved. The shutters shall he provided with top and bottom guide rails of Angles or T-iron as specified and 25 mm. dia. steel pulleys at the-bottom guide black with steel pulleys at the top. The frame shall be riveted and /or welded and wherever riveting shall be done 3.15 mm. gussets plates shall be provided at the junctions.

2.0. Workmanship

2.1. The shutters shall be single or double leaf shutters as specified. The guide rails shall be sufficiently long and continued along the wall on the both ends so that the sliding shutters can rest against walls, living full opening when so required.

2.2. The guide rails shall be fixed to the floor by means of anchor bolts embed in the cement concrete floor. The steel section at the top shall be suitably supported from the walls. Two channel section shall suitably fixed vertically below the extreme clamps in the wall and floor to avoid the shutters from going out of the supports at the top and bottom. A suitable clamping arrangement will be provided at either end of the opening to avoid the shutters from rolling back into opening.

2.3. All the adjoining work damaged while fixing shall be made good to match the existing work.

2.4. All members of the sliding shutter including T-iron shall be thoroughly cleaned of nisi scales dust etc. and given a priming coat of red lead before fixing them in position

3.0. Mode of measurements & payment

3.1. The sliding doors shall be measured on sq. meter. The height of the shutters shall be measured form outside to outside of the guide, rail and width outside of shutters including vertical channels in sides. The rate includes providing handles stopped and locking arrangement etc. complete.

3.2. The rate shall be for a unit of one sq. meter.

SECTION-12**Labour for fixing fixtures & fastening****12.4. Fixing metallic tower bolts of sizes with necessary screws etc. complete (tower bolts and screws to be paid under separate items:)****1.0. Workmanship**

1.1. This item provides for labour for fixing metallic tower bolts of any size with screws, mitts etc,

1.2. The tower bolts shall be fixed in proper position as shown in the drawings or as directed. There shall be fixed truly vertical or horizontal as the case may be.

1.3. The screws shall be driven home with screw driver. In no case the screws shall be hammered in.

1.4. All recesses and seats shall be cut to the exact size for counter sinking etc. where so required.

1.5. Care shall be taken to see that no gaps are left between the fitting and the surface meant to receive the fittings.

1.6. The fittings shall be properly cleaned and left in original finish after fixing.

2.1. Mode of measurements & payment

(1) Cutting of holes, recesses, and seats involved in process of fixing.

(2) Cost of filling and cushioning materials where so required for proper seating of new fittings.

(3) Cost of nails etc. for temporary positioning of fitting.

(4) Cost of cleaning materials like old washed dhoti stain remover etc.

(5) Cost of making good the over cut recesses or holes if any.

(6) Cost of making hole of required size on the wooden frame for housing the bolt for locking.

2.2. The rate includes cost of labour involved in all operations required for proper completion of the items including carriage, handling, fixing etc. complete.

2.3. The rate shall be of unit of one number.

12.5. Fixing metallic flush bolts of size with necessary screws etc., complete (flush bolts and screws shall be paid under separate items):**1.0. Workmanship**

1.1. The relevant specifications shall be followed as per item No. 12.4. except for fixing metallic flush bolts instead of tower bolts.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 12.4. shall be followed.

2.2. The rate shall be for a unit of one number.

12.8. Fixing metallic or plastic door handles of sizes with necessary screws etc. complete (door handles and screws to be paid under separate items)**1.0. Workmanship**

1.1. The relevant specifications of item No. 12.4. shall be followed except fixing door handles instead of tower bolts.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 12.4. shall be followed.

2.2. The rate shall be for a unit of one number

12.10. Fixing metallic gate and shutter hooks and eyes of sizes (hooks and eyes to be paid under separate items)**1.0. Workmanship**

1.1. The relevant specifications shall be followed as per item No. 12.4 except that fixing of eye and hooks instead of tower bolts.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2. The rate shall be for a unit of one number (Hook & Eye)

12.11. Fixing metallic door latches of size with necessary screws (door latches and screws to be paid under separate items) :

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4 shall be followed except that fixing metallic door latches instead of tower bolts.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2. The rate shall be for a unit of one Number.

12.12. Fixing metallic mortise night latches with necessary screws including making necessary crews holes in wooden door shutters etc., complete (mortise night latches and screws to be paid under separate items):

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4 above shall be followed except that the fixing of mortise night latches instead of tower bolts.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2. The rate shall be for a unit of one number.

12.18. Fixing metallic ball catchers 100 mm. dia. (Ball catches to be paid under separate item):

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4 shall be followed same except fixing of ball catchers 100 mm dia.

2.0. Mode of measurements and payment

2.1. The relevant specification of item No. 12.4 shall be followed.

2.2. The rate shall be for a unit of one number.

12.20. Fixing metallic casement window fasteners with necessary etc. complete. (Casement window fasteners and screws to be paid under separate items):

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4. shall be followed except fixing metallic casement windows fasteners.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2: The rate shall be for a unit of one number.

12.21. Fixing metallic casement stays of sizes with necessary screws etc., complete. (Casement stays and screws to be paid under separate items)

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4 shall be followed except fixing of metallic casement stays.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2. The shall be for unit of one number.

12.24. Fixing metallic cupboard of ward robe locks of sizes with necessary screws etc. complete (Locks and screws to be paid separately) :

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4 shall be followed except that fixing metallic cupboard or ward robe locks of size with necessary screws etc. complete.

2.0. Mode of measurements & payment

2.1 The relevant specifications of item No. 12.4 shall be followed.

2.2. The shall be for a unit of one number

12,25. Fixing metallic or plastic cupboard or ward robe knobs of size with necessary screws/ bolts etc., (knobs and screws/bolts to be paid separately) :

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4 shall be followed except that fixing metallic or plastic cupboard or ward robe knobs of sizes with necessary screws/bolts etc. complete.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2. The shall be for a unit of one number.

12.26. Fixing metallic floor stoppers of sizes with rubber cushion, screws etc., to suit shutter thickness complete, (floor door stopper with rubber cushion and screws to be paid under separate items) :

1.0. Workmanship

1.1. The relevant specifications of item No. 12.4 shall be followed except that fixing metallic floor stoppers.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2. The shall be for a unit of one number.

12.28. Fixing metallic door handles or knobs for mortise jocks with necessary screws etc. complete (doors, handles/knobs and screws to be paid separately) :

1.0. Workmanship

The relevant specifications of item No. 12.4 shall be followed except that fixing metallic door handles or knobs for mortise with necessary screws etc. complete.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 12.4 shall be followed.

2.2. The rate shall be for a unit of one number.

SECTION-13**Glazing****13.1.(I) Providing and fixing sheet glass, selected quality (type-C) bedded in putty and fixed with wooden beading including cost of wooden beading of first class teak wood and necessary cutting of glass 5 mm. thick.****1.0. Materials**

The glass shall conform to M-38. The wood beading shall conform to M-29, Putty shall conform to I.S. 419-1967.

2.0. Workmanship

The glass shall be sheet glass of selected quality of 5 mm. thick.

2.1. The size of glass for glazing shall allow a clearance of 2.5 mm. between the edges of glass and the wood or metal surrounds. The clearance may be increased, provided the depth of the rebate of groove is sufficient to provide not less than 1.5 m. cover to the glass. The detailed process of glazing shall be as specified in I.S. 3548-1966.

2.2. All stains from the surface of glass shall be removed and cleaned with thinner or spirit without any extra payment.

2.3. Wooden beading :

2.3.1. The size of the wood beads for glass panes shall be 1.5 cms. x 3 cms unless otherwise specified. Beads shall be secured to wooden frames with either panels pins or screws and to metal frames in the way provided for in the frame.

2.3.2. Sufficient putty compound shall be applied to the rebate so that when the glass has been pressed into the rebate, a bed of compound not less than 1.5 mm. thick will remain between the glass and the rebate. There should also be surplus of compound squeezed out above the rebate which should be stripped at an angle not under cut to prevent water accumulating. Beads should be bedded with compound against the glass and wood beads should also be bedded against the rebate. Care should be taken to see that no voids are left between the glass and the bead.

3.0. Mode of measurement & payment

3.1. All measurements of cutting shall, unless otherwise stated, be held to include the consequent waste.

3.2. Each pane of glass shall be measured to the nearest 0.5 cms. both in width and height/length.

3.3. Irregular shaped or circular panes shall be measured as the smallest rectangular area from which the irregular or circular pane can be cut.

3.4. The rate includes cost of materials, labour required for completion of the item including hoisting, carriage, temporary erections like scaffolding etc.

3.5. The rate also includes :

(i) The wastages and breakage involved in the process.

(ii) Straight cutting on glass and glazing sheets.

(iii) Cost of subsidiary materials required for proper fixing and functioning of glass i.e. nails, spirit, putty, teak wood beading glass, pins, etc. complete.

3.6. The rate shall be for a unit of sq. meter.

13.1.(M) Providing and fixing sheet glass selected quality (Type-C) bedded in putty and fixed with wooden beading including cost of wooden beddings of first class teak wood, and necessary cutting of glass 6 mm. thick.**1.0. Materials and workmanship**

1.1. The relevant specifications of item No. 13.1 (I) shall be followed except that the sheet glass of selected quality shall be 6 mm. thick.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 13.1.(I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

13.3.(C) Providing and fixing rough cast wired glass 6 mm. thick bedded in putty and fixed with wooden beading including' the cost of wooden beadings of Indian teak wood and necessary cutting of glass wired figures glass.

1.0. Materials :

Wire figure glass shall conform to M-38. Wooden beading shall conform to M-29, Putty shall conform to I.S. 419-1967.

2:0. Workmanship

The relevant specification of item No. 13.1(1) shall be followed except that the wired figured glass of 6 mm. thick shall be used.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 13.1(1) shall be followed.

3.2. The rate shall be for a unit of one sq. nit.

3.5.(3) Providing and fixing sheet glass ordinary quality bedded in putty and fixed with wooden beading including the cost of wooden beadings of first class teak wood and necessary cutting of glass 3 mm. thick.

1.0. Materials

Glass shall conform to M-38. Wooden beading shall conform to M-29. Putty shall conform to I.S. 419-1967. **2.0**

Workmanship

The relevant specification of item No. 13.1 (I) shall be followed except that the wired figured glass of 6 mm. thick shall be used.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 13.1 (I) shall be followed.

3.2. The rate shall be for a unit of one sq. mt.

13.5.(3) Providing and fixing sheet glass ordinary quality bedded in putty and fixed with wooden beading including the cost of wooden beadings of first class teak wood and necessary cutting of glass 3 mm. thick.

1.0. Materials

Glass shall conform to M-38. Wooden beading shall conform to M-29. Putty shall conform to I.S. 419-1967.

2.0. Workmanship

2.1. The specification of this item shall be followed as per item No. 13.1(1) except that the sheet glass of ordinary quality shall be used and thickness of sheet glass shall be 3 mm. thick.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 13.1(1) shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

13.5.(4) Providing and fixing sheet glass ordinary quality, bedded in putty and fixed with wooden beadings including the cost of wooden beadings of first class teak wood and necessary cutting of glass 4 mm. thick.

1.0. Materials and Workmanship

The relevant specifications of item No. 135 (3) shall be followed, except that the thickness of ordinary sheet glass shall be 4 mm.

2.0. Mode of measurements and payment

2.1. The relevant specification of item No. 13.1(1) shall be followed.

2.2. The rate shall be for a unit of one sq. meter,

13.7. Extra for using ground glass (Frosted or obscured on one side) instead of plain glass.

1.0. Materials

Glass shall conform to M-38. Wooden beading shall conform to M-29. Putty shall conform to I.S. 419-1967.

2.0. Workmanship

The specifications of this item shall be followed as per item No. 13.1 except that ground glass (Frosted or obscured on one side) shall be used.

3.0. Mode of measurements and payment

3.1. The payment shall be made on sq. mt. basis extra over and above the payment for plain glass for using ground glass [Routed of obscured).

3.2. The relevant specifications of item No. i3.5 (III) shall be followed.

3.3. The rate shall be for a unit of one sq. meter.

13.11.(A) Difference in cost of material and labour involved in method of glazings if changed in item No. 13.1 to front and back puttied and sprigged 01 fixed with glazing pins :

1.0. Materials and Workmanship

1.1. The relevant specification of item No. 13.1 shall be followed except that the glazing is to be done by front and back puttied and sprigged or fixed with glazing pins.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 13.1 (I) and 13.1 (II) shall be followed.

2.2. The extra rate for extra cost involved shall be paid over and above item No. 13.1(1) & 13.1 (II).

2.3. The rate shall be for a unit of one sq. meter.

13.12. Grinding, polishing and round of edges or glazing sheets.

1.0. Materials

The glass shall conform to M-38.

2.0. Workmanship

The edges of glass or glazing sheets shall be grained, polished and rounded of such that it renders uniform look throughout the length and shall be neatly finished. The work shall be carried out in best workman's like manner.

3.0. Mode of measurements & payment

3.1. The edges of glass round, polished and rounded off shall be measured in meter.

3.2. The rate shall be for a unit of one running meter.

SECTION-14
Paving & Floor Finishing

- 14.2.(A) 40 mm. thick marble chips flooring rubbed and polished (i.e. Terrazzo) to granolithic-finish with under layer 30 mm. thick cement concrete (1:2:4:) (1 cement :2 coarse sand : 4 graded stone aggregate 10 mm. and down gauge) and top layer, 10 mm. thick with white, black or white and black marble chips of required sizes from 1 mm. to 4 mm. nominal size laid in cement marble powder mix 3 : 1 (3 cement : 1 marble powder by weight, in proportion of 4: 7 (4 cement marble powder mix : 7 marble chips by volume): Dark shade pigment with ordinary cement (in top layer only).**

1.0. Materials

Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-G. Stone grit shall conform to M-8.

The pigment incorporated in terrazzo shall be of permanent colour and shall conform to requirement mentioned in Appendix-A in IS: 2114-1962. Marble chips shall conform to M-46. The marble powder shall pass through I.S. Sieve Terrazzo-30.

2.0. Workmanship

2.1. Terrazzo finish shall be laid over a layer of base concrete in case of ground floor. When the terrazzo floor is laid over R.C.C. slabs a cushioning layer consisting of 75 mm. thick lime concrete shall be provided below the terrazzo floor. The terrazzo flooring shall consist of an under layer of cement concrete and layer of terrazzo which shall be paid monolithically.

2.2. Under Layer :

2.2.1. The under layer shall be of cement concrete mix 1:2:4. The maximum size of aggregate used shall not exceed 10 mm. Specification for cement concrete shall be followed as per item No. 5.4.1.

2.3. Terrazzo Topping :

2.3.1. The topping shall have mix of ordinary cement, and marble powder in proportion 3:1 (3 cement : 1 marble powder by weight) and marble aggregate shall be mixed in proportion 4:7 (4 cement marble powder : 7 marble chips by volume). The thickness of concrete and cushioning layer shall not be less than 10 cms. and 7.5 cms. respectively. The minimum thickness of under layer and topping shall be 40 mm.

2.4. Panels :

2.4.1. The floor both while laying the under layer and topping shall be divided into panels not exceeding 2 sq. m. in area so as to reduce the risk of cracking due to differential shrinkage or expansion of terrazzo and sub-floor. The joints be so located that the layer dimensions of any panel do not exceed 2 M. The panels shall preferably be separately. However where the butt joint are provided, the bays shall be laid alternatively allowing for an interval of at least 24 hours between the laying of adjacent bays.

2.5. Mixing of materials :

2.5.1. With a view to avoid variation in colour, mixing shall be done in trough or tub, and the complete quantities of cement and pigment required for one unit shall be mixed at the beginning of the work. Colour cement or cement and pigment mix shall be dry mixed with marble powder. The mix thus obtained shall be mixed with aggregate. Care shall be taken not to get the materials into a heap as this would result in coarser aggregates moving on the sides and cement to the centre. To the dry mix thus prepared, water shall be added in small quantities while materials are being worked to get a mix of proper consistency. The mixture shall be plastic but not so wet as to flow. The wet mix shall be used within half an hour mix of addition of wafer during preparation laying.

2.6. Laying :

2.6.1. The base shall be divided into panels with the help of dividing strips including the strips required for decorative design up to the finished surface level of the floor. Screeds strips shall be used where the dividing strips are not used. The base shall be cleaned of all dust, dirt laitance and any loose materials. It shall be then wetted with water mopped and smeared*with cement slurry at 2.75 kg./sq.mt. Under layer shall be then be spread and leveled with a screening board. The top surface shall be left rough to provide a good bond to die terrazzo.

2.6.2. The terrazzo topping shall be laid while the under layer is still plastic but has hardened enough to prevent cement from rising to the surface. This is normally achieved between 18 to 24 hours after laying of under layer. A cement slurry preferably of the same colour as the topping shall be brushed on the surface immediately before laying the topping. The terrazzo mix shall be laid to a uniform thickness on the screed bed and be completed thoroughly by taping or rolling and trowel led smooth. Excessive troweling or rolling in early stages shall be avoided as it results in working up cement to the surface which will produce a surface liable to cracking and will require more grinding to expose marble chips. The terrazzo surface shall be tamped, trowel led, and brought true to required level by a straight edge and steel floats in such a manner that the maximum amount of marble chips come up and are spread uniform over the surface and no part of the surface is left without chips.

2.7. Curing :

2.7.1. The surface shall be left dry for air curing for a period of 12 to 18 hours. Thereafter water shall be allowed to stand overnight in pools for period of minimum of four days. The floor shall be prevented from being subjected to extreme temperature.

2.8. Grinding and finishing :

2.8.1. Grinding and finishing shall be done either by hand or by machine. In case of manual grinding, the process of grinding shall begin after two days, while in case of machine grinding, the process shall be started after seven days, after completion of laying.

2.8.2. First grinding shall be done by carborundum stones of 60-grit size. The surface shall then be washed clean and grouted with a grout of cement or /and coloring matter in the same mix and proportion as the topping in order to fill any pin holes that appear. It shall be allowed to dry for 24 hours and wet cured for four days in the same manner as mentioned in Para 2.7 above.

2.8.3. The second grinding shall be done with carborundum stone of 80 grit size. The surface shall then be prepared as after first grinding. The third grinding shall be done with carborundum stone of 120 to 150 grit size. The surface shall then be washed again and allowed to dry for 12 hours, and wet cured for four days as before. The fourth grinding shall be done with carborundum stone of 320 to 400 grit size. The surface shall again be washed clean and rubbed hard with felt and slightly moistened Oxalic acid powder @ 5 gms. per sq. meter of floor surface. After the finishing work is over, the surface shall be washed with dilute oxalic acid solution and dried for floor polishing, machine fitted with felt or Hessian bobs shall then be run over it until floor shines. In case wax-polished surface is required, wax-polished shall be applied on the surface with the help of soft linen over a clean and dry surface. The polishing machine fitted with bobs shall be run over it, clean saw dust shall be spread over the floor surface and polishing machine again operated which will remove excess wax and leave glossy surface. Floor shall not be left slippery.

3.0. Mode of measurements and payment

3.1. Terrazzo flooring shall be measured as laid in sq. meters. Length and breadth shall be measured for visible area of work done. No deduction shall be made for nor extra for any opening in floor or area up to 0.10 sq. meter. The rate shall cover laying the floor at different levels in the same room or court-yard and nothing extra shall be paid on that account.

3.2. The rate includes the cost of all materials and labour involved in all operations described above. The rate shall also not include diving strip.

3.3. The rate shall be for a unit of one sq. meter.

14.2.(B) 40 mm. thick marble chips, flooring rubbed and polished (i.e. Terrazzo) to granolithic finish with under layer 30 mm. thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 10 mm. and down gauge) and top layer 10 mm. thick with white, black or white and black marble chips of required sizes from 1 mm. 4 mm. nominal size laid in cement marble powder mix 3 :1 (3 cement : 1 marble powder by weight) in proportion of 4: 7 (4 cement : marble powder mix : 7 marble chips by volume) light shade pigment with white cement (in top layer only).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.2 (A) shall be followed except that light shade pigment with white cement shall be used in top layer

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.2 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.2.(C) 40 mm. thick marble chips, flooring rubbed and polished (i.e. Terrazzo) to granolithic finish with under layer 30 mm. thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 10 mm. and down gauge) and top layer 10 mm. thick with white, black or white and black marble chips of required sizes from 1 mm. to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble powder by weight) in proportion of 4:7 (4 cement : marble powder mix : 7 marble chips by volume). Medium shade pigment with approx, 50% white cement and 50% ordinary cement (In top layer only).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.2. (A) shall be followed except that medium shade pigment with approximately 50% white cement and 50% ordinary cement in top layer only shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.2. (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.2.(D) 40 mm. thick marble chips, flooring rubbed and polished (i.e. Terrazzo) to granolithic finish with under layer 30 mm. thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 10 mm. and down gauge) and top layer 10 mm, thick with white, black or white and black marble chips of required sizes from 1 mm. to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble powder by weight) in proportion of 4:7 (4 cement : marble powder mix : 7 marble chips by volume). White cement without any pigment (in top layer only).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.2.(A) shall be followed except that white cement without any pigment in top layer only shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.2.(A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.2.(E) 40 mm. thick marble chips, flooring rubbed and polished (i.e. Terrazzo) to granolithic finish with under layer 30 mm. thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 10 mm. and down gauge) and top layer 10 mm. thick with white, black or white and black marble chips of required sizes from 1 mm. to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble powder by weight) in proportion of 4:7 (4 cement : marble powder mix : 7 marble chips by volume), light shade pigment with ordinary cement (in top layer only).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.2(A) shall be followed except that the light shade pigment with ordinary cement (in top layer only) shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.2 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.4.(A) Marble chips skirting (Terrazzo) or dodo rubbed and polished to granolithic finish top layer 6 mm. thick with white black or white and black marble chips of sizes from smallest to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble by weight) in proportion of 4:7 (4 cement : 7 marble chips by volume) 20 mm. thick with under layer 14 mm. thick in cement plaster 1:3 (1 cement : 3 coarse sand) : Dark shade pigment with ordinary cement (in top layer only).

1.0. Materials

1.1. The relevant specifications of item No. 14.2 (A) shall be followed.

2.0. Workmanship

2.1. Under layer: The under layer for terrazzo on vertical surfaces like skirting and dedos shall be of stiff cement mortar 1:3 (1 cement : 3 coarse sand) finished rough so as to give a good bond to the topping.

2.2. Terrazzo topping shall not be less than 6 mm. thick and the combined thickness of under layer and topping shall be less than 20 mm. The other details shall be followed same as per specifications of item No. C 24 except that the light shade pigment with white cement in top layers shall be used.

3.0. Mode of measurements & payment

3.1. The skirting and dedo shall be measured in square meters correct to two places of decimals. The height shall be measured from the finished level of floor.

3.2. The rate shall be for a unit of one sq. meter.

14.4.(B) Marble chips skirting (Terrazzo) or dedo rubbed and polished to granolithic finish top layer 6 mm. thick with white black or white and black marble chips of sizes from smallest to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble by weight) in proportion of 4:7 (4 cement : 7 marble chips by volume) 20 mm. thick with under layer 14 mm. thick in cement plaster 1:3 (1 cement : 3 coarse sand) : light shade pigment with white cement (In top layer only).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.4 (A) shall be followed except that the light shade pigment with white cement in top layers only shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.4(A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.4.(C) Marble chips skirting (Terrazzo) or dedo rubbed and polished to granolithic finish top layer 6 mm. thick with white black or white and black marble chips of sizes from smallest to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble by weight) in proportion of 4:7 (4 cement : marble powder mix 7 marble chips by volume) 20 mm. thick with under layer 14 mm. thick in cement plaster 1:3 (1 cement : 3 coarse sand) : medium shade pigment with approximate 50% white cement and 50% ordinary cement (In top layer only).

1.0. Materials and workmanship

1.1. The relevant specifications of item No. 14.4(A) shall be followed except that the medium shade pigment with approximate 50% white cement and 50% ordinary cement in top layers only shall be used.

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 14.4 (A) shall be followed.

2.2. The rate shall be for a unit for one sq. meter.

14.4.(D) Marble chips skirting (Terrazzo) or dodo rubbed and polished to granolithic finish top layer 6 mm. thick with white black or white and black marble chips of sizes from smallest to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble by weight) in proportion of 4:7 (4 cement : marble powder mix 7 marble chips by volume) 20 mm. thick with under layer 14 mm. thick in cement plaster 1:3 (1 cement : 3 coarse sand) : White cement without any pigment (In top layer only).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.4 (A) shall be followed except that the white cement without any pigment in top layers shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.4 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.4.(E) Marble chips skirting (Terrazzo) or dedo rubbed and polished to granolithic finish top layer 6 mm. thick with white black or white and black marble chips of sizes from smallest to 4 mm. nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble by weight) in proportion of 4:7 (4 cement : marble powder mix 7 marble chips by volume) 20 mm. thick with under layer 14 mm. thick in cement plaster 1:3 (1 cement : 3 coarse sand) : light shade pigment with ordinary cement (In top layer only).

1.0. Materials & workmanship

1.1. The relevant specifications of item No. 14.4 (A) shall be followed and except that the light shade pigment with ordinary cement in top layers only shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.4 (A) shall be followed and except that the light shade pigment with ordinary cement in top layers only shall be used.

2.2. The rate shall be for a unit of one sq. meter.

4.16 Providing and laying cushioning layer on R.C.C. slab consisting of 75 mm. thick lime concrete using brick aggregate of 20 mm. nominal size 50% mortar comprising of 1 lime : 2 fine sand.

1.0. Materials

1.1. Water shall conform to M-1. Lime mortar or proportion 1:2 shall conform to M-10. Brick aggregate 20 mm. nominal size shall conform to M-14.

2.0. Workmanship

2.1. The relevant specifications of item No. 1.8 shall be followed except that the proportion of mix shall be 50% mortar comprising of 1 lime : 2 coarse sand and the size of brick aggregate shall be 20 mm. nominal size. The lime concrete work shall be carried out in 7.5 Cms. average thickness as a cushioning layer on R.C.C. slab.

3.0. Mode of measurements and payment

3.1. The lime concrete work shall be measured for visible area of work done.

3.2. The rate shall be for a unit of one sq. meter.

14.19.(A) Precast terrazzo (Mosaic) tiles 20 mm. thick with white, black or white and black marble chips of sizes up to 6 mm. laid in floors, treads of steps and landings on a bed of 25 mm. average thickness of lime mortar 1:1.5 (1 lime putty : 1.5 fine sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and polishing complete with precast files of light shades, using white cement.

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Lime Mortar shall conform to M-10 cement mortar shall conform to M-1. The precast terrazzo tiles of 20 mm. thick shall be light shade using white cement and conform to M-47.

2.0. Workmanship

2.1. The work shall be carried out as per I.S. 1443-1972.

2.2. Bedding :

2.2.1. Before spreading the mortar, the sub-base of the floor shall be cleaned of all dirt, scum and loose materials and then well wetted without forming any pools of water on the surface.

2.2.2. In case; of R.C.C. floors, the top shall be left a little rough, all points of level for the finished surface shall be marked out. The lime mortar of proportion 1:1.5 (1 lime putty : 1.5 fine sand) or cement mortar of proportion C.M. 1 : as directed shall be then evenly and smoothly spread over the base. Bedding layer of mortar shall be not less than 10 mm. and average thickness of bedding shall be 25 mm.

2.3. Laying :

2.3.1 Before laying the terrazzo (Marble/Mosaic) tiles, the tiles shall be thoroughly wetted with water. Neat cement grout of required-consistency at 4.4. Kg. cement/sq. mt. shall be spread on the mortar bed. The tiles shall be laid on the neat cement float and shall be evenly and firmly bedded to the required level and slope, There shall be no hollows left. The joints shall be uniform thickness and in straight line as per the pattern.

2.3.2 The surface of flooring shall be checked frequently with a straight edge at least two meters long so as to obtain a true surface with required slope.

2.3.3. The tiles which are fixed in the floor adjoining the wall shall go about 10 mm. under plaster. Skirting or dedo shall be left unfinished for about 50 mm. above finished floor level and unfinished strip then left earlier shall be finished.

2.3.4. In places where full tiles cannot be fixed, the tiles shall be cut to the size and smoothed at edges to give straight and true joints.

2.3.5. After the tiles have been laid, the surplus cement slurry and the joints shall be cleaned and washed fairly deep before cement hardens.

2.3.6. The day after tiles have been laid, the joints shall be cleaned or gray cement grout with a wire brush to a depth of about 5 mm. and then grouted with white cement with or without pigment to match the shade of the topping of tiles. The same cement slurry shall then be spread over the whole surface in a thin coat to protect the surface from abrasive damage and to fill pin holes that may exist on the surface.

2.4. Curing :

2.4.1. The flooring shall be kept wet with damp sand or water for seven days. It shall be kept undisturbed at least for 14 days. The grinding shall normally be commenced after 14 days.

2.5. Polishing :

2.5.1. After the tiles are properly cured, first grinding shall be done with carborundum stone of 48 to 60 grade grit fitted in machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water, baring all pin holes. It shall then be covered with a thin coat of white cement mixed with or without pigments to match the colour of the topping of the tiles. Pin holes if any shall thus be filled. This grout shall be kept moist for a week. Thereafter second grinding shall be done when other works are finished. The machine shall be fitted with carborundum of grit 220 to 350 using water in abundance. The floor shall then be washed clean with water. Oxalic acid powder shall then be dusted at 33 grams per square meter on the surface and the surface rubbed with machine fitted with Hessian bobs or rubbed hard with pad of woolen rags. The floor shall then be washed clean and dried with a soft cloth or linen. The finished floor shall not sound hollow when tapped with mallet.

2.5.2. If any tile is disturbed or damaged it shall be refitted or replaced properly jointed and polished.

2.5.3. Testing of the tiles shall be carried out by the contractor at his own cost as per I.S. requirement for required test.

3.0. Mode of measurements & payment

3.1. The terrazzo tiles flooring shall be measured in sq. meters for visible area of work done.

3.2. No deductions shall be made nor extra paid for any opening in the floor area up to 0.1 sq. mt. Nothing extra shall be paid for use of cut tiles or for laying the floors at different levels in the same room or court yard. Mosaic tiles laid in floor borders and bands etc.-shall be measured in the same item and nothing extra shall be payable on account of these or similar bonds formed of half or multiples of half size, standard tiles or other uncut tiles.

3.3. The treads of stairs and steps paved with tiles without nosing shall also be measured under this item.

3.4. Extra rate shall however be paid for such area where width of treads does not exceed 30 cms.

3.5. The rate shall include the cost of all materials, labour involved in all the operations as described above.

3.6. The rate shall be for a unit of one sq. meter.

14.19.(B) Precast Terrazzo (Marble/Mosaic) tiles 20 mm. thick with white, black or white and black marble chips of size up to 6 mm. laid in floors treads of steps and landing on a bed of 25 mm. average thickness of lime mortar 1:1.5 (1 lime putty :1.5 fine sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles, including rubbing and polishing complete with precast tiles of medium shades using approximately 50% white cement and 50% ordinary cement.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.19(A) shall be followed except that the precast terrazzo (marble mosaic) tiles shall be of medium shades using approximately 50% white cement and 50% ordinary cement.

2.0. Mode of measurement and payment

2.1. The rate shall be for a unit of one sq. meter.

14.19.(B) Precast Terrazzo (Marble/Mosaic) tiles 20 mm. thick with white, black or white and black marble chips of size up to 6 mm. laid in floors treads of steps and landing on a bed of 25 mm. average thickness of lime mortar 1:1.5 (1 lime putty :1.5 fine sand) or C.M. 1:6 jointed with neat cement slurry mixed with neat cement slurry mixed with pigment to match the shade of tiles including rubbing and polishing complete with precast tiles of dark shade using ordinary cement.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 14,19 (A) shall be followed except that the precast tiles shall be of Dark shade using ordinary Portland cement.

2.0. Mode of measurements & payment

2.1. The mode of measurement and payment shall be same as item No. 14.19 (A)

2.2. The rate shall be for a unit of one sq, meter,

14.21.(A) Precast terrazzo (Marble Mosaic) tiles 20 mm. thick with marble chips of sizes up to 6 mm. in skirting and risers of steps not exceeding 30 cms. in height on 10 mm. thick cement plaster 1:3 C1 cement :3 coarse sand) jointed with neat cement slurry rubbing and polishing complete with tiles of light shades using white cement.

1.0. Materials

Water shall conform to M-1. Cement Mortar shall conform to M-11. The precast terrazzo (Marble/Mosaic) tiles of light shades using white cement tiles 20 mm. thick shall conform to M-47.

2.0. Workmanship**2.1. Laying :**

The work shall be carried out for skirting or dedo. Before fixing precast Terrazzo (Mosaic marble) tiles of shade and size as specified, the surface shall be prepared by heavy scraping, making joints etc, to the required line, level and plumb. The surface shall be thoroughly wetted before commencing the laying work. Thereafter about 10 mm. thick backing of cement mortar in specified proportion shall be applied on the surface in true line and level generally as per specifications of plaster item.

2.2. Fixing :

The back of each tile to be fixed shall be smeared with cement paste of matching colour and the mosaic tiles shall then be gently tapped against the surface, with a wooden mallet. The skirting shall be done only after the flooring is completed. Any pipes coming out of the wall through the dedo or skirting shall only be at the intersection of the horizontal and vertical joints. The tiles shall not have staggered joints. The joints shall be true to entire line both ways and vertical joints shall be in line with joints or flooring. Tiles shall be fixed as close as possible to the adjoining tiles and any difference in the thickness of the mosaic tiles shall be evened out in the cement paste so that all the tiles faces are set in conformity with one another. The skirting shall project uniformly and not more than 6 mm, thickness beyond the finished surface above. Top of skirting or dedo shall be truly horizontal. The risers of steps, skirting or dedo shall rest on top of treads of flooring. Wherever required the tiles shall be cut (sawn) and thin edges smoothed before use.

2.3. Curing :

Curing shall be done for 7 days continuously.

2.4. Finishing:

Skirting and dedo shall be hand polished to have an even smooth and shining surface. In case of skirting only 10 mm. x 10 mm. groove shall be provided at the junction of cement plaster and cement tiles.

3.0. Mode of measurements & payment

3.1. The terrazzo tiles with light shade using white cement base shall be paid under this item. The length shall be measured along finished surface of the riser, skirting or dedo, correct to a centimeter height measured from finished level of treads, or floor to the top (under side of treads in case of steps).

3.2. The rate shall include all materials and labour required for all the operations involved and described above.

3.3. The rate shall be for a unit of one sq. meter.

14.21.(B) Precast terrazzo tiles 20 mm. thick with marble chips of sizes up to 6 mm. in skirting and risers of strips not exceeding 30 cms. in height on 10 mm. thick cement plaster C.M. 1:3 (1 cement :3 coarse sand) jointing with neat cement slurry including rubbing and polishing complete with tiles of : medium shades using approximately 50% white cement and 50% ordinary cement.

1.0. Materials and workmanship

1.1. The relevant specifications of item No, 1*1 21 (A) shall be followed except that the work is for using tiles of medium shades using approximately 5C^j/o white cement and 50% ordinary cement.

2.0. Mode of measurements & payment

2.1. The mode of measurements and payment shall be followed same as item No. 14.21 (A).

2.2. The rate shall be for a unit of one sq. meter.

14.21.(C) Precast terrazzo tiles 20 mm. thick with marble chips of sizes up to 6 mm. in skirting and risers of steps not exceeding 30 cms. in height on 10 mm. thick cement plaster in C.M. 1:3 (1 cement :3 coarse sand) jointing with neat cement slurry including and polishing complete, with tiles of Dark shade using ordinary cement.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.21 (A) shall be followed except that the tiles of dark shade using Portland cement shall be used.

2.0. Mode of measurements and payment

2.1. The mode of measurements and payment shall be followed as per item No. 14.21 (A).

2.2. The rate shall be for a unit of one sq. meter.

14.25.(A) Chequered terrazzo tiles 22 mm. thick with marble chips of size up to 6 mm. in floor on 25 mm. thick bed of lime mortar 1:1.5 (1 lime putty : 1.5 coarse sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and polishing etc. complete, light shade using white cement.

1.0. Materials

Water shall conform to M-1. White cement shall conform to M-4. Lime mortar of proportion 1:1.5 shall conform to M-10. Cement mortar shall conform to M-11. Chequered tiles shall conform to M-47 D.

2.0. Workmanship

2.1. The relevant specifications of Item No. 14.21 (A) shall be followed except that chequered tiles of light shade using white cement shall be used.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item No. 14.21 (A) shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

14.25.(B) Chequered terrazzo tiles 22 mm. thick with marble chips of size up to 6 mm. in floor on 25 mm. thick bed of lime mortar 1:1.5 (1 lime putty : 1.5 coarse sand) or C.M. 1:6 painted with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and polishing etc. complete, medium shade using approximate 50% the cement and 50% ordinary cement.

1.0. Materials and workmanship

1.1. The relevant specification of item No. 14.25 (A) shall be followed except that chequered tiles of medium shade approximate 50% white cement and 50% ordinary cement shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.25 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.25.(C) Chequered terrazzo tiles 25 mm. thick with marble chips of size up to 6 mm. in floor on 25 mm. thick bed of lime mortar 1:1.5 (1 lime putty : 1.5 coarse sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and polishing etc, complete, : Dark shade using ordinary cement.

1.0. Materials and workmanship

1.1. The relevant specification of item No. 14.25 (A) shall be followed except that chequered tiles of dark shade using ordinary cement shall be used.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.25 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.27.(A) Chequered terrazzo tiles 28 mm. thick with marble chips of size up to 6 mm. in treads of stairs and staircases in 12 mm. thick bed of lime mortar 1:5 coarse sand) to C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and polishing etc. complete, Dark shade using ordinary cement.

1.0. Materials and workmanship

1.1. The relevant specification of item No. 14.25 (A) shall be followed except that chequered tiles 28 mm. thick of light shade using white cement shall be used in trades, stair cases etc.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.25 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.27 (B) Chequered terrazzo tiles 22 mm. thick with marble chips of size up to 6 mm. in floor in on 25 mm. thick bed of lime mortar 1:1.5 (1 lime putty : 1.5 coarse sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and polishing etc. complete : Medium shade of using approximately 50% white cement and 50% ordinary cement.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 14.25(A) shall be followed except that the chequered tiles 28 mm. thick of medium shade using approximately 50% white cement and 50% ordinary cement shall be used in treads of stair, staircases etc.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 14.25 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.27.(C) Chequered terrazzo tiles 28 mm. thick with marble chips of sizes up to 6 mm. in treads of stairs and staircases in 12 mm. thick bed of lime mortar 1:1.5 (1 Lime putty: 1.5 coarse sand) or c.m. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of tiles including rubbing and polishing complete : Dark shade using ordinary cement.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 14.25 (A) shall be followed except that chequered tiles 28 mm. thick of dark shade using ordinary cement shall be used in treads of stair, staircase etc.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 14.25 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter,

14.29 White glazed tiles 6 mm. thick in flooring, treads of steps and landings laid on a bed of 12 mm. thick cement mortar 1:3 (1 cement : 3 coarse sand) finished with flush pointing in white cement.

1.0. Materials

Water shall conform to M-1 Cement mortar shall conform to M-11 White glazed tiles shall conform to M-55

2.0. Workmanship**2.1. Bedding :**

2.1.1. The sub grade shall be cleaned, wetted and mopped. The bedding shall then be laid evenly over the surface tamped and corrected to desired level and allowed to harden enough to offer a rigid cushion to tiles and to enable the monsoon to place wooden planks across and squat on it.

2.1.2. The white glazed tiles shall be laid on cement mortar bedding of 12 mm. thick in C.M. 1:3. The mortar shall have sufficient plasticity for laying and there shall be no hard lumps that would interfere with the evenness of bedding. The base shall be cleared and well wetted. The mortar shall then be spread in thickness not less than 10 mm. at any place and average 12 mm. thickness. The proportion of the cement mortar shall be as specified in the item.

2.2. Fixing tiles :

2.2.1. The tiles before laying shall be soaked in water for at least tow hours. Neat gray cement grout at 33 kg/Cement/Sq. mt. of honey like consistency shall be spread over the mortar bedding as directed. The edges of the tiles shall be smeared with neat cement slurry. The tiles shall be well pressed and gently tapped with a wooden mallet till they are properly bedded and in level with the adjoining tiles. There shall be. no hollows in bed or joints. The joints between the tiles shall be as thin as possible in straight line or as per pattern.

2.2.2. The tiles shall not have staggered joints. The joints shall be true to centre line both ways. The Nahni trap coming in the flooring shall be so positioned that its grating shall replace only one tile as far as possible. Where full size tiles cannot be fixed they shall be cut (Swan) to the required size and the edges rubbed smooth to ensure straight and true joints. The joints shall be filled with grey cement grout with wire brush or trowel to a depth of 5 mm. and loose material removed. White cement shall be used for pointing the joints. After fixing the tiles finally in an even plane the flooring shall be kept wet and allowed to nature undisturbed for 7 days.

2.3. Cleaning :

2.3.1. The surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, it shall be carefully washed, cleared by dilute acid and dried. Proper precautions and measures shall be taken to ensure that the tiles are not damaged in any way till the completion of the .construction.

3.0. Mode of measurements & payment

3.1. The work done shall be measured in sq. mt. for visible area of work done. The length and width of the flooring shall be measured not between the faces of skirting or dedos or plastered face of wall as the case may be. The paving under dedo or skirting shall not be measured. No deduction shall be made not extra paid for any opening in the floor of area-up to 0.1 sq.mt. Nothing extra shall be paid for laying the floors at different levels in the same rooms.

3.2. The rate shall be for a unit of one sq. meter.

14.32. White glazed tiles 6 mm. thick in skirting, risers of steps and dedo on 10 mm. thick cement plaster 1:3 (1 cement :3 coarse sand) and jointed with white cement slurry.

1.0. Materials

Water shall conform to M-1 Cement mortar shall conform to M-11 White glazed tiles shall conform to M-55

2.0. Workmanship

2.1. Preparation of Surface:

In case of brick masonry wall, the joints shall be raked out to a depth of least 15 mm. while the masonry is being laid. In case of concrete wall the surface shall be chiseled and roughed with wire brushes. The surface shall be cleaned and wetted thoroughly before commencing the laying work.

2.2. Laying ;

2.2.1. The wall surface shall be covered with 10 mm. thick plaster of cement mortar 1:3 mix and allowed to harden. The plaster shall be roughened with wire brushes both way. The back of tiles shall be floated with grey cement slurry set and edges with white cement slurry in bedding mortar. The tiles shall be gently tapped in position on after the other keeping the joints as thin as possible. Top of skirting or dedo shall be truly horizontal and the joints vertical or as per required pattern.

2.2.2. Risers of steps, skirting and dedo shall rest on top of treads or flooring. Where full size tiles cannot be fixed, They shall be cut to the required size and the edges be smoothed.

2.2.3. The joints shall be cleaned and flush pointed with white cement. The surface shall be kept wet for seven days. After curing the surface shall be washed clean.

3.0. Mode of measurements and payment

3.1. The rate shall include the cost of all materials and labour required for various operations described above. Risers of steps, skirting and dedo shall be measured in square meters, length and height shall be measured along the finished face of the skirting or dedo including curves, where special such as covers, internal and external angles, etc., used. The length and height shall be measured correct to the centimeter except in case of risers and skirting where height shall be measured correct to 3 mm

3.2. The rate shall be for a unit of one sq. meter.

14.34. Providing and fixing 50 mm. internal or external -angles of white glazed tiles.

1.0. Materials

Water shall conform to M-1. Cement mortar shall conform M-11. Glazed tiles shall conform to M-55.

2.0. Workmanship

2.1. The relevant specifications of item No. 14.32 shall be followed except that the internal or external angles of glazed tiles shall be of thickness not less than the tiles with which they are used. The fixing shall be done as per directions.

3.0. Mode of measurements and payment

3.1. Rate shall be including the cost of materials and labour involved in all the operation described above. Internal or external angles of glazed tiles shall be measured in running meters correct to a centimeter. length being measured on the exposed face of the special at its centre line. No extra payment shall be made for corner places at angles junctions of cover beads and cornices for using cut length of special.

3.2. The rate shall be for a unit on one running meter.

14.36.(A) Providing and laying marble stone slab flooring over 20 mm. (Average) base of cement mortar 1:6 (1 cement : 6 coarse sand) or L. M. 1:1.5 laid and jointed with gray cement slurry including rubbing and polishing compete : Marbles slab 25 mm. thick.

1.0. Materials

Water shall conform to M-1. Lime mortar shall conform to M-10. Cement mortar shall conform to M-1). Marble stone slab 25 mm. thick shall conform to M-51.

2.0. Workmanship

2.1. Dressing of slabs :

Every stone shall be cut to required size and fine chisel dressed to give a smooth and even surface on all sides to full depth. A straight edge laid along the sides of the stone shall be fully in contact with it Chisel dressing shall also be done on top surface to remove any waviness. The sides and top surface of marble

slabs shall be machine rubbed or table rubbed with coarse sand before using. All angles and edges of slabs shall be true, square and free from chipping.

2.2 The thickness of stone shall be 25 mm. The allowable tolerance shall be 2 mm. allowable. The 'tolerance shall \pm 5 mm. in length and breadth.

2.3. Bedding:

Bedding of marble slabs shall either be lime mortar 1:1.5 (1 lime putty : 1.5 coarse sand) or cement mortar 1:6 (1 cement : 6 coarse sand) of average thickness 20 mm. thick as given in description of item. Minimum thickness at any place shall not be less than 10 mm.

2.4. Laying

The surface of sub-grade shall be cleared, wetted and mopped. Mortar of specified mix and thickness shall then be spread on an area sufficient to receive one marble slab. The slab be washed clean before laying. It tie laid on top pressed and tapped gently to bring it in level with other slabs. It shall then be lifted and a side. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows, or depressions. The mortar shall then be allowed to harden it over this surface cement slurry or honey like consistency at 4.4 Kg. of cement per sq. meter. The edges of slabs already paved shall be buttered with gray cement. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slab. The joints shall be as fine as possible. Surplus cement on the surface of the slab shall be removed. The slab fixed in the floor adjoining the walls shall enter not less than 10 mm. under the plaster skirting or dedo. The junction between the walls and floors shall be finished neatly. The finished surface shall be true to level and slopes as directed.

2.5. **Curing** : The floor shall be cured for a minimum period of seven days.

2.6. Polishing and finishing:

Unevenness at the meting edges of slab shall be removed by fine chiseling. Finishing etc. shall be done as per relevant specifications of item No. 14.21 (A) or terrazzo tiles flooring except that cement slurry with/or without pigments shall not be applied on the surface before each polishing.

3.0. Mode of measurements and payment

3.1. Marbles stone flooring with various kinds of marble shall be measured in sq. meter. The length and breadth shall be measured between-the finished face of skirting or dedo or wall plaster No deduction shall fie made nor extra shall be paid for nay opening in the floor or area up to 0.05 sq. mt. Nothing extra shall be paid for laying stone at different levels in the same room. Treads and steps of stairs paved with marble stone slabs shall be also be measured under flooring.

3.2. The rate shall be for a unit of one sq. meter.

14 43.(A) Kota stone slab (Polished, Green colour) flooring over 20 mm. (avage) thick base of cement mortar 1:6 (1 cement : 6 coarse sand, or lime mortar 1:1.5 laid over and jointed with gray cement slurry including rubbing and polishing complete 25 mm. thick.

1.0. Materials

1.1. Water shall conform to M-1. Lime mortar shall conform to M-10. Cement mortar shall conform to M-11 Polished kota stone shall conform to M-49,

2.0. Workmanship

2.1. Each slab shall be cut to the required size and shape and fine chisel dressed at all the edges. The sides trust dressed shall have a full contract if a straight edge is laid along. The sides shall be table rubbed with coarse sand before paving. All angles and edges of the slabs shall be true square and free from chippings and giving a plane surface. The thickness shall be 25 mm. (Average) as specified in the item but not less than 20 mm. at any place of the slab.

2.2. Bedding for the Kota stone slabs shall be of cement mortar 1:6 (1 cement : 6 coarse sand) or L.M. 1:1.5 of average thickness 20 mm given in the description of the item. Sub grade shall be cleaned, wetted and mopped Mortar of the specified mix and thickness shall then be spread on an area sufficient to receive one kota stone slab. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped gently to bring it in level with the other slabs. If shall then be lifted and laid aside. Top surface of the mortar shall then be corrected by adding fresh mortar at hollows or depressions. The mortar shall then be allowed to harden bit. Over this surface, cement slurry of honey-like consistency shall be applied. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly padded in level with and close to the adjoining slab. The joint shall be as fine as possible. The slabs fixed in the floor adjoining, the

walls shall enter not less than 10 mm. under the plaster, skirting or dedo. The junction between the wan and floor shall be finished neatly. The finished surface shall be true to levels and slopes as directed

2.3. The floor shall be kept wet for a minimum period of 7 days so that bedding and joints set properly

2.4. Polishing shall be normally commenced after 14 days of laying the stone slab. First polishing shall be done with carborundum stones of 120 grade grit fitted in the heavy machine and then second polishing shall be done with carborundum stone of 220 to 350 grade grit fitted in heavy machine. Water shall be properly used during polishing. The stone shall then be washed clean with water. When directed by the Engineer-in-charge, wax polish of approved quality shall be applied on the surface with the help of soft cloth over a clean and dry surface. Then the polishing machine fitted with bobs shall be run over it.

2.5. The holes required for Nahni traps, pipes and any other fittings shall be made, without any extra cost.

3.0. Measurement & payment

3.1. The rate shall include the cost of all materials and labour involved in all the operations described above. The kota stone flooring shall be measured in square meters correct to two places decimal, length and breadth shall be measured correct to a centimeter and between the finished face of skirting dedo plaster and no deduction shall be made nor extra paid for any opening in floor of areas up to 0.1 sq

3.2. The rate shall be for a unit of one sq. meter

14.43.(B) Kota stone slab flooring over 20 mm. (average) thick base of cement mortar 1:6 (1 cement :6 coarse sand) or L.M. 1:1.5 laid over and jointed with gray cement slurry including and polishing complete : 30 mm. thick.

1.0. Materials and workmanship

1.1. The relevant specifications of item No 14.43 (A) shall be followed except that the thickness of stone shall be 30 mm.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No 14.43 (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.44. Kota stone slab 25 mm. thick in riser of steps dedo and pillars laid on 10 mm. thick cement mortar 1:3 (1 cement : 3 coarse sand) and jointed with gray cement slurry including rubbing and polishing etc. complete.

1.0. Materials

Water shall conform to M-1. Cement mortar shall conform to M-11. Kota stone slab 25 mm thick shall conform to M-49.

2.0. Workmanship

2.1. The relevant specifications of item No. 14.43(A) shall be followed except that the kota stone fixed for risers of steps, dedo or skirting in C.M. 1:3 and the polishing shall be done manually instead of machine polishing.

3.0. Mode of measurements and payment

3.1. The risers of steps, skirting or dedo shall be measured in sq. meter. Length shall be measured along the finished faces of risers, skirting or dedo. Height shall be measured from finished level of treads of floor to top. Lining of pillars shall be measured under this item.

3.2. The rate shall be for a unit of one sq. meter.

14.46.(A) Rough chiseled dressed (Kota stone green) stone flooring over 20 mm. thick base of cement mortar 1:5 (1 cement :5 coarse sand), or L.M. 1:1.5 including pointing with cement mortar 1:2 (1 cement : 2 stone dust) etc. complete 25 mm. thick.

1.0. Materials

Water shall conform to M-1. Lime mortar shall conform to M-10. Cement mortar shall conform to M-11. Rough chisel dressed stone shall conform to M-48.

2.0. Workmanship

2.1. The relevant specifications of item No. 14.43 (A) shall be followed except that the rough chisel dressed stone of 25 mm. thickness of approved quality are to be fixed on cement mortar bedding in CM 1:5 or L.M. 1:1.5 of 25 mm. average thickness.

2.2. Dressing of stone slab :

Every stone slab shall be cut to the required size and shape and rough chisel- dressed on top, if required, so that the dressed surface shall not be more than 6 mm, from straight edge placed on it. The sides shall

also be chisel-dressed to a minimum depth of 20 mm. so that the dressed edge shall at no place be more than 30 mm. from straight edge butted against it. Beyond this depth, the sides may be dressed slightly splayed so as to form an inverted V shaped joint with adjoining also. The surface shall be reasonable true and plane and all the angles and edges shall be square and free from chippings. Where the stone slabs are to be used for nosing, exposed edges shall be rough chisel-dressed to full depth and cut to the uniform thickness.

2.3. Thickness of the stone slab shall be 25 mm. with permissible tolerance of ± 2 mm.

2.4. Laying :

The surface of the sub-grade concrete shall be cleaned, wetted and mopped. The bedding of specified mortar mix shall be spread under each slab to the specified thickness. The slab shall be washed clean before laying. It shall be laid on top, pressed and so that all hollows underneath filled surplus mortar works up through the joints. The top shall be tapped and brought level to the adjoining slab. The thickness of the joints shall not exceed 5 mm. Subsequent slabs shall be laid in the same manner

2.5. Curing & Finishing :

Any surplus mortar on the surface of the slab shall be cleaned off and joints-finished flush. The joints shall be raked out uniformly to a minimum depth of 12 mm. under the plaster, skirting or dado. The junctions between wall plasters and floor shall be finished neatly and without waviness. The pointing shall be done with C.M. 1:2. The pointing shall be cured for a minimum period of seven days. The finished floor shall not sound hollow when tapped with wooden mallet and the finished surface shall be true to level and slopes as directed.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 14.43 (A) shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

14.46.(B) Rough chisel dressed (Kota stone green) stone flooring over 20 mm. thick base of cement mortar 1:5 (1 cement : 5 coarse sand) or Lime Mortar 1:1.5 including pointing with cement 1:2 (1 cement : 2 stone dust) etc., complete-40 mm. thick.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 14.46 (A) shall be followed except that the thickness of stone slabs shall be 40 mm. thick.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No 14.46(A) shall be followed.

2.2. The rates shall be for a unit of one sq. meter.

14.71.(A) Cement concrete flooring for I.P.S, 1:2:4 (for Indian Patent Stones) (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) laid in one layer finished with a floating coat of neat cement 40 mm. thick.

1.0. Materials

Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Stone aggregate 20 mm. nominal size shall conform to M-12. Cement concrete of 1:2:4 proportion measured by volume shall conform to relevant specifications of ordinary grade 1:2:4 concrete.

2.0. Workmanship

2.1. The cement concrete flooring of 40 mm thick (Average) is to be laid as per the site condition. The concrete shall be mixed in a mechanical mixer at the work. Hand mixing may however be allowed for smaller quantities of work and in case of failure of machineries or as permitted by the Engineer-in-charge. It shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However in such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mechanical mixing shall be done for period of 1.1/2 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose, Flooring or specified thickness shall be laid in accordance with approved pattern or as directed. Finishing operation shall depend upon the temperature

and atmospheric conditions. The surface shall be left for some time till moisture disappears from it. Fresh quantity of cement shall be mixed with water to form a thick slurry and spread over the surface while the concrete is still green. Use of dry cement or cement and sand mixture sprinkled on this surface to stiffen the concrete or absorb excessive moisture shall not be permitted. The cement slurry shall then be properly pressed twice by means of iron floats, once when the slurry is applied and the second time when cement setting and finished floated smooth. The surface shall be marked with string or B.R.C. fabric jali to make the surface non-slippery as and when directed. The junction of floors with wall plaster, dado or skirting shall be rounded off where so

required up to 25 mm. radius. Flooring in lavatories and bath rooms shall be laid after fixing of water closet and squatting pans and floor traps which shall be plugged while laying the floors and opened after the floors are completed. Any damage done to water supply or sanitary fittings during execution of work shall be made good.

2.2. After the final set, the concrete shall be kept continuously wet. if required by ponding for a period of not less than 7 days from the date of placement.

2.3. The form work shall be provided if necessary as directed by Engineer-in-charge. Concreting shall be done as per alternate bay method with necessary centering either by mastic or cement mortar as directed

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials and labour involved in all the operations described above. No deduction shall be made or extra paid for any opening up to 0.1 sq. mt. In area in the floor, nothing extra shall be paid for laying the floor at different levels in the same room or the counter yard.

3.2. The rate shall be for a unit of one sq. meter.

14.71.(B) Cement concrete flooring (Indian patent stone) 1:2:4 coarse sand 4: graded stone aggregate 20 mm. nominal size) laid in one layer finished with floating coat of neat cement : 50 mm. thick.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 14.71 (A) shall be followed except that the thickness of concrete flooring shall be 50 mm.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 14.71. (A) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

14.74. Cement concrete payment (25 mm. to 50 mm. thick) with 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm. nominal size) including finishing with a floating coat of neat cement complete.

1.0. Materials and workmanship

1.1. The relevant specifications of item No. 14.71 (A) shall be followed except that the thickness of concrete flooring vary from 25 mm. to 50 mm.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No.14.71 (A) shall be followed except that thickness shall be measured correct up to 1 mm. flooring laid in borders, margins and treads of steps, shall be measured under item of flooring in respective of width.

2.2. The rate shall be for a unit of one cubic meter.

14.81.(C) 20 mm. thick precast concrete tile with aggregate of sizes up to 6 mm. laid in floors, treads of steps and landings on 20 mm. thick bed of cement mortar 1:6 (1 cement : 6 coarse sand) or L.M. 1:1.5 jointed with neat cement slurry with pigment to match the shade of the tiles complete with precast tiles of Dark Shades ordinary cement.

1.0. Materials

Water shall conform to M-1. Cement shall conform to M-2. Sand shall conform to M-6. Lime mortar 1:1.5 shall conform to M-10. Cement shall conform to M-11. Tiles shall conform to M-47 (A) cement concrete tiles shall conform to I.S. 1237-1959 and pigments to be admixed with mortar or for grouting shall conform to I.S. 2114-1962

2.0. Workmanship

2.1. The tiles shall be laid on the sub-grade of concrete of the R.C.C. slab. Bedding shall be in the mortar 1:1.5 or cement mortar (1:6). The amount of water added shall be minimum required for sufficient plasticity and workability C.M. or lime mortar where the ingredients shall be thoroughly mixed dry hard lumps removed and water added to give a good workability.

2.2. The base shall be cleaned of all dust, dirt and scum and properly wetted without allowing water pools. For a bedding of cement mortar shall be then spread evenly over the base of two rows of tiles and three to five meters in length. The top shall be kept rough so that cement slurry can be absorbed. The thickness of the bedding shall be not less than 10 mm. at any place. The laying of tiles shall be commenced with neat cement slurry of honey-like consistency and shall be spread over the mortar bed over an area sufficient to receive about 20 tiles. The tiles shall then be fixed in this grout one after the other, each tile being gently tapped and properly bedded in line and level with the adjoining tiles. The joints shall be as narrow as possible and normally shall not exceed 1.5 mm. After the day's work the excess cement slurry on top shall be cleaned as also the joints with a broom struck and washed before the slurry sets hard. Next day the joints shall be filled with the cement grout of the same shade as the matrix of the tiles. Tiles which are fixed in the floor adjoining the wall shall go a minimum of 10 mm. under the wall plaster, skirting or dedo. For the purpose, plaster etc. may be left unfinished by about 50 mm. above the proposed finished level of the floor. The unfinished strip shall be plastered after laying the floor tiles. Where full tile cannot be used, tile shall be cut to the size to be used.

2.3. The flooring shall be cured for 7 days.

3.0. Mode of measurements and payment

3.1. The rate shall include the cost of all materials and labour involved in all the operations described above.

3.2. The rate shall be for unit of one sq. meter.

14.86. Chequered precast cement concrete tiles 22 mm. thick with aggregate of sizes up to 6 mm. in floors, treads of steps and landings on 20 mm. thick bed of C.M. of 1:6 (1 cement : 6 sand) or lime mortar 1:1.5 (1 Lime putty : 1.5 coarse sand) jointed with cement slurry with pigment to match the shade of tiles.

1.0. Materials

1.1. The relevant specifications of item No. 14.25 (A) shall be followed.

2.0. Workmanship

2.1. The relevant specifications of item No 14.21 (A) shall be followed except that chequered precast cement concrete tiles 22 mm. thick shall be used in floors, treads of steps and landings on average 20 mm. thick bed of C.M. 1:6 or L.M. 1:1.5.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 14.21 (A) shall be followed.

3.2. The rate shall be for unit of one sq. meter.

14.87. Extra for polishing and polishing the precast cement concrete tiles in flooring, skirting or dedo.

1.0. Workmanship

1.1. Grinding and rubbing shall normally be commenced after 14 days of laying the tiles, except for skirting or small areas, machine shall be used for the purpose.

1.2. First grinding shall be done with carborundum stones of 48 to 60 grade grit fitted in machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water baring all pin holes It shall then be covered with a thin coat of gray or white cement mixed with or without pigments to match the colour of the topping of the tiles Pin holes if any shall thus be filled. This grout shall be kept moist for sufficient period as directed. Thereafter, second grinding shall be started with carborundum of 120 grit. Grouting and curing shall be followed again. Final grinding shall be done when other works are finished. The machine shall be fitted with carborundum of grit 220 to 350 using water in abundance. The floor shall then be washed clean with water Oxalic acid powder shall then be dusted as needed on the surface and the surface rubbed with machine fitted with Hessian bobs 01 rubbed hard with pad of woolen rags. The floor shall then be washed, cleaned and dried with a soft cloth of linen. The finished floor shall not sound hollow when tapped with a mallet.

1.3. If any tile is disturbed or damaged it shall be refitted or replaced properly jointed and polished. 1,4. For skirting, dedo or small areas where it is not possible to do machine polishing all the above operations are to be done manually.

2.0. Mode of measurements and payment

2.1. The rate shall include the cost of all materials and labour involved to all the operations as described above.

2.2. The rate shall be for a unit of one sq, meter.

14.90. Providing and laying brick on edge flooring laid dry, grouted with C.M. 1:6 (1 cement : 6 coarse sand) including finishing the joints flush, curing etc. complete.

1.0. Materials

Water shall conform to M-1. Cement mortar shall conform to M-11. Burnt bricks shall conform to M-15.

2.0. Workmanship

2.1. The flooring shall be laid on concrete sub grade where so provided. The slope in the floor shall be provided in the sub-grade. Where sub-grade is not provided, the earth below shall be properly sloped, watered, rammed and consolidated. Before laying the flooring it shall be moisture. Plinth masonry off-eta shall be depressed so as to allow the sub grade concrete to rest on it.

2.2. Laying :

The brick shall be laid in plain, diagonal herring bond, or other pattern as directed. The bricks shall be dry laid properly and set home by gently tapping. On completion of the portion of flooring the vertical joints shall be grouted with C.M. 1:6 and all joints shall be finished flush. The joints shall be as fine as possible and not exceeding 5 mm. These points shall be filled with cement mortar 1:6.

2.3. Curing :

The brick paving shall be cured for 7 days.

3.0. Mode of measurements and payment

3.1. The length and breadth shall be measured correct to a centimeter between skirting dedo or wail plaster. No deductions shall be made nor extra paid for any opening up to 0.1 sq.mt. in area in the floor Nothing extra shall be paid for laying the floors at different levels in the same room or courtyard.

3.2. The rate shall be for unit of one sq. meter.

SECTION-15
Roof Covering

- 15.1. Providing corrugated G.I. sheets roofing fixed with galvanized iron 1J' or 1L' hook bolts and nuts 8 mm. dia. with bitumen and G.I. limpet washers filled with white lead complete excluding the cost of purline, rafters and trusses (1) 0.8 mm. thick sheet.**

1.0. Materials :

Corrugated G.I. sheets shall conform to M-23.

2.0. Workmanship

2.1. Spacing of purlines : One purline shall be provided at the ridge and one at the eaves. The spacing of other purlines for 0.8 mm. thick G.I. sheets shall not exceed 1.80 meters. The purline shall coincide with the centre line of the end lap. The ridge purlines shall be placed in such a way that the ridges can be fixed properly. The portion overhanging the wall support shall not be more than one fourth of the 'spacing of purlins.

2.2. The top surfaces of the purlines shall be painted before the sheets are fixed over them. Embedded portions of purlins shall be finished with tow coats of coal-tar.

2.3. Laying of sheets :

2.3.1. The sheets shall be laid in purlins to a true plane with the line of corrugations truly parallel or normal to the sides of area to be covered. The sheets shall not generally be built into gables and parapets. They shall be bent up along their side edges close to the wall, and the junction shall be protected by suitable flushing or by projecting drip course.

2.3.2 The laps at end shall be provided 150 mm. minimum for roof slopes 1 in 2 (1 vertical : two horizontal) and steeper but 200 mm. shall be provided for flatter slopes than those above. The side lap shall be provided two ridges of corrugations at each side.

2.3.3. The sheets shall be cut to the dimensions or the shape of the roof either along their lengths or their width or in slant across the line of corrugations at hips and valleys. The sheets shall be cut carefully with a straight edge and chisel to give straight finish. The sheets shall be laid such that the laps are turned away from the usual direction of local heavy rain.

2.3.4. Fixing of sheets :

2.3.4.1. Sheets shall be fixed to the purlins or other roof members such as hips or valley rafter etc. with 1J' or 1L' galvanized hook bolts, and galvanized nuts 8 mm. dia. with bitumen limpet washers and G.I. washers. Limpet washers with white lead shall be used. Length of hook bolt shall be varied to suit the site requirement. Bolts shall be sufficiently long so that after fixing the project above the top of their nuts by not less than 12 mm the grip of 1J' or 1L' hook bolts on the sides of purlins shall not be less than 25 mm. There shall be minimum of three hooks bolts placed at the ridge of corrugations in each sheet in every purlin and their spacing shall not exceed 300 mm. Coach screw shall not be used for fixing the sheets to purlin, where the slopes of roof are not less than 2.1/2 degree (1 vertical and 2.1/2 horizontal). Sheets shall be jointed together at the side laps by galvanized iron bolts and nuts 25 mm. x 6 mm. size each bolt with a bitumen and G.I. limpet washer filled with white lead. Where the overlaps at the sides extend to two corrugations, these bolts shall be placed zigzag over lapping corrugations, so that the ends of the overlapping sheets are drawn tightly towards each other. The spacing of same bolts shall not exceed 600 mm. along each of the staggered rows.

2.3.5. Holes for all bolts shall be drilled and not punched in the ridges of the corrugations from the under side, while the sheets are on the ground. The holes in the sheets shall be at least 50 mm. from the edge. ' Sheets drilled wrongly shall be rejected. The holes in the washers shall be of the exact diameter of the hook bolts or the beam bolts. The nuts shall be tightened from above to give a leak-proof roof

3.0. Mode of measurements and payment

3.1. The measurements of the C.G.L sheet roof shall be taken for finished work in superficial area in general plane (not girthed on the roof). The laps between the C.G.I. Sheets both at their ends and along the side edges shall not be measured. The overlaps of C.G.I, sheets over the valley piece and their under lap under the ridge, hip and flashing piece shall be included in the measurements.

3.2. No deductions in measurements shall be made for openings for chimney stacks, sky light etc., of area up to 0.40 sq. mt. nor extra be paid for labour in cutting and for wastage etc. in forming such openings.

3.3. The rate of roof shall include the cost of all materials and labour involved in all operations described above. The rate also includes the cost of provision, erection and removal of the scaffolding, benching, ladders, templates and tools required for the proper execution and erection of the work. The rate includes the cost of purlins, rafters and trusses.

3.4. The rate shall be for a unit of one sq. meter.

15.7. **Providing ridges of hips 600 mm. overall in plain G.I. sheets fixed with G.I. 'J' or 'L' hooks bolts and nuts 8 mm. dia. G.I. limpet and bitumen washer etc. complete. 0.80 mm. thick sheet.**

1.0. Material

The G.I. valley gutters and ridges shall conform M-23 A.

2.0. Workmanship

2.1. The relevant specification of item No. 15.1 shall be followed except that the work shall be carried out for ridges or hips. The overlaps for ridges and hips on either side over the C.G.I. sheets and end legs shall be minimum 225 width of the ridges and hips shall be as described in the item.

2.2. Ridges shall be fixed to the purlins with same 8 mm. dia. G.I. hook bolts and nuts and bitumen and G.I. limpet washers, which fix the sheets for the pureline. Hips shall be fixed to the roof members with the same 8 mm. dia G.I. hook bolts and nuts and bitumen and G.I. limpet washers which fixed the sheets. At least one of the fixing bolts shall pass through the end laps of the ridges and hips on other sides. If this is not possible, extra hook bolt shall be provided. End laps of ridges and lips shall be jointed together by galvanized iron seam bolts and G.I. Washers. There shall be at least two such bolts in each end lap.

2.3. Ridges and hips shall fit in squarely on the sheets.

3.0. Mode of measurements and payment

3.1. The measurements of ridges or hips shall be taken for finished work in length along their centre lines.

3.2. No laps shall be measured.

3.3. The payment for ridges and hips shall be made in a similar way as in case of C.G.I, sheet roofing.

3.4. The rate shall be for a unit of one running meter.

15.8. **Providing valleys 900 mm. overall in plain 1.6 mm. thick G.I. Class-3 fixed with 'J' or 'L' hook bolts and nuts galvanized from 'J' or 'L' hook bolts and 8 mm. dia. G.I. limpet and bitumen washers complete.**

1.0. Materials

1.1. The G.I. valleys 900 mm. overall in galvanized plain sheet of 1.6 mm. thickness shall be of class-3. The valleys shall be 900 mm. wide overall and flashing shall be 380 mm. wide overall. There shall be bent to the required shape without damage to the sheets in the process of bending.

2.0. Workmanship

2.1. The relevant specifications of item NO. 15.1. shall be followed except that the work shall be carried out for G.I. valleys 900 mm. overall with G.I. sheets 1.6 mm. thickness.

2.2. Wherever the edge of a roof sheeting or valley gutter is turned up against a wall, the edge shall be weather proofed with a flashing. Flashing shall be bent to shape and fixed. Lap over the sheet shall be not less than 150 mm. over the roofing sheets. The end between the flashing sheets shall not less than 225 mm.

2.3. The flashing shall be inserted into brick work or masonry joints to a depth of 50 mm. These joints shall be filled with cement mortar (1:3). The flashing shall be well secured to the masonry. Whenever flashing has to be laid at a slope, it shall be stepped at each course of masonry, the step being out back at angle or not less than 30 degrees to the vertical.

2.4. Valleys shall be bent to shape and shall have end lap projection on either side under C.G.I, sheet not less than 225 mm. Valleys shall be fixed to the roof member below, with same 8 mm. dia. G.I. hook, bolts and nuts and bitumen and G.I. limpet washer which fix the sheets to these members. At least one of the fixing bolts shall pass through the end laps of the valley piece. If necessary extra bolts shall be provided for this purpose.

3.0. Mode of measurements and payment

3.1. The measurements for valley shall be taken for finished work in length along their centre lines.

- 3.2. No laps shall be measured.
- 3.3. The rate excludes the cost of boarding underneath which shall be paid separately.
- 3.4. The rate of flashing includes the cost of mortar for fixing in wall and other labour and materials required for it.
- 3.5. The rate shall be for a unit of one running meter.

15.10.(I) Providing and fixing 150 mm. wide 450 mm. overall semicircular plain, G.I. sheets clas-3 Gutter with iron brakes 40 mm. x 3 mm. size bolts nuts, washers etc. including making necessary connections with rain water pipes : 0.80 mm. thick.

1.0. Materials

1.1. These shall be of plain galvanized sheets Class-3 of 0.80 mm. thickness. The gutter shall be designed to carry the maximum discharge from the roof without flowing over and shall be constructed wherever possible with sunk channel or gutter.

2.0. Workmanship

2.1. The longitudinal edges shall be turned back to the extent of 12 mm. and beaten to form a rounded edge. The ends of the sheets at junctions of pieces shall be hooked into each other and beaten flush to avoid leakages.

2.2. The size of gutters shall be as specified in the item.

2.3. The gutter shall be laid with a minimum fall in 120. Gutter shall be true to line and slope and shall be supported on fixed M.S. Flat iron brackets bent to shape or any other suitable bracket.

3.0. Mode of measurements and payment

3.1. The measurements of gutters shall be taken for finished work in length along their centre lines. No. laps shall be measured.

3.2. The rate gutter shall include the cost of all labour and materials specified above including all specials such as angles, junctions, drop ends or funnel shaped connecting pieces, stop ends etc. flat iron brackets and bolts and nuts required for fixing the latter to the roof members.

3.3. The rate shall be for a unit of one running meter.

15.20.(A)(I) Providing asbestos cement sheets, roofing fixed with G.I. plain and bitumen washers complete excluding cost of purlins, fakers and trusses : 7 mm. thick, corrugated sheet.

1.0. Materials :

1.1. Asbestos cement sheets shall conform to M-24.

2.0. Workmanship

2.1. The maximum spacing of purlins shall be 1.6 meters in case of 7 mm. thick A.C. sheets and 1.4 meters for 6 mm. thick A.C. sheets.

2.2. Laying & fixing of Sheets

The sheets shall be laid on the purlins and other roof members as per cods practice. The top bearing surfaces of all purlins and other roof members shall be in one plane so that the sheets when being fixed shall not be required to be forced down to rest on the purlins. The finished roof shall present uniform slope and the line of corrugation shall be straight and true. The sheets shall be laid with smooth side upwards. Corrugated sheets shall be valid starting at the eaves either from left to right or right to left depending upon the direction of wind. Before actual laying of the sheets is started, the purlins spacing and the size of sheets shall be checked to ensure that the arrangements shall provide the laps required and the specified overhang at the eaves. In case the sheets are laid from right to left, the first sheet shall be laid uncut but the remaining sheets in the bottom row shall have the top left hand corners cut or mitered. The sheets in the second and other immediate rows shall have bottom right and corner of the first sheet cut. All other sheets except the last sheets shall have both bottom right hand corner of the first sheet cut. All other last sheet shall have only top left hand corner cut. The last of the top row sheets shall have the bottom right hand corner cut with exception of the last sheet which shall be left uncut. If the sheets are laid from left to right, the first sheet shall be laid and cut and the remaining procedure shall be reversed.

2.3. The free overhang of the sheets at the eaves shall not exceed 400 mm. in case of 7 mm. thick sheets and 300 mm. in case of 6 mm. thick sheets.

2.4. The meter described above is necessary to provide snug fit. Where 4 sheets meet at a lap the length of meter shall be 150 mm. and the width of miter shall be equal the width of the side lap. The cutting may be done with ordinary wood-saw at site.

2.5. Laps :

The sheets shall be laid with an end lap of 150mm. minimum. In case of roof with a' pitch flatter than 1 vertical to 2.1/2 horizontal (Approx. 22) or in the case of very exposed situations appropriate larger Taps may be provided. The sheets shall be laid with side lap of half a corrugation.

2.6. Fixing Accessories : The sheets shall be secured to the purlins and other roof members by means of 8 mm. dia galvanized iron bolts (J) type hook bolts in case of angle iron purlins and 'L' type bolts in case of R.S. joints, precast concrete, or timber purlin, and nuts bearing on galvanized iron washers and bitumen washers. The grip of 'J' or 'L' bolts on the side of purlins shall not be less than 25 mm, Each galvanised iron 'J' or 'L' hook bolts shall have bitumen washer and galvanised iron washer placed over the sheets before the nuts is screwed down from above. On each purlin there shall be one hook bolt on the crown adjacent to the side lap on either side bitumen washer shall be of approved quality. The G.I. flat washer shall be 25 mm. in diameter and 1.60 mm. thick and bitumen water shall be 35 mm. in dia. and 1.5 mm. thick with hole to suit the required size of fixing accessory. Each nut shall be screwed lightly at first. After a dozen or more sheets are laid, the nuts shall be tightened to ensure a leak proof joint and also nuts tightened only to extent so as to prevent damage to the sheets. The length of the 'J' bolts or crank bolts shall be 75 mm. more than the depth of purlins for single sheet fixing and 90 mm. more where two sheets overlap or where ridges or other accessories are to be fixed. The minimum length of coach screw for timber purlins shall be 110 mm.

2.7. Holes :

The holes for fixing the sheet shall be drilled in the centre of end lap to sheets to suit the purlins i.e. on the centre line of the purlin, if these are of timber and square head coach screws are used, or as close as possible to the back of purlins if 'J' or 'L' bolts are used as with steel angles or precast concrete or timber purlins. Holes for hook bolts etc. shall be 2 mm. more than diameter of the fixing bolts. No holes shall be nearer than 40 mm. to any edge of sheet or accessory.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item 15.1 shall be followed, except that the over lap of the corrugated sheets over valley gutters, roof lights, caves, filler piece and underlay of the corrugated sheets below ridges, hips north light curves, flashing pieces, roof light sheets and large board shall be included in the measurement. No deduction shall be made for holes cut for extractor or cowl type ventilators. Deductions shall be made for roof light sheets.

3.2. The rate shall be for a unit of one sq. meter.

15.20.(A)(III) Providing asbestos cement sheets roofing fixed with G.I. plain and bitumen washers complete excluding the cost of purlins, rafters and trusses: 6 mm. thick corrugated sheets.**1.0. Materials and Workmanship**

The relevant specifications of item No. 15.20 (A)(I) shall be followed except that the thickness of A.C. sheets shall be 6 mm.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 15.20 (A)(I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

15.25.(D) Providing and fixing ridges and hips in asbestos cement sheets roofing with G.I. 'J' or 'L' hook, bolts and nuts 8 mm. dia. G.I. plain and bitumen washers complete. North tight adjustable ridges.**1.0. Materials**

1.1. The ridges and hips of Asbestos cement sheets roofing shall conform to M-24.

2.0. Workmanship

2.1. The relevant specifications of item 15.20 (A) (I) shall be followed except that the work is to be carried out for ridges and hips in A.C. sheet roofing.

2.2. The ridges shall be laid as per manufacturer's instructions with rolls of the two wings in case of adjustable ridges, fitting closely and with a separation of serrated ridges registering correctly with the sheet underneath. The staggered lapping of two wings of adjustable ridge section and the lap between the adjustment pieces on the same wing of ridges shall be as per manufacturer's instructions. The end portion of the wing of the adjustable ridges which project beyond the verges of the roof shall be cut and trimmed off neatly.

2.3. Hips :

In laying hip pieces, serrations to suit the corrugations in the sheets below should be cut in them so that they shall be snug fit over the sheets. The wings of ridges shall be fixed to the sheet below with seam bolts and nuts 8 mm. dia. G.I. 'J' or 'L' hook bolts and bitumen and G.I. washers which fix the sheets to the purlins. In addition, in north light adjustable ridges, the roll of the two wings shall be jointed together at their crown, with 8 mm. dia G.I. seam bolts and nuts at the rate of two numbers per pair wings. Each seam bolt shall be provided with one bitumen and a pair of G.I. washers. Where the plain wing angular or plain C.C. (1.2:4) up to a full length of the overlaps. The exposed face shall be finished perpendicular to the sheeting. Wings of hips shall be fixed to the roof members below with the same 8 mm. dia. G.I. 'J' or 'L' bolts end nuts which fix the sheets to the member. In addition, they shall be secured to the sheet below with 8 mm. dia G.I. seam bolts, nuts and washers so that taken together with hook bolts, there shall be bolt on each wing at least at every fifth Corrugation of the sheets below in case of corrugated and at least every second corrugation of the sheet below in case of semi corrugated sheets. Each seam bolt shall be provided with one bitumen and pair of G.I. washers.

3.0. Mode of measurements & payment

3.1. Measurements of ridges, hips and other accessories shall be for finished work and the length shall be taken along the centre line. The lap shall not be measured. The under lap of ridges under expansion joint pieces shall be measured.

3.2. The rate of ridges and hips shall not include the cost of expansion joint pieces, closing of gap, between plain ridge and the sheet corrugation with concrete.

3.3. The rate shall be for a unit of one running meter.

15.26. Filling cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm. nominal size) in gaps of A.C. sheet corrugation and wing of ridges.**1.0. Materials**

Water shall conform to M-1. Cement shall conform to M-3. Coarse sand shall conform to M-6. Stone grit shall conform to M-8.

2.0. Workmanship

2.1. The relevant specifications of item No. 5.4.1 of C.C. shall be followed except that the work shall be for filling gaps of A.C. sheet corrugation and wings of ridges.

3.0. Mode of measurements & payment

3.1. The measurements of filling gaps in ridges, hips of A.C. sheet corrugation and wings of ridges shall be for finished work. The length shall be measured along the centre line.

3.2. The rate shall be for a unit of one running meter.

15.27 (III) Providing and fixing asbestos cement roofing accessories with galvanised iron 'J' or 'L' hook bolts and nuts, G.I. plain and bitumen washer etc. complete : North light and ventilator curves.**1.0. Materials and Workmanship**

1.1. The relevant specifications of item No. 15.10 (I) shall be followed except that the work is carried out for accessories for asbestos cement roofing north light and ventilator curves.

1.2. The accessories such as north light and ventilator curves shall be laid and secured with same G.I. hook bolt to secure the sheets to the roof, or with separate G.I. hook bolts to the roof members below and/ or with 8 mm. dia. G.I. bolts nuts and washers to the sheeting, generally as per manufacturer's written instructions.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 15.25 (D) shall be followed.

2.2. The rate shall be for a unit of one running meter.

15.29.(I) Providing and fixing asbestos cement socketed half eaves gutter with bolts, nuts, bitumen washer etc. and flat iron brackets 40'mm. x 3 mm. size including asbestos rope and plastic roofing compound in joints complete : 150 mm. nominal size.**1.0. Materials & Workmanship**

1.1. The relevant specifications of item No. 15.10(f) shall be followed except that the asbestos cement socketed half round eaves gutter shall be provided. The size of gutter shall be 150 mm. nominal.

1.2. Gutters shall be laid with a minimum fall of 1 in 120 which should be increased where possible. Gutters shall be true to line and slope and shall be laid with requisite accessories such as drop ends, stop ends, nozzles, m angles and union slips, as directed. The size of outlet of drop ends and nozzles shall be the same as the size of rain water pipe into which they discharge water. Gutters and their accessories shall be supported by m.s. flat iron bracket. Where these are required to be fixed to the side of rafter they shall be fixed with 40 mm. by 3 mm. section bent to shape and fixed rigidly to the sides of the rafter with 3 Nos. of 10 mm. dia. bolts, nuts and washers. The brackets shall overlap the rafter not less than 300 mm. and connecting bolts be 115 mm. centers.

1.3. Where the brackets are to be fixed with purlins, these shall consist of 40 x 3 mm. M.S. flat iron bent to shape with one/and turned at a right angle and fixed to the purlins face with a 10 mm. dia bolt, nut and washer. The perpendicular overhang portion of 40 mm. x 3 mm. bracket shall be stiffened by another 40 x 3 mm. flat bent to right angle shape with its longer leg connected to the bracket with two numbers of 6 mm. dia. M.S. Bolts nuts and washers and its shorter legs fixed to the face of purlins with one number 10 mm. dia bolt nuts and washers. The overhang of the vertical portion of the flat iron bracket from the face of the purlin shall not exceed 225 mm.

1.4. Requisite slope in the gutter shall be given in the line of bracket. The brackets shall be placed at not more than 900 mm. centers.

1.5. The gutters shall be fixed to the brackets with 2 Nos. 8 mm. G.I. seam bolts and nuts, each bolt and nut being equipped with a pair of bitumen and G.I. washers. These connection bolts shall normally be above the water line of the gutter..

1.6. Spigot and socket end of gutters of socketed half round gutter and their accessories shall be connected together at their laps with one row of 8 mm. dia. G.I. bolts and nuts. Each of the bolts and nuts shall be provided with a pair of bitumen and a pair of G.I. washers. The gap between socket and spigot shall be packed with approved plastic roofing compound and flanked on the both sides with 6.35 mm. dia asbestos rope. The connecting G.I. Bolt shall be then tightened so that the lapped joint becomes leak-proof. The outer face of packed asbestos rope shall not be further than 6 mm. from the edges of the spigot and socketed ends. Where both ends of gutters and / or their accessories to be connected together are spigot ends, they shall be laid as butt jointed with 1.5 mm. gap in between over union clips. The union clips connected to the two butt ends of the gutter or other sections with two rows. The gap between union clips and ends of gutter sections or accessories shall be packed with plastic roofing compound flanked with edges of 6.35 mm. dia asbestos ropes as before. The whole joint shall be made leak-proof by tightening the bolts.

2.0. Mode of measurements & payment

2.1. The asbestos socketed half round eaves gutter shall be measured for finished work and the length shall be measured along the centre line. -

2.2. The rate of gutters shall include the cost of providing and fixing accessories such as drops ends, stop ends, nozzles, and fixing union clips together with bolts, nuts and washers.

2.3. The rate shall be for a unit of one running meter.

15.29.(II) Providing and fixing Asbestos cement socketed half round eaves gutters with bolts, nuts, bitumen washers etc. and flat iron brackets 40 mm x 3 mm. size including Asbestos rope and plastic roofing compound in joint etc. complete. 300 mm. nominal size.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 15.29 (I) shall be followed except that the size of the Asbestos socketed eaves half round gutter shall be 300 mm. nominal size.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 15.29(1) shall be followed.

2.2. The rate shall be for a unit of one running meter.

15.51. Tiled roofing with Mangalore pattern roof tiles including teak reefers of size 50 mm. x 25 mm.

1.0. Materials

(1) Mangalore pattern roof tiles shall conform to M-25, (2) Teak wood batten shall conform to M-29.

2.0. Workmanship

2.1. Laying

The maximum distance between centre to centre of rafters shall be not more than 500 mm. Teak wood reefers 50 mm. x 25 mm. be nailed to each rafter at central distances suited to the size of the tiles by

means of nails 50 mm. long. The reapers shall be of well seasoned teak wood and shall be straight pieces of uniform size and colour and not shorter than the length necessary to cover at least four rafter. The under face and sides of the reapers shall be planned before fitting up. Joints shall come over the rafter. The joints of two adjacent rows of reapers shall not come over the same rafter. At the eaves, there shall be two reapers of such thickness and shape that the uniformity of the top slope of the roof shall be preserved.

2.2. The work of valleys shall be executed as under :

Galvanized iron sheet 1200 mm. wide and 1.25 mm. thick shall be used for valleys. The sheet shall be extended by about 450 mm. under the tiles on either side in a depth of 100 mm. at centre. The sheet shall be carried 75 mm. into the wall and set with cement mortar unless flushing is specified. The laps, if any, on the slope shall be 300 mm. The sheets shall be laid over the reapers and nailed. Two reapers 50 mm x 25 mm. each shall be fixed over the galvanized iron sheet 150 mm. away from the centre line of the valley, on either side to keep the tiles and mortar from falling into the gutter of the valley.

2.3. Laying :

The tiles shall be laid from the eaves towards the fidges after fitting of the reapers, the rebate of the tiles resting fully against the reapers. The joints of the hips and ridges tiles and also those between them and the plain tiles shall be set in and well grouted with lime mortar and the mortar surface painted and finished off with a mixture of red paint and port land cement or preserve informality of colour. The finished slope of roof shall be uniform from ridges to eaves. The eaves line shall be perfectly straight, horizontal and parallel to each other. The end over gales shall be protected by lime borders and neatly finished.

2.4. At the side of valleys and for 230 mm. on either side of the roof at valleys cement plastering 12 mm. thick shall be done to prevent the rain water from the gutter leaking by the sides of valleys.

2.5. At the eaves, wide tie shall be placed over the ends of the last tiles and secured by means of galvanized iron washers and screws 25 mm. into the rafter to prevent tiles from being blow up. Care shall be taken to put the screws in the, ridges and not in the gutter or the tiles, Where full tiles are not necessary, half tiles manufactured for the purpose shall be used.

3.0. Mode of measurements and payment

3.1. The measurement of the roof shall be taken for finished work for superficial area flat in the plane, of the roof and not girthed. Laps shall not be measured.

3.2. No deduction in measurements of roofed shall be made for openings of area up to 0.40 sq. mt. nor shall any extra be paid for labour and wastage in forming such openings.

3.3. The rate includes the cost of all materials and labour including ridges, hips, eaves and bottoms.

3.4. The rate shall be for a unit of one square meter.

15.75 Providing and fixing five courses water proofing treatment with bitumen felt consisting/ of second and fourth course of blown bitumen or/and residual bitumen applied hot 1.20 kg./sq. mt. of area for each course and first course with fiber base bitumen saturated underlay type and third course with fiber base self finished felt type 2 Grade-I, fifth and final course of stone grit 6 mm. and down size or pea sized gravel spreaded at 0.008 cum/sq.mt. including preparation of surface, excluding grading complete.

1.0. Materials

The tar felt shall conform to M-76. The bitumen primer shall conform to I.S. 3388-1965. The bitumen shall conform to I.S. 702-1961. The grit or gravel shall conform to M-8.

2.0. Workmanship

2.1. Preparation of surface :

2.1.1. Well defined cracks other than hair cracks in the roof structure shall be cut to V section cleaned and filled up flush with cement sand slurry or with bitumen conforming to I.S. 702-1961. The surface to be treated shall have minimum slope of 1 in 120. The grading shall be carried out prior to the application of water proofing treatment by cement mortar or lime surkhi mortar or as specified in description of item.

2.1.2. The surface or room, part of parapet and gutters, drain mouths etc. over which the water proofing treatment is to be applied shall be cleaned or all foreign matter such as funguses, moss and dust by wire brushing and dusting.

2.1.3. Drain outlet shall suitably placed with respect to the roof gradient to ensure rapid drainage and prevent local accumulation of water on the roof, surface, masonry drain mouth shall be widen sufficiently and rounded with cement mortar.

2.1.4. For cast iron drain outlets, a groove shall be cut all round to touch the treatment.

2.1.5. When a pipe passes through a roof on which water proofing treatment is to be laid a cement concrete angle fillet shall be built round it and the water proofing treatment taken over the fillet.

2.1.6. In case of parapet wall over 450 mm. in height for trucking in the water proofing treatment a horizontal groove 75 mm. wide and 65 mm. deep at minimum height of 150 mm. above roof level shall be left in the vertical face at the time of construction. The horizontal face of the groove shall be shaped with cement mortar 1:4.

2.1.7. In case of low parapet where the height does not exceed 450 mm. no groove shall be provided and the water proofing treatment shall be carried right over the top.

2.1.8. In case of existing R.C.C. and stone and vertical face of the parapet wall, a fillet 75 mm. in radius shall be constructed.

2.1.10. At the drain mouths the fillet shall be suitably cut back and rounded off for easy application of water proofing treatment and easy flow of water.

2.1.11. Outlet at every low dividing wall about less than 300 mm. in height cut open to full depth and the bottom and the sides shall be rounded smooth and corners rounded off for easy application of water proofing treatment.

2.2. Priming coat:

2.2.1. Bitumen primer shall conform to I.S. 3335-1965. A priming coat consisting of bituminous solution of low viscosity shall be applied with brush on the roof and wall surface at specified weight per unit area to assist adhesion to bonding materials as specified in the description of the item.,.

2.2.2. Where a floating treatment to water proofing with self finished bitumen felt is required i.e. where water proofing treatment is required to be isolated from the roof structure, a layer of bitumen saturated felt (under lay) shall be spread over the roof surface and tucked into the flashing grooves. To keep the underlay free from the structure nonbonding materials shall be used below underlay. Overlapping to the adjoining strip of underlay shall be minimum of 75 mm. as sides and 10 mm. at ends, and shall be sealed with the same bonding materials, as used for self finished felt treatment. The underlay shall be of type I saturated felt conforming to I.S. 1322-1970.

2.3. Laying of Felt :

2.3.1. The self finished tar felt shall be cut to the required lengths, brushed clean to dusting materials, laid out flat on the roof to eliminate curls and subsequent sketching. The felt shall be laid in lengths running at right angles to the direction of run off gradient commencing at the lowest level and working up to crest, so that the lower laps of the adjacent felt layer offer minimum obstruction to the flow of water. The felt shall not be laid in a single piece of very long lengths as it is likely to shrink. 6 to 8 meters are suitable length. The roof shall be cleaned and dried before the felt treatment is begun. Each length shall be laid in position and rolled up for a distance of half its-lengths. The hot bonding materials heated to correct working temperature as specified by manufacturer shall be poured on the roof across the full width of the felt as the latter is steadily unfolded and pressed down. The excess of bonding materials which squeezes out at the ends shall be removed as the laying proceeds. The pouring shall be so regulated that the correct weight of the bonding materials as per unit area is spread uniformly over the surface. When the first half of the tar felt has been bonded to the roof, the other half shall be rolled up and then unrolled on the hot bonding materials in the same way. Subsequent strips shall also be laid in the same manner. Each strip shall overlap the preceding one by at least 75 mm. at the longitudinal edges and 100 mm. at the ends. All overlaps shall be firmly bonded with hot bitumen. Streaks and trailing of bitumen near edges or laps shall be leveled by heating the overlaps with blow lamp and leveling down unevenness.

2.3.2. Third layer of bonding materials in four course treatment shall be carried out in similar manner after the flashing has been complete.

2.3.3. Water proofing treatment shall be carried out in the drain pipe or out-lets by at least 100 mm. The Water proofing treatment laid on the surface shall overlap the upper edge of water proofing treatment in the drain outlets by at least 100 mm. Flashing felts shall be laid as flashing. Wherever junction of vertical horizontal surfaces occurs longitudinal laps shall be 100 mm. The lower layer of flashing felt shall overlap the roofing felt by 100 mm on vertical and sloping faces. Last course of flashing should not be of stone grit or pea sized gravel but it shall be replaced by providing two coats of bitumen solution of approved quality.

2.3.4. The lower edge of flashing shall overlap the flat portion for the roof and the upper edge of the flashing shall be trucked into the horizontal groove 75 mm. thick wide, 65 mm. deep provided at minimum height of 150 mm. from top of the roof surface. The flashing treatment shall be firmly held in place in the grooves with wooden wedges at intervals and the grooves shall be filled with cement mortar 1:4 (1 cement : 4 coarse sand) or cement concrete (1:2:4) (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm. nominal size) and surface finished smooth with the rest of wall. The cement work shall be cured of bituminous solution shall be applied on the vertical and sloping surface of flashing.

2.3.5. After the top flashing felt layer has been laid, the penultimate layer of bonding material shall be applied over the roofing felt and horizontal overlap, and vertical and sloping surfaces of flashing shall be spread uniformly over the hot bounding materials on the horizontal roof surface and pressed into it with wooden roller.

2.3.6. The material for surface finish shall be spread as described in the item over top layer.

2.3.7. If ballooning occurs the defects may be rectified as under.

2.3.8. Remove the gravel on the ballooned surface. The cut open and squeeze out the trap vapor by firm pressure applied by hand, seal the bitumen felt so lifted back on the surface by applying additional bitumen, finally seal the cut with piece of bitumen felt with bitumen application.

3.0. Mode of measurements & payment

3.1. The measurements for this item shall be taken as under:

(a) Water proofing of roof with bitumen shall be measured in sq. mt. length and breadth shall be measured correct to centimeter.

(b) Measurement shall be taken for the superficial area of roofing and flashing treatment including flashing over the parapet wall, low dividing walls and expansion joints and at the pipe projection etc. Overlapping and tucking into flashing grooves shall not be measured.

(c) Slopping and vertical surface of water proofing treatment shall be measured under the four or five course treatment as the case may be irrespective of the fact that the final course of grit or gravel is replaced by bitumen primer.

(d) In measurements, no deductions shall be made for either openings or recesses for chimney stacks, roof lights etc. for areas up to 0.40 sq. mt. not anything extra shall be paid for extra labour and materials in forming such openings. For similar area exceeding 0.04 sq. mt. deduction shall be made in measurements for full opening but nothing extra shall be paid for extra labour and materials in forming such openings.

(e) The grading (coba bedding) shall be paid separately but cleaning of surface and treatment shall not be measured or paid separately.

3.2. The rate includes cost of all materials and labour.

3.3. The rate shall be for a unit of one sq. meter.

15.87(A) Providing and fixing on wall face C.I rain water pipe including filling the joints with spun yarn soaked in neat cement slurry and cement mortar 1:2 (1 cement : 2 fine sand) 75 mm. dia.

1.0. Materials

Water shall conform to M-1. The C.I. rain water pipes and fittings shall conform to M-68. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. C.I. rain water pipes shall be of the specified diameter and shall be in full lengths of 1.8 meters including socket ends of the pipes unless shorter lengths are required at junction with fittings.

2.2. Fixing :

The pipe and fittings shall be fixed in vertical alignment unless otherwise specified and shall be secured to the walls at joints with M.S. clamps. The clamps shall be M.S. sheet 30 mm. bent to required shape and size so as to fit tightly on the socket of pipe when tightened with screw bolts. It shall be formed out of two semi-circular pieces, hinged with 6 mm. dia M.S. pin on one side and provided flanged ends on the other side with holes to fit in the screw bolt and nut 40 mm. long. The clamps shall be provided with hook made out of 275 mm. long, 10 mm. dia M.S. bar invested to the ring at the centre of one semicircular piece. The clamps shall be fixed to the walls. The clamps shall be kept above 25 mm. clear of finished face of wall so as to facilitate cleaning and painting the pipes.

2.3. The pipe shall be fixed vertically. The spigot of the upper pipe shall be properly fitted in the socket of the lower pipe such that there is uniform annular space filling with the jointing material. The annular space between the spigot and socket shall be filled with, a few turns of spun yarn soaked in cement slurry or with stiff cement mortar 2:1 (1 cement : 2 fine sand) well pressed with caulking tools and finished smooth at top at an angle of 45°, sloping up. The joint shall be kept wet at least for 7 days by tying four fold of gunny bag to pipe and keeping it moist constantly.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 15.93(B) of A.C. rain water pipes shall be followed except that the C.I. rain water pipe shall be fixed.

3.2. The rate shall be for a unit of one running meter.

15.88.(A) Providing and fixing M.S. Holder bat clamps of approved design to C.I. or S.C.I, pipes embedded and including cement concrete blocks (108 mm. x 100 mm. size) in 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) and cost of cutting holes and making good the wall etc. complete : 75 mm. dia.

1.0. Materials of Workmanship

1.1. The relevant specifications of item no. 15.94(6) shall be followed except that the M.S. holder bat clamps of approved design shall be C.I. rain water pipe-75 dia.

1.2. The bat clamps shall be fixed as directed with C.C. blocks of 100 mm. x 100 mm. The relevant specification of item No. 5.4.1 shall be followed for concrete work.

2.0. Mode of measurements and payment

2.1. The bat clamps of M.S. holder suitable for 75 mm. dia shall be measured for finished item.

2.2. The rate includes cost of all materials and labour etc. required for satisfactory completion of this item.

2.3. The rate shall be for a unit of one number.

15.90(A) Providing and fixing and embedding sand C.I. rain water pipe in the masonry surrounded with 12 mm. thick cement mortar of the same mix as that of masonry : 75 mm. dia. pipe.

1.0. Materials

Water shall conform to M-1. Cement mortar shall conform to M-11. The C.I. pipe and fittings shall conform to M-68.

2.0. Workmanship

2.1. The relevant specifications of item No. 15.87 (A) shall be followed except that C.I. pipe 75 mm. dia shall be embedded in masonry surrounded with 12 mm. thick cement mortar.

2.2. The pipes shall be fixed in the masonry work as it proceeds. The pipe shall be kept vertical or to the line as directed. The pipe shall have minimum surroundings of 12 mm. thick cement mortar at every portion of external surface. The length shall be caulked with spun yarn and cement mortar as soon as the next length of pipe is placed in position. The socket end of the pipe shall be kept closed till the next length of pipe is fitted and jointed to prevent any brick-bats or concrete or pieces of wood falling in and cocking the pipes.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 15.87 (A) shall be followed.

3.2. The rate shall be for a unit of one running meter.

15.93(6) Providing and fixing on wall face asbestos cement rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement : 2 coarse sand) complete : 80 mm. dia.

1.0. Materials

1.1. Asbestos cement pipes of 80 mm. dia shall conform to I.S. 1626-1960 for pipes fixed on wall face. A.C. pipe shall conform to M-74.

2.0. Workmanship

2.1. Asbestos cement rain water pipes and fittings shall be of the diameter, size and type specified in the item. The pipe shall be full lengths of 2 meter as far as possible. All the pipes shall be fixed on wall face at locations indicated on drawings or as ordered by the Engineer-in-charge. Pipe shall be secured to face of wall below all joints by M.S. clamps with wooden gut ties.

2.2. The spigot of the upper pipe shall be properly fitted into the socket of the lower pipe such that there is uniform annular space for fitting with the jointing materials. One third depth of annular space between the

item. The pipe shall be full lengths of 2 meter as far as possible. All the pipes shall be fixed on wall face at locations indicated on drawings or as ordered by the Engineer-in-charge. Pipe shall be secured to face of wall below all joints by M.S. clamps with wooden gut ties.

2.2. The spigot of the upper pipe shall be properly fitted into the socket of the lower pipe such that there is uniform annular space for fitting with the jointing materials. One third depth of annular space between the socket and the spigot shall be filled with spun-yarn soaked in bitumatic jointing compound and shall be pressed home by means of caulking tool. The remaining 2/3 depth of the joints shall be filled in with stiff cement mortar 1:2 and shall be pressed with caulking tool and finished smooth at top at an angle of 45 sloping up.

3.0. Mode of measurements and payment

3.1. The pipe shall be measured including all fittings along its length in running meter. No allowance shall be made for the portion of pipe length entering the sockets of the adjacent pipe or fittings.

3.2. The rate includes the cost of all materials and labour involved in all the operations including jointing.

3.3. The rate shall be for a unit of one running meter.

15.93.(C) Providing and fixing on wall face asbestos cement rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement : 2 coarse sand) complete : 100 mm. dia.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 15.93 (B) shall be followed except that the diameter of pipes shall be 100 mm.

2.0. Mode of measurements & payment

2.1. The pipe shall be measured including all fittings along its length in running meter. No allowance shall be made for the portion of pipe length entered into the sockets of the adjacent pipe or fittings.

2.2. The rate includes the cost of all materials and labour involved in all the operations including jointing.

2.3. The rate shall be for a unit of one running meter.

15.94.(B) Providing and fixing for A.C. pipe on wall plugs and standard holder bat clamps comprising of two semi circular halves of flat iron and cast iron base screwed on wooden plugs : 80 mm. dia.

1.0. Materials and workmanship

1.1. The bat clamps shall consist of a iron base with a projecting 1 shaped lay, teeth web of which the semicircular halves of the flat iron clamps are bolted. The base on the holder bat clamp shall be screwed on a pair of wooden plugs fixed in the wall with screw slotted driven through the holes in the base. The ' screws shall be not less than 75 mm. long-for 80 mm. diameter pipes and 100 mm. diameter pipes. The plugs shall be fixed in the wall to a depth of 150 mm. in cement mortar, 1:2 centrally to the holes in the base of the bat clamps and with their front face projecting to such a length' from the brick face that when the bat clamps is fixed, the outer base of its base shall be flush with the plaster face of the wall. The plugs shall be 110 mm. x 50 mm. wide at face increasing to 160 mm. x 70 mm. width at rear and shall be 70 mm. deep through out.

2.0. Mode of measurement & payment

2.1. The work shall be measured on number basis of clamps prescribed with accessories including cost of all materials and labour involved in all the operation including jointing etc. complete fixing in position etc. complete.

2.2. The rate shall be for a unit of one number.

15.94 (C) Providing and fixing for A.C. pipe on wall plugs and standard holder bat clamps comprising of two semi circular halves of flat iron and cast iron base screwed on wooden plugs : 100 mm. dia.

1.0. Materials and workmanship

1.1. The relevant specifications of item No. 15.94 (B) shall be followed except that the standard holder bat clamps shall be for A.C. pipe of 100 mm. dia.

2.0. Mode of measurements and payment

2.1. The work shall be measured on number basis of clamps including cost of all materials and labour involved in all the operation including jointing, fixing in position etc. complete.

2.2. The rate shall be for a unit of One Number.

15.95.(A) Providing and fixing on wall face asbestos cement fittings for rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement : 2 coarse sand). Bend of required degree. 80 mm. dia without door. 100 mm. dia. without door.

1.0. Materials

1.1. The bend of required degree and size as specified in item shall be of best quality and made as approved by the Engineer-in-charge. The fittings shall conform to I.S, 1626-1960.

2.0. Workmanship

2.1. The fitting (bend of required degree) shall be fixed as per relevant specifications of item No. 15.93 (B), except that the A.C. bends of required degree shall be provided instead of pipe.

3.0. Mode of measurements and payment.

3.1. The rate shall be for a unit of One Number.

15.95.(B) Providing and fixing on wall face asbestos cement fittings for rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement: 2 coarse sand) off set 50 mm. (2) 80 mm. dia. (3) 100 mm. dia.

1.0. Materials & Workmanship

1.1. The relevant specification of item No. 15.95 (A) shall be followed except the off set 50 mm. of specified size of A.C. pipe shall be used instead of bends.

2.0. Mode of measurements & payment

2.1. The rate shall be for a unit of One Number

15.95.(C) Providing and fixing on wall face asbestos cement fittings for rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement : 2 coarse sand) off set 75 mm. (2) 80 mm. dia (3) 100 mm. dia.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 15.95 (A) shall be followed except that off-set 75 mm. of specified size of A.C. Pipe shall be provided instead of bends.

2.0. Mode of measurements & payment

2.1. The rate shall be for a unit of One Number.

15.95.(J) Providing and fixing on wall face Asbestos cement fittings for rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement : 2 coarse sand) junction equal angle. (3) 80 mm. dia without door (5) 100 mm. dia. without-door.

1.0. Materials and workmanship

The relevant specifications of item 15.95 (A) shall be followed that junction of equal of angle of specified size of A.C. pipe shall be provided instead of bends.

2.0. Mode of measurements & payment

2.1. The rate shall be for a unit of One Number.

15.95.(K) Providing and fixing on wall face Asbestos cement fittings for rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement : 2 coarse sand) : junction of equal double angle. (3) 80 mm. dia. without door (5) 100 mm. dia. without door.

1.0. Materials and workmanship

1.1. The relevant specification of item 15.95 (A) shall be followed except that junction of equal double angles of A.C. rain water pipe of specified size shall be provided instead of A.C, Bend.

2.0. Mode of measurement & payment

2.1. The rate shall be for a unit of One Number.

15.95.(L) Providing and fixing on wall face Asbestos cement fittings for rain water pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 cement : 2 coarse sand) : Standard shoe. (2) 80 mm. dia. (3) 100 mm. dia.

1.0. Materials and workmanship

1.1. The relevant specification of item No. 15.95 (A) shall be followed except that the standard shoe of A.C. pipe of specified size shall be provided instead of bend.

2.0. Mode of measurement & payment

2.1. The rate shall be for a unit of One number.

SECTION-16
Ceiling Lining

16.3.(A) Providing and fixing wooden planks ceiling with long Lied and grooved jointing and Wood screws (Frame work and cover fillets to be measured and paid separately) : Indian Teak Wood (i) 12 mm. thick (ii) 20 mm. thick (iii) 25 mm. thick.

1.0. Materials

1.1. The Indian Teak wood shall conform to M-29.

2.0. Workmanship

2.1. General

The planks shall be clean sawn in the direction of the grain, cut square and straight. Each plank shall have tongued and grooved jointing. On exposed faces, it shall be planed for full face.

2.2. The frame for supporting the ceiling may be wooden or metal and the size and the other details of frame work shall be as directed, Suspenders of M.S. angles or other sections may be used for suspending the frame. Use of wooden suspenders shall be permitted. The bottom surface of the frame shall be checked and corrected to true surface and slope.

2.3. Fixing :

Planks of a specified timber and thickness shall be used. The width of the planks shall not be more than 100 mm. up to 20 mm. thick planks and 150 mm. for planks above 20 mm. thick and length shall not exceed 3 meters. The planks shall be of uniform width except in the first and last lines of planks adjacent to the two walls where remaining additional odd width shall be adjusted equally on both sides. The minimum, length of planks in finished work shall be such that it will span at least two spacing of the supporting frame work except where shorten lengths are unavoidable. The planks shall be planed true on the exposed sides.

2.4. The longitudinal edges of the planks shall be jointed with tongued and grooved type joints as described in the item.

2.5. The outer lines of planks shall be accurately fixed parallel and close to be wall. Each subsequent plank shall be carefully jointed up. The plank shall be fixed to the frame above with two screws at each and joints of frame and one at every intermediate joint. (The screws shall not be thinner than designations 8 and of a length not less then twice the thickness of the boards). The screws shall be counter sunk and the screw holes filled with putty or-sloping out way. The unexposed face of planks shall be treated with wood preservative before the board is fixed.

3.0. Mode of measurement & payment

3.1. The supporting frame, cover fillets, and suspenders shall not be included in rate of ceiling.

3.2. No deductions in measurements shall be made for opening not exceeding 0.46 sq. m. and no extra payment shall be made for forming such openings.

3.3. Each type of work in ceiling shall be measured separately.

3.4. The rate shall be for a unit of One sq. meter.

16.4. Providing and fixing Fiber insulation board lining with butt jointing and nails (Frame work and cover fillets to be measured and paid separately) (i) 12 mm. thick (ii) 18 mm. thick (iii) 25 mm. thick.

1.0. Materials

1.1. The fiber insulation board of specified thickness shall conform to I.S. 3348-1965.

2.1. Fixing :

The work shall be carried out as per detailed drawings for panel arrangements.

2.2. All boards are subject to slight movements due to moisture and temperature changes, and this shall be allowed for in fixing. Preferably the board shall be stored up for at least 24 hours before use in the same environment as the one in which they are to be fixed.

2.3. Frame work :

The studs and grounds for fixing the boards shall be spaced at 300 mm. to 450 mm. centers both ways the .actual spacing selected depending on the width of the cut board in the panel arrangements. All edges of the boards shall be supported. Intermediate supports shall be provided at dedo heights for picture rails and cornices etc.

2.4. Planked battens 40 mm. x 20 mm. shall toe used for grounds on solid walls. The batten shall be plugged to wall as described-under. The batten snail be fixed on tapering plugs with 50 mm. long wood screws. The tapering plug shall be trapezoidal in shape having base 50 x 50 mm. at bottom 38 x 38 mm. at top with depth of 50 mm. Plugs shall be embedded in C.M. 1 : 3 and shall be placed at 450 x 500 mm. centers. The plugs shall treated with coal tar and battens shall be treated with wood preservative before use. On uneven wall faces the battens shall be plugged and fitted with packing pieces at the back where necessary. The frame shall be treated with wood preservative before boards are nailed on.

Nailing shall be done by nails having a shank diameter of 2.5 mm. and head diameter of about 8 mm. Nails shall have length as per requirements. The nails shall be placed at supports at 100 mm. to 150 mm centre to centre and at edges 75 mm. centers. Minimum clearance for nails from edges shall be 10 mm. The nails shall be rustles where the nail heads are exposed. Where the joints are to be covered with beading, felt headed (clout) nails shall be used instead of lost head nails.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 16.3.(A) shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

16.13(1) Providing and fixing plywood lining with butt jointing and nails (frame work and cover fillets to be measured and paid for separately) 6 mm. thick play.**1.0. Materials :**

6 mm. thick plywood shall conform to M-37.

2.0. Workmanship

The relevant specifications of item 16.4 shall be followed except that 6 mm. thick plywood shall be fixed in lining.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item 16.4 shall be followed.

3.2. The rate shall be for a unit of One sq. meter,

16.13(11) Providing and fixing plywood lining with but jointing and nails (frame work and cover fillets to be measured and paid for separately) 9 mm. thick ply.**1.0. Materials & Workmanship**

1.1. The relevant specifications of item No. 16 13 (I) shall be followed except that the thickness of plywood to be fixed shall be 9 mm.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 16.4 (I) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

16.21(1) Providing and fixing plain asbestos sheet lining with butt jointing and wood screws (frame work and cover fillets to be paid for separately), Class-A-6.5 mm. thick.**1.0. Materials**

1.1. Plain A.C. Sheets 6.5. mm. thick shall be conform to M-24.

2.0. Workmanship

2.1. The relevant specifications of item No. 16.4. shall be. followed except that the plain A.C. sheets class A of 6.5 mm. thickness shall be fixed in lining.

2.2. In fixing asbestos cement sheets, care shall be taken to avoid rigid fixing as this may cause cracking if the supporting structure expands or shrinks. The sheet shall be fixed with wood screws to wooden ground

and the screw holes shall be drilled slightly longer than the screws. Asbestos sheet may also be advantageously fixed on to walls with cement plaster backing. The screws shall be fixed at 150 mm. to 200 mm. at supports. The boards shall be fitted either with wooden cover fillets or asbestos strips as described in item.

3.0. Mode of measurement and payment

3.1. The relevant specifications of item No. 16.4 shall be followed.

3.2. The rate shall be for a unit One sq. meter.

18.21 (II) Providing and fixing plain asbestos sheet lining with butt jointing to wood screws (frame work and cover fillets to be paid for separately), Class-B-5 mm. thick.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 16.21 (I) shall be followed except that the plain A.C. sheet of Class-B 5 mm. thick shall be fixing in lining.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 16.21 (I) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

**SECTION-17
Plastering and Paints****17.58 (I) 10 mm. thick cement plaster in single coat on fair side of brick concrete walls for interior plastering up to floor two level and finished even and smooth in (i) C. M. 1:3.****1.0. Materials**

1.1. Water shall conform to M-1. The cement mortar of proportion 1:3 shall conform to M-13.

2.0. Workmanship**2.1. Scaffolding:**

Wooden bullies, bamboos, planks, trestles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

2.2. Preparation of back-ground :

2.2.1. The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be toughened by wire brushing if it is not hard and by hacking if it is hard. In case of concrete surface, if a chemical retarded has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the readers if left on the surface. Trimming of projections on brick/concrete surfaces where necessary shall be carried out to get an even surface.

2.2.2. Raking of joints in case of masonry where necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

2.2.3. The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry, such area shall be moistened again.

2.2.4. For external plaster, the peasting operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be-started wherever the building frame and cladding work are ready and the temporary supports of the ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

2:3. Application of plaster:

2.3.1. The plaster about 15x15 cms. shall be first applied horizontally and vertically at not more than 2 meters intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel or wooden float according as a smooth or a smooth or a sandy granular texture is required Excessive troweling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Hounding or chamfering, corners, arises junctions etc. shall be carried out with proper templates to be size required.

2.3.2. Cement plaster shall be used within half an hour after addition of water. And mortar or plaster which is partially set shall be rejected and removed forthwith from the site.

2.3.3. In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically, when recommencing the plaster, the edges of the old work shall be scraped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15 cm. to any corners or arises. It shall not be closed on the body of features such as plaster bands and cornices not at the corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

2.3.4. Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging matting or gunny bags oh the outside of the plaster and keeping them wet.

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials, labour and scaffolding etc. involved in the operations described under workmanship.

3.2. All plastering shall be measured in square meters unless otherwise specified. Length breadth or height shall be measured correct to a centimeter.

3.3. Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves or open joints in brick work, stone work etc. or space between laths. Thickness of plaster shall be average thickness with minimum 10 mm. at any point on this surface.

3.4. This item includes plastering up to floor two level.

3.5. The measurement of wall plastering shall be taken between the walls or partition (dimensions before plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.

3.6. Soffits of stairs shall be measured as plastering on ceilings, following soffits shall be measured separately.

3.7. For jambs, soffits, sills etc. for openings not exceeding 0.5 sq. met each in area for ends of joints beams, posts, girders, steps etc. not exceeding 0.5 sq. mt each in area and for openings exceeding 0.5 sq. mt and not exceeding 3.00 sq. mt. in each area deductions and additions shall be made in the following manners.

(a) No deductions shall be made for ends of joints, beams, posts etc. and openings not exceeding 0.5 sq. mt each and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings, for finish to plaster around ends of joints, beams posts etc.

(b) Deduction for openings exceeding 0.5 sq. mt but not exceeding 3 sq.mt. each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings, (i) When both faces of all wall are plastered with same plaster, deduction shall be made for one face only, (ii) When two faces of wall are plastered with different types of plasters or if one face is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, window etc. on which width of reveals is less than that on the other side but no deductions shall be made on the other side. Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from areas of plaster and / or pointing as the case may be.

3.8. For openings having door frames equal to or projecting beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

3.9. In case of openings of area above 3 sq. mt. each, deduction shall be made for openings but jambs, soffits and sills shall be measured.

3.10. The rate shall be for a unit of One sq. meter.

17.58 (II) 10 mm. cement plaster in single coat on fair side of brick/concrete walls for interior plastering up to floor two level and finished even and smooth in C.M. 1:4.

1.0. Materials & workmanship

1.1. The relevant specifications of item No. 17.58 (I) shall be followed except that the proportion of mortar is C.M. 1 :4 instead of C.M. 1:3.

2.0. Mode of measurements & payment

2.1. The mode of measurements and payment shall be the same as for item No. 17.58 (I)

2.2. The rate shall be for a unit of One sq. meter.

17.58 (III) 10 mm. cement plaster in single coat on fair side of brick/concrete walls for interior plastering' up to floor two level and finished even and smooth in C.M. 1:6.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 17.58 (I) shall be followed except that the proportion of mortar is cement mortar 1:6.

2.0. Mode of measurements & payment

2.1. The mode of measurement and payment shall be followed same as item No. 17.58(1)

2.2. The rate shall be for a unit of one square meter.

17.61.(I) 20 mm. thick cement plaster in single coat on rough side of single or half brick wall for interior plastering up to floor two level, finished even and smooth in cement mortar 1:3 (1 cement : 3 sand).

1.0. Materials & workmanship

1.1. The relevant specifications of item No. 17.59 (I) shall be followed except that the thickness of cement plaster shall be 20 mm. The plastering work shall be in single coat on rough side of half brick wall for interior plastering up to floor two level, finished even and smooth in C.M. 1:3.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 17.59(1) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

17.61.(II) 20 mm. thick cement plaster in single coat on rough side of single or half brick wall for interior plastering up to floor two level, finished even and smooth in cement mortar 1:4 (1 cement : 4 sand).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 17.59. (II) shall be followed except that the thickness of plastering shall be 20 mm. in C.M 1:4.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 17.59 (I) shall be followed.

2.2. The rate shall be for a unit of one sq. meter

17.61 (III) 20 mm. thick cement plaster in single coat on rough side of single or half brick wall for interior plastering up to floor two level, finished even and smooth in C.M. 1:6 (1 cement : 6 sand).

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 17.59 (III) shall be followed except that thickness of plaster shall be 20 mm. C.M 1:6.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 17.59 (I) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

17.69 Extra over items 51 to 65 for finishing with a floating coat of neat cement slurry.

1.0. Materials & workmanship

1.1. The relevant specification of item No. 17.58 and 1761 shall be followed for materials and workmanship except that this work is only providing smooth cement finish with floating coat of neat cement slurry

1.2. The coat of cement and fine sand mortar of proportion V1 (1 5 mm thick about) shall be applied to the plastered surface with a trowel to provide uniform texture while the base coat is still plastic.

1.3. In any continuous face of wall the finishing treatment should be carried out continuously and day lo day breaks made to coincide with architectural breaks in order to avoid unsightly Junctions

1.4. Curing : All the plaster work shall be kept damp continuously for a period 7 days

2.0. Mode of measurements and payment

2.1. The payment shall be made for a unit of 1.0 sq. mt of work done over an above the finishing of work of base coat.

2.2. The relevant specifications of item of base coat shall be followed for measurements and payment.

2.3. The rate shall be for a unit of One sq. meter.

17.70. Extra over item 17.58 to 17.61 for providing and mixing water proofing materials m cement mortar in proportion recommended by the manufacturers.

1.0. Materials and Workmanship

The relevant specification of item No 17.58 to 1761 shall be followed except that the water proofing materials of approved made shall be added to the cement at the rate specified or as directed by The Engineer-in-charge. The proportion proofing materials of water to be mixed with 50 kg bags shall be as recommended by the manufacturers of the water proofing material

2.0. Mode of measurements & payment

2.1. The payment shall he made extra for this work over and above the plaster work

2.2. The rate shall he for a unit or 1 Kg of water proofing materials used in 1 bag of weighing 50 Kg cement used extra over the rate of plastering work

17.91. Extra over item No. 17.59 to 17.61 for plastering on ceiling and soffits of stair up to floor two level instead of plastering on walls.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No 17.59 (1) shall no followed except that this work is for ceiling, soffits of stairs up lo two floe

1.2. The smooth concrete surface shall be suitable roughened to provide bond before plastering.

2.0. Mode of measurement and payment

2.1. The payment shall be made for a unit of One sq meter of work done extra over and above the payment of plaster work on wall surfaces.

2.2. The rate shall be for a unit of one sq. meter.

17.94(1) Extra over item No. 1 to 69, 71 to 87 and 90 for interior plastering above floor two level for every additional storey height (i) Single coat plaster.

1.0 Materials and Workmanship

1.1 The relevant specification of Item No. 17.59 (1) shall be followed except that the whole work is to be carried out above floor two level.

2.0. Mode of measurements and payment

1.2. The mode of measurement and payment shall be same as item No. 17.59(1).

2.2. The extra payment shall be made over and above the floor two level rate for every additional floor height.

17.94 (II) Extra over item 1 to 69, 71 to 87 and 90 for interior plastering above floor two level for every additional storey height. Tow coat plaster.

1.0. Materials & workmanship

1.1. The relevant specifications of item No. 17.94 (I) shall be followed except that extra payment for work shall be for a two coat plaster.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 17.94(1) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

17.94(111) Extra over item 1 to 69, 71 to 87 and 90 for interior plastering above floor two level for every additional storey height. Floating coat of neat cement.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 17.94 (I) shall be followed except that the extra payment shall be made for work of floating coat of neat cement slurry.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 17.59 (I) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

17.95. 20 mm. thick sand face cement plaster on walls up to height of 10 mm. and above ground level consisting of 12 mm. thick backing coating of C.M. 1:3 (1 cement : 3 sand) and 8 mm. thick finishing coat in C.M. 1:1 (1 cement : 1 sand) etc. complete.

1.0. Materials

1.1. Water shall conform to M-1. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. The work shall be carried out in the coats. The backing coat (base coat) shall be 12 mm. thick in C.M. 1:3. The relevant specifications of item No. 17.58(I) shall be followed except that the thickness of back coat shall be 12 mm. average. Before the first coat hardens its surface shall be beaten up by edges of wooden tapers and close dents shall be made on the surface. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days, depending upon the weather conditions. The surface shall not be allowed to dry during this period.

2.2. The second coat shall be completed to 8 mm. thickness in C.M. 1:1 as described above, including raising sand facing by bushing. The sample of sand face shall be got approved before the work is started. The whole work shall be carried out uniformly as per sample approved.

2.3. Curing :

The curing shall be started overnight after finishing of plaster. The plaster shall be kept wet for a period of 7 days. During this period, it shall be protected from all damages.

3.0. Mode of measurement & payment

3.1. The relevant specifications of item No. 17.58 shall be followed except that the sand face plaster on outside up to 10 m. above ground level shall be measured under this item.

3.2. The rate shall be for a unit of One sq. meter.

17.116(A) Pointing on brick work with cement mortar 1:3 (1 cement : 3 coarse sand) flush pointing.

1.0. Materials

1.1. Water shall conform to M-1. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. The flush pointing work shall be carried out with cement mortar of proportion 1:3(1 part of cement and 3 part of coarse sand) by volume.

2.2. Preparation of surface.

2.2.1. The joints shall be raked to such a depth that the average of new mortar measured from either the sunk surface to finished pointing or from the -edge of the brick shall be average 10 mm.

2.3. Application of Mortar and Finishing :

2.3.1. The mortar shall, be pressed in to the raked out joints with a pointing trowel according to the types of pointing specified in item. The mortar shall not spread over the corner edges or surface of the masonry. The pointing shall then be finished with the pointed tools.

2.4. Curing :

2.4.1. The pointing shall be kept wet for 7 days. During this period, it shall be suitably protected from all damages.

3.0. Mode of measurements & payment

3.1. No deductions shall be made end of joints, beams and posts etc. and openings not exceeding 0.5 s. mt. each and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings.

3.2. Deductions for openings exceeding 0.5 sq. mt. but not exceeding 3 sq. mt. each shall be paid as follows and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings : (i) When both faces of walls are pointed with same type of pointing, deduction shall be made for one face only, (ii) When two faces of walls are pointed with different type of pointing or if one face is plastered and the other is pointed, deduction shall be made in the plaster or pointing on the side of frame for door, windows etc. on which the width of reveals is less than that on the other side but no deduction shall be made from plaster or pointing on the other side.

(iii) When only one face is treated and the other face is not rested, full deduction shall be made, if the width of the reveals on the treated side is less than on the untreated side, but if the width of the reveal is more then no deduction shall be made nor any addition shall be made for reveals/jambs, soffits, sills etc. **3.3.** In case of openings of area above 3 sq. mt each deduction shall be made for opening but jambs, sills, and soffits, shall be measured.

3.4. The rate shall be for a unit of One sq. meter.

17.116(8) Pointing on brick work with cement mortar 1:3 (1 cement : coarse sand) Ruled pointing.**1.0. Materials & Workmanship**

1.1. The relevant specifications of item No. 17.116 (A) shall be followed except that the pointing to be done ruled pointing as under:

1.2. The joints shall be initially formed as for flush pointing and then while the mortar is still green, a groove of specified shape shall be formed by running forming tool straight along the centre line of joints till a smooth and hard surface is obtained. The vertical joints shall also be finished in a similar way. The pointing lines shall be uniform in width and truly horizontal and parallel in case of floor and ceiling.

2.0. Mode of measurements & payment

2.1. The mode of measurements and payment shall be the same as per item No. 17.116(A).

2.2. The rate shall be for a unit of One sq. meter.

17.117(A) Pointing on brick work with cement mortar 1:4 (1 cement : 4 sand) Flush pointing.**1.0. Materials & Workmanship**

1.1. The relevant specifications of item No. 17.116 (A) shall be followed.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item-No. 17.116 (A) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

17.117(6) Pointing on brick work with cement mortar 1:4 (1 cement : 4 sand) Ruled pointing.**1.0. Materials & Workmanship**

1.1. The relevant specifications of item No. 17.116(6) shall be followed except that the proportion of C.M. 1:4 shall used for ruled pointing.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 17.115 (A) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

17.140.(A) Pointing on coursed stone masonry with cement mortar 1:3 (1 cement : 3 sand) flush pointing.**1.0. Materials and workmanship**

1.1. The relevant specifications of item No. 17.116 (A) shall be followed except that the pointing shall be done on coursed stone masonry with C:M. 1:3 and the mortar shall be simply struck off with a trowel and the work left showing the natural irregularities in line and the surface of the stones themselves.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No.17.116 (A) shall be followed.

2.2. The rate shall be favor a unit of One sq. meter.

17.140(B) Pointing on course stone masonry with cement mortar 1:3 (1 cement ; 3 sand) Ruled pointing.**1.0. Materials and Workmanship**

1.1. The relevant specifications of item No. 17.140 (A) and 17.116 (B) shall be followed.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 17.116(A) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

17.44.(A) Pointing on uncoarsed stone masonry with cement mortar 1:3 (1 cement : 3 sand) Flushing pointing.**1.0. Materials & Workmanship**

1.1. The relevant specifications of item No 17 116(A) shall be followed except that the flush pointing shall be done on uncoarsed rubble masonry work if C.M 1 3 and the mortar shall be simply Struck off with a trowel and the work left showing the natural irregularities in line and the surface of the stone themselves.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 17.116(A) shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

17.144.(B) Pointing on uncoarsed stone masonry with cement mortar 1:3 (1 cement : sand) Ruled pointing.**1.0. Materials & Workmanship**

1.1. The relevant specification of item No 17 116 (Aj and 17 144 (A) shall be followed except that the ruled pointing work -shall be carried out on uncoarsed rubble masonry work in CM 1.3.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 17.116(A) shall be followed.

2.2. The rate shall be for a unit of One sq. meter

17.0.0.1 Providing cement vata (10 cms x 10 cms) size quarter round in cement mortar 1:1 including neat cement finishing, watering, etc. complete.**1.0. Materials**

1.1. Water shall conform to M-1 .Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. The work of cement vata of 10 cms x 10 cms. size shall be earned out at Functions of parapets and terraces as directed. The vata shall be finished in quarter round shape. The work shall be earned out in the neat workman like manner. The inter portion of rain water pipe shall be rounded off properly during constructing the vata. The work shall be cured for 7 days.

3.0. Mode of measurements and payment

3.1. The work shall be measured for finished item in running meter.

3.2. The rate shall be for a One running meter.

SECTION-18**White Washing & Distemping**

18.11. White washing with lime on undecorated wall surfaces (two coats) to give an even shade including thoroughly brooming the surface to remove all dirt, dust, mortar drops and other foreign matter.

1.1. Materials

1.1.1. The clear Cole shall be made from glue and boiling water by mixing 1 Kg. mixture shall be suitably tinted where required for use under coloured distemper it directed. Glue shall conform to I.S. 352-1959 (Specifications for animal glue)

1.1.2. Lime used shall be Freshly burnt class 'C' Lime (fat lime) and white in colour conforming to I S. 712-1973. Water shall conform to M-1. Best quality of gum shall be used in (the preparations of white wash. Ultramarine blue or Indigo : This shall conform to I.S. 55-1970 for points, and shall be used for preparation of white was, Pigments. Mineral colours, not affected by lime shall be used in preparing colour wash.

2.0. Workmanship

2.1. Preparation of white wash solution Surface already white or colour. The fat lime shall be slaked as site and shall be mixed and stirred with about five liters of water for 1 kg. of unslaked lime to made a trim cream This shall be allowed to stand for d period of 24 hours and then shall be screened through a clean coarse cloth, 4 Kg. of gum dissolves in hot water shall be added to each cubic meter of lime cream Small quantity of ultramarine blue (Up to 3 gins, per kg. of lime) shall also-be added to the last two coats of white wash solution and the whole solution shall be stirred thoroughly before use.

2.2. Preparation of surface:

2.2.1. The surface shall be thoroughly cleaned of all dust, dirt, mortar cropping and other foreign matter before white wash is to be applied.

2.2.2. The surface spoiled by smoke soot shall be scrapped with steel wire brushes or steel scrapers 01 shall be rubbed with over-burnt surkhi or brick bats. The surface shall be then broomed to remove all dust dirt and shall he washed with clean water.

2.2.3. Oil or grease spots shall be removed by suitable chemical and smooth surface shall be rubber with wire Crushes.

2.2.4. All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly. Such portion shall he wetted and allowed to dry. They shall then be given one coat of white wash

2.2.5. All unnecessary nails shall be removed the holes, cracks, patches etc. shall be made good with material similar in composition to the surface to be prepared

2.3. Scaffolding :

Wherever scaffolding is necessary it shall be erected in such a way that as far as possible on part of scaffolding shall rest against the surface to be white or colour washed A properly secured strong and well tied suspended platform (Zoola) may be used for white washing. Where ladders are used pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings, proper stage scaffolding shall be erected where necessary.

2.4. Application of white wash :

2.4.1. On the surface so prepared the white wash shall be applied with 'Moon' brush. The first stroke of the brush shall be from top downwards, another from bottom upwards over the first stroke and similarly one stoke from the right another from the left, over the first stroke brush before it dries. This will form one coat each coat shall be allowed to dry before and uniform finish free from brush marks and it should not come oft easily when rubbed with finger

2.4.2. Splashing and dropping if any on the doors and windows, ventilators etc shall be removed and the surface cleaned.

2.4.3. Priming and Alkali resistant treatments, scraping of surface washing etc. surface spoiled by smoke soot removed of oil and grease spots, treatment for infection with efflorescence moulds moos, fungi, algae and lichen and patch repairs to plaster wherever done shall not be paid extra.

3.0. Mode of measurement & payment

3.1. All the work shall be measured in the decimal system as under:

- (a) Dimensions shall be measured to the nearest 0.01 m.
- (b) Area in individual item shall be worked out to the nearest 0.01 sq.m.

All the work shall be measured in sq. mt. Deductions for jambs, soffits, sills etc. for openings not exceeding 0.5 sq. mt. each in area, for ends of joists, posts, beams, girders, steps etc. not exceeding 0.5 sq mt. each in area and for openings exceeding 0.5 sq. mt. and not exceeding 3.0. sq. mt. each in area, deductions and additions shall be made as under.

3.2. No deductions shall be made for ends of joists, beams, posts, etc. and openings not exceeding 0.5 sq mt. each. No addition shall be made for reveals, jambs, soffits, sills etc. of these openings not for finish around ends of joints, beams, posts etc.

3.3. No deductions for openings exceeding 0.5 sq.mt. but not exceeding 3 sq. mt. each shall be made as follows and no addition will be made for reveals, jambs, soffits etc. of these openings :

- (a) When both the faces of walls are provided with finish, deduction shall be made for one face only.
- (b) When each face of wall is provided with different finish, deduction shall be made for that side of frame for door, windows, etc. on which width of reveals is less than that of the other side. Where width of reveals on both faces of wall are equal, deduction of .50% of area of opening on each face shall be made from total area of finish.
- (c) When only one face of wall is treated and the other face is not treated, full deduction shall be made if the width of reveal on the treated side is less than that on the untreated side, but if the width of the reveal is equal or more than on the untreated side neither deductions nor additions to be made for reveals, jambs, soffits, sills etc.

3.4 In case of area of openings exceeding 3 sq. mt. each, deductions shall be made for openings but jambs, soffits, sills shall be measured.

3.5. No deductions shall be made for attachment such as casing, conducts, pipe, electric wiring and the like.

3.6. Corrugated surfaces shall be measured flat as fixed and not girth. The quantities so measured shall be increased by the following percentage and the resultant shall be included with the general areas:

- (a) Corrugated steel sheets..... 14%
- (b) Corrugated A.C. sheets..... 20%
- (c) Semi corrugated A.C. Sheets..... 10%
- (d) Nainital pattern roof (Plain sheeting sheets)..... 10%
- (e) Naintial pattern roof (with corrugated sheets)..... 25%

3.7. Cornices and other wall features, when they are not picked out in a different finish/colour shall be girthed and included in the general area.

3.8. The rate shall include the cost of ail materials, labour, scaffolding, protective measures etc. involved in all the operations described above.

3.9. The rate shall be for a unit of One sq. meter.

18.12. **White washing with lime on decorated wall surface (One coat) to give an even shade including thoroughly brooming in the surface to remove dust, mortar, drops and loose scales of lime wash and other foreign matter.**

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.11 shall be followed except that the white washing work shall be carried out on decorated wall surface single coat.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 18.11 shall be followed.

2.2. The rate shall be for a unit of One sq. meter

18.13 **Extra over items 18.11 and 18.12 for every subsequent coat of white washing with lime on wall surfaces.**

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.11 shall be followed except that this work is for extra coat over and above two coats on wall surface.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.11 shall be followed except that the payment of subsequent coat shall be made extra over and above the item No. 18.11 for every subsequent coat applied.

2.2. The rate shall be for a unit of One sq. meter.

18.14. Extra over item 18.11 for white washing with the lime on ceiling and / or sloping roof.**1.0. Materials and Workmanship**

1.1. The relevant specifications of item No. 18.11 above shall be followed except that this work is for ceiling and / or sloping roof.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.11 shall be followed except that extra payment for white washing on ceiling and/or sloping roof shall be made over and above the payment of item No. 18.11

2.2. The rate shall be for a unit of One sq. meter.

18.15 Extra over 18.12 for white washing with lime on decorated dealings and sloping roofs.**1.0. Materials and Workmanship**

1.1. The relevant specifications of item No. 18.12 shall be followed except that the white washing work shall be carried out on decorated ceilings and/or sloping roofs.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.52 shall be followed except that extra payment for white washing on ceiling and/or sloping roof shall be made over and above the payment of item No. 18.12.

2.2. The rate shall be for a unit of one sq. meter.

18.16. Extra over the item No. 18.13 for every subsequent coat of white washing with lime on ceiling and /or sloping roofs.**1.0. Materials and Workmanship**

1.1. The relevant specifications of item No. 18.11 and 18.13 shall be followed except that this work is for extra coat over and above two coats of ceiling and / or sloping roofs.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.11 and 18. 13 shall be followed except that the extra payment for white washing shall be made for sloping roof or/and ceiling for every subsequent coat applied over and above item 18.11 and 18.13.

2.2. The rate shall be for a unit of one sq. meter.

18.17. Colour washing with lime on undecorated wall surfaces (Two coats) over and including priming coat of white washing to give even shade including thoroughly brooming the surface to remove all dirt, dust, mortar drops and other foreign matter. The relevant specifications for the materials and workmanship 18.11 shall be followed except that it shall be for colour wash.**1.0. Materials**

1.1. Clear-Cole : This shall be made from glue and boiling water by mixing 1 kg. of glue to every 15 liters of water. The mixing shall be suitably tinted to match with colour of colour washing as directed. Glue shall conform to I.S. 852-1969.

1.2. Lime : Lime used shall be freshly burnt class 'C' lime (Fat lime) and white in colour conforming to I.S. 712-1973.

1.3. Water : Water shall conform to M-1.

1.4. Gum ; Best quality of gum shall be used in the preparation of white or colour wash. The colour pigment of required tint and shade shall be mixed in lime cream. The mineral colour not affected by lime shall be used in preparing the colour wash.

2.0. Workmanship

2.1. Sufficient quantity of colour wash enough for the complete job shall be prepared in one operation to avoid any difference in shade. The basic white wash solution shall be prepared in accordance with item 18.11 Mineral colours not affected by lime shall be added to the white wash solution. No colour wash shall be done until a sample of the colour has been approved. It shall be noted that small samples of colour appears lighter in shade than when the same shades are applied precisely to large surface. The colour shall

be of event, tint, over the colour shall be of event tint, over the whole surface. If it is patchy or otherwise badly applied, it shall be rejected. Preparation of the colour wash with pigment shall be as under:

(a) With Yellow and Red Ocher :

Solid lumps if any in the powder shall be crushed to powder and solution in water prepared and then added to white wash sieving it through a coarse cloth, mixed evenly and thoroughly to white wash in-small quantities till required shade is obtained.

(b) With Blue Vitriol :

Fresh crystals of hydrous copper sulfate (i.e. vitriol) shall be ground to fine power and dissolved in small quantity of water. Sufficient quantity of solution enough to produce the colour wash of required shade shall be strained through a clean cloth, the filtrate being mixed evenly and thoroughly to the white wash.

(c) Colour wash from other colouring pigment shall be prepared in accordance with the instructions of the manufacturer.

2.2. Preparation of Surface :

The surface shall be prepared by removing mortar dropping and foreign matter and thoroughly cleaned with wire of fiber brush or any other suitable means as directed by the Engineer-in-charge. All loose pieces and scales shall be scrapped off and holes filled with mortar.

2.2.1. For scaffoldings and application of colour wash, relevant specification of item No. 18.11. above shall be followed. The colour wash shall be applied as under:

The colour wash shall be applied in accordance with the procedure given in item No. 18.11. "Application of white wash for colour washing on undercoated surface after the surface has been prepared. The first primary coat shall be of white wash and subsequent coats (minimum two) shall be colour wash and the entire surface shall represent a smooth and uniform finish. To start with, patch of 0.1 sq. mt. on prepared surface shall be colour washed with first coat of white wash and subsequent coats of colour wash solution entire work of colour washing is taken up in hand, it shall be noted that small areas of colour wash will appear lighter than when the same shade is applied to the large surface.

2.2.2. For colour washing on decorated surfaces, after (he surface has been prepared, a coat of white wash shall be applied for the patches and repairs. Then one coat or more of colour wash shall be applied over the entire surface, such that the colour washed surface shall present a uniform colour shade. No primary coat is needed for a decorated surface bearing colour of same shade on surface required change of colour after the surface has been prepared as described above. Two coats of white wash shall be applied before application of specified number (minimum two) of coats of colour wash of the new shade.

2.3. Protective measure :

The surface of doors, windows, floors, articles, of furniture etc. and such other parts of the building not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white wash splashed if any.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 18 11 shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

18.18. Colour washing with lime on decorated wall surfaces (one coat) to give even shade including thoroughly brooming the surface to remove all dirt, dust, mortar drops and loose scales of lime wash and other foreign matter.

1.0. Materials and Workmanship

The relevant specifications item No 18.17 shall be followed except that the colour washing shall be carried out on decorated wall surface in one coat

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No 18.7 shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

18.19. Extra over item No 13.17 and 18.18 for every subsequent coat of colour wash with lime on wall surfaces.

1.0 Materials and Workmanship

1.1 The relevant specifications item No. 18.17 shall be followed except that this work is for extra coat of colour wash over and above two coats on wall surface.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 18.17 shall be followed except that the extra payment for every subsequent coat of white wash shall be made over and above the rate of item. 18.17 and 18.18.

2.2. The rate shall be for a unit of one sq. meter.

18.20. Extra over item 18.17 for colour washing on ceilings and /or sloping roofs.**1.0. Materials and workmanship**

1.1. The relevant specifications of item No. 18.17 shall be followed except that this work is for colour washing on ceiling and/or sloping roofs.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.17 shall be followed except that the-rate shall be paid extra over and above the rate of item No. 18.17 for providing colour washing on ceiling and /or sloping roof.

2.2. The rate shall be for a unit of One sq. meter.

18.29. Cement washing with port land cement slurry on undecorated wall surfaces, (one coat) to give a smooth finish including thoroughly brooming the surface to remove all dirt, dust, mortar drops and other foreign matter.**1.0. Materials**

1.1. Water shall conform to M-1. Part land cement shall conform to M-3.

2.0. Workmanship

2.1. The relevant specification of item No. 18.11 for preparation of surface, scaffolding, application of wash etc. shall be followed except that the cement wash shall be applied, instead of white wash. Cement applied with brushes to form a smooth bodied opaque surface.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 18.11 shall be followed.

3.2. The rate shall be for a unit of one sq. meter.

18.30. Extra over item No. 18.29 for every subsequent coat of cement washing with port land cement slurry.**1.0. Materials Workmanship**

1.1. The relevant specifications of item No. 18.29 shall be followed except that the work of cement slurry wash shall be provided for every subsequent coat above item No. 18.29 to be applied.

2.0. Mode of measurements and payment

2.1. The relevant specification of item No. 18.29 shall be followed except that the extra rate shall be paid for every subsequent coat and above the rate of item No. 18.29.

2.2. The rate shall for a unit of One sq. meter.

18.33. Removing dry or oil bound distemper by washing scraping and sand papering the wall surface smooth including necessary repairs to scratches complete.**1.0. Materials and Workmanship**

1.1. All loose places and scaled shall be removed by sand papering and surface shall be cleared of all greasycay, dust, dirt, etc. on decorated wall surfaces. Where heavy scaling has taken place, the entire surface shall be scrapped by means of steel scrappers so as to remove all accumulated distemper, leaving clean surfaces. Necessary repairs to the scratches shall be made as directed.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.11. shall be followed.

2.2. The rate shall be for a unit of One sq. meter,

13.34. Extra over item No. 18.33. for removing dry oil bound distemper on ceiling and sloping and roofs.**1.0. Workmanship**

1.1. The relevant specifications of item No. 18.33 shall be followed except that removing dry/oil bound distemper from sloping roof/ceiling is to be carried out.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.33 shall be followed except that the payment shall be made for removing dry/oil bound distemper from ceiling/sloping roof over and above the rate of item No. 18.33.

2.2. The rate shall be for unit of one Sq. meter.

18.38. Distemping with dry (water bound) Distemper of approved brand and manufacture (two coats) and of required shade on undecorated wall surfaces to give an even shade, over and including a priming coat of white washing after thoroughly brooming the surface free from mortar droppings and other foreign matters.

1.0. Materials

1.1. The dry distemper and primer shall be of approved brand and manufacture. The dry distemper shall be of required colour and shade and the same shall conform to I.S. 427-1965. Writing shall conform to I.S. 63-1964.

2.0. Workmanship

2.1. Scaffolding : Where scaffolding is required it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be distemped. A properly secured strong and well tied suspended platform (Joolas) may be used for distemping. Where ladders are used- pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. \For distemping to ceiling, proper stage scaffolding shall be erected where necessary.

2.2. Preparation of Surface.

2.2.1. The undecorated surface to be distemped shall be thoroughly brushed free from dust, dirt, grease, mortar, droppings and other foreign matter and sand papered smooth. New plaster surface shall be allowed to dry at least 2 months before application of distemper.

2.2.2. All unnecessary nails shall be removed. Pitting in plaster shall be made good with plaster of Paris mixed with dry distemper of the colour to be used. The surface shall then be rubbed down again with a fine grades and paper and made smooth. The surface affected by moulds, moss, fang, algae lichens, efflorescence etc. shall be treated in accordance with I.S. 2395 (Part-I) 1966 before applying distemper. Any unevenness shall be made good by applying putty made of plaster of Paris mixed with water on entire surface including filling up the undulations and then sand papering the same after it is dry.

2.3. Priming coat :

2.3.1. A priming coat of whitening shall be applied as per item No. 18.11 over the prepared surface in case of new work on undecorated surface. No coat of white washing with lime shall be used as a priming coat for distemper.

2.3.2. Application of plaster shall be done as under:

The primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical stokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours before oil bound distemper or paint is applied.

2.3.3. Distemper is not recommended to be applied within six months of the completion of wall plaster.

2.4. Proportion of Distemper : The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturers only. Sufficient quantity of distemper required for one day's work shall be prepared.

2.5. Application of Distemper coat :

2.5.1. For undecorated surfaces after the primer coat is dried for at least 48 hours, the surfaces shall be lightly sand papered to make them smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed immediately by vertical strokes which together shall constitute one coat. The subsequent coats shall be applied after a time interval strokes which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit proper drying of the proceeding coat. The finished surface shall be even and uniform without patches, brush marks, distemper drops etc.

2.5.2. Sufficient quantity of distemper shall be mixed to finish on room at a time. The application of a coat in each room snail be finished in one operation and no work shall be started in any room which cannot be completed, on the same day.

2.5.3. 15 cm. double bristle distemper brush shall be used. After the day's work, brushes shall be thoroughly washed in hot water with soap solution and hang down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

2.6. Protective Measures : The surfaces of doors, windows, floors, articles of furniture etc. and such other parts of the building as are not to be distempered shall be a plashed form being splashed upon. Such surfaces shall be cleaned of distemper a plashes if any.

3.0. Mode of measurements and payment

3.1. Pruning coal of distemper primer, scraping of surface spoiled by smoke soot, removal of oil and grease spots, treatment for infraction of effloresces, mould moss, fungi, algae and lichens and patch repairs to plaster shall be included in this item for which nothing extra shall be paid.

3.2. All the work shall be measured net in the decimal system as in places subject to the following limits unless otherwise stated hereinafter:

(a) Dimensions shall be measured to the nearest 0.01 m.

(b) Area in individual items shall be worked out to the nearest 0.01 sq. m. All work shall be measured in sq. meter. No deductions shall be made for ends of joints, beams, posts, etc. of these openings nor for finish around the ends of joints, beams, posts etc.

3.3. Deductions of openings exceeding 0.5 sq.m. but not exceeding 3 sq. m. each shall be made as follows and no addition shall be made for reveal, jambs, soffits etc. of these openings:

(a) When both the faces of walls are provided with the same finish deductions shall be made for one face only.

(b) When each face of wall is provided with different finish, deduction shall be made for that of frame for door, windows etc. on which width of reveal is less than that of the other side but no deductions shall be made on the other side. Where the width of reveals on the both the faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of finish.

(c) When only one face of wall is treated and the other face is not treated, full deductions shall be made if the width of the reveal on treated side is less than that on untreated side but if the width of the reveals is equal or more than that of untreated side neither deductions nor additions to be made for reveals, jambs, sills and soffits shall be measured

3.4. In case of openings of area exceeding 3 sq.m. each, deduction shall be made for openings, but jambs, sills and soffits shall be measured.

3.5. No deductions shall be made for attachments such as casing, conduits, pipes, electric wiring and the like.

3.6. Item includes removing nails, making good holes, cracks, patches with materials similar in composition to the distemper.

3.7. The rate includes cost of all materials, labour, scaffolding, protective measures etc. involved in all the operations described above This shall also include conveyance, delivery, bundling, unloading storing etc.

3.8. The rate shall be for a unit of One sq. meter.

18.39. Distemping with dry (wafer bound) distemper of approved brand and manufacture (one coat) and of required shade, on decorative wall surface to give an even shade after thoroughly brushing the surface clean of all grease dirt, loose pieces of scales including preparing the surfaces and even sand papered smooth.

1.0. Materials and workmanship

The relevant specifications of Kern No. 18,38 shall be followed except that the dry distemper shall applied on decorative wall surface in on coat.

2.0. Mode of measurements and payment

2.2. The rate shall be for a unit of One sq. meter.

18.40. Extra over item 38 and 39 for every subsequent coat of distemper with dry distemper of approved brand and manufacture.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.38 shall be followed except that the extra work for applying subsequent coat of dry distemper is to be carried out over and above the work of item No. 18.38 and 18.39.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.38 shall be followed except that extra rate shall be paid for every subsequent coat applied over and above the rate of item No. 18.38 and 18.39.

2.2. The rate shall be for a unit of One sq. meter.

18.41. Extra over item 38 for distempering with dry distemper on ceiling and sloping roofs.**1.0. Materials and workmanship**

1.1. The relevant specifications of item No. 18.38 shall be followed except that the dry distempering shall be carried out on ceiling and sloping roofs of undercoats surface.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 18.38 shall be followed except that extra rate shall be paid for carrying outwork on ceiling/sloping roof on undecorated surface over and above the rate of item 18.38.

2.2. The rate shall be for a unit of One sq. meter.

18.42. Extra over item 39 and 40 for distempering with dry distemper on ceiling/sloping roofs.**1.0. Materials and Workmanship**

1.1. The relevant specifications of item No. 18.39 shall be followed except that the work shall be carried out on ceiling/sloping roofs on decorated surfaces.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.39 shall be followed except that the extra rate shall be paid for the distempering work carried out by dry distempered on ceiling/sloping roofs with decorated surfaces over and above the rate of item N. 18.39.

2.2. The rate shall be for a unit of One sq. meter.

18.44. Distempering (two coats) with oil bound distemper of approved brand and manufacture and of required shade on undecorated wall surfaces to give an even shade, over and including a priming coat with distemper primer of approved brand and manufacture after thoroughly brushing the surface free from mortar droppings and other foreign matter and also including preparing the surface even and sand papered smooth.**1.0. Materials**

1.1. Oil bound washable distemper and primer shall be of approved brand and manufacture. The distemper shall be of required colour and shade and the same shall conform to I.S. : 428-1969.

2.0. Workmanship**2.1. Scaffolding**

Where scaffolding is required, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be distempered. A properly secured and well tied suspended platform (Joola) may be used for distempering. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. For distempering to ceiling, proper stage scaffolding shall be erected where necessary.

2.2. Preparation of surface :

2.2.1. The undecorated surface to be distempered shall be thoroughly brushed from dust, dirt, grease, mortar dropping and other foreign matter and sand papered smooth. New plaster surface shall be allowed to dry for at least 2 months before applications of distemper.

2.2.2. All unnecessary nails shall be removed. Pitting in plaster shall be made good with plaster again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of distemper is allowed. The surface affected by moulds, moss, fungi, algae lichens, efflorescence etc. shall be treated in accordance with I.S; 2395 (Part 01) 1966. Before applying distempering, any unevenness shall be made good by applying putty made of plaster of paris mixed with water on entire surface including filling up the undulation and then sand papering the same after it is dry.

2.3. Priming coat :

2.3.1. A priming coat of distemper primer of approved manufacture and shade shall be applied over the papered surface in case of new work on undecorated surface. If the distemper priming is done after the wall surface dries completely, the distemper primer shall be applied.

2.3.2. Application of primer shall be done as under: The primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours before oil bound distemper or paint is applied.

2.3.3. Oil bound distemper is not recommended to be applied within six months of the completion of wall plaster.

2.4. Preparation of oil bound distemper :

2.4.1. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer only. Sufficient quantity of distemper required for a days work shall be prepared.

2.5. Application of Distemper coat:

2.5.1. For undecorated surfaces, after the primer coat is dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out priming coat. All loose particles shall be dusted off after rubbing. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed immediately by vertical strokes which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit proper drying of the preceding coat. The finished surface shall be even and uniform without patches, brush marks, distemper drops etc.

2.5.2. Sufficient quantity of distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room which cannot be completed on the same day.

2.5.3. 15 cm. double bristled distemper brush shall be used. After day's work brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

2.6. Protective measurements : The surfaces of doors, windows, floors, articles of furniture etc. and such other parts of the buildings as are not to be distempered shall be protected from being splashed upon. Such surfaces shall be cleaned of distemper splashes if any.

3.0. Mode of measurements and payment

3.1. Priming coat of distemper primer, scraping of surface spoiled by struck roots, removal of oil and grease spots, treatment for infraction of effloresces., mould moss, fungi, algae and lichen and patch repairs to plaster shall be included in this item for which nothing extra shall be paid.

3.2. All the work shall be measured net in the decimal system as in place subject to the following limits unless otherwise stated hereinafter:

(a) Dimensions shall be measured to the nearest 0.01 m.

(b) Area in individual items shall be worked out to the nearest 0.01 sq. m. All work shall be made for ends of joints, beams, posts etc., and openings, not exceeding 0.5 sq.mt. each and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings not for finish around ends of joints, beams, posts etc.

3.3. Deductions of opening exceeding 0.5 sq.m. but not exceeding 3 sq. m. each shall be made as follows and net addition shall be made for reveals, jambs, soffits etc. of these openings :

(a) When both the faces of wall are provided with same finish, deductions shall be made for one face only.

(b) When each face of wall is provided with different finish, deduction shall be made for that side of frame for doors, windows etc. on which width of reveals is less than that of the other side but no deduction shall be made on the other side. Where the width of reveals on the both the faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of finish.

(c) When only one face of wall is treated and the other face is not treated, full deductions shall be made if the width of the reveal on treated side is less than that on untreated side but if the width of the reveal is equal or more than that on untreated side neither deductions nor additions to be made for reveals, jambs, soffits, sills etc.

3.4. In case of opening of area exceeding 3 sq. m. each deduction shall be made for openings but jambs, sills and soffits shall be measured.

- 3.5. No deductions shall be made for attachments such as casings, conduits, pipes, electric wiring and the like.
- 3.6. Item includes removing nails, making good holes, patches with materials similar in composition of distemper.
- 3.7. The rate includes cost of ail materials, labours, scaffolding, protective measures etc. involved in all the operations described above. This shall also include conveyance, delivery, handing , unloading, storing work etc
- 2.8. The rate shall be for a unit of one sq. meter
- 18.45. Distemping (two coats) with oil bound washable distemper of approved brand and manufacture and of shade required on undecorated wall surfaces to give an even shade, over and including a priming coat with alkali resistance primer of approved brand and manufacture after thoroughly brushing the surface free from mortar droppings and other foreign matter and also including preparing the surface even and sand papered smooth.**
- 1.0. Materials and Workmanship**
- 1.1. The relevant specifications of item No. 13.44 shall be followed except that the primer of alkali resistance primer of approved brand and manufacture shall be used instead of distemper primer.
- 2.0. Mode of measurements and payment**
- 2.1. The mode of measurements and payment shall be the same as for item No. 18.44 above.
- 2.2. The rate shall be for a unit of one sq. meter.
- 18.46. Distemping (one coat) with oil bound washable distemper of approved brand of required shade on decorated wall surfaces to give an even shade after thoroughly brushing the surfaces clean of all grease, dirt, loose pieces of scales and also including distemping with oil bound washable distemper of preparing the surface even and smooth.**
- 1.0. Materials and Workmanship**
- The relevant specifications of item No. 18.44 shall be followed except that the distemping with oil bound washable distemper shall be carried out on decorated wall surfaces in on coat.
- 2.0. Mode of measurement and payment**
- 2.1. The relevant specification of item No. 18.44 shall he followed.
- 2.2. The rate shall be for a unit of one sq meter.
- 18.47. Extra over item 18.44 to 18.46 for every subsequent coat of distemping with oil bound washable distemper of approved brand and manufacture.**
- 1.0. Materials and Workmanship**
- 1.1. The relevant specifications of item No. 18 44 shall be followed except that this work is for providing extra coat of oil bound distemping over and above two coats of distemping.
- 2.0. Mode of measurements and payment**
- 2.1. The relevant specification of item No, IS K shall be followed except that the extra rate shall be paid over and above the rate for every subsequent coats over two coats of item 18.44 and 18.46.
- 2.2. The rate shall be for a unit of one sq. meter.
- 18.48. Extra over item 18.44. and 18.45 for distemping with oil bound washable distemper on ceiling and sloping roofs.**
- 1.0. Materials and Workmanship**
- The relevant specifications of item No. 18.44 shall be followed except that the distemping shall be carried out on ceiling/sloping roofs.
- 2.0. Mode of measurements and payment**
- 2.1.1. The relevant specifications of item No. 18.44 shall be followed except that the extra rate shall be paid for carrying our distemping work on ceiling/sloping roofs over and above the rate of item No. 18.44 and 18.45.
- 2.2. The rate shall be for a unit of one sq. meter.
- 18.49. Extra over item 18.46 and 18.47 for every subsequent coat of distemping on ceiling and sloping roofs.**

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.44 shall be followed except that the distempering work shall be carried out for subsequent coats over item No. 18.46 and 18.47.

2.0. Mode of measurements and payments

2.1. The relevant specifications of item No. 18.46 shall be followed except that the extra rate shall be paid for every subsequent coat of distemper applied over and above the rate of item No. 18.46 and 18.47.

18.51. Finishing wall with water proofing cement paint of an undecorated wall surfaces (two coats) to give an approved brand and manufacture and of required shape, even shade after thoroughly brushing the surface to remove.

1.0. Materials

1.1. The water shall conform to M-1. Cement water proofing paint shall conform to I.S. 5410-1969.

2.0. Workmanship

2.1. **Scaffolding** : The relevant, specifications of item No. 18.11 shall be followed.

2.2. Preparation of surface :

The relevant specifications of item No. 18.11 shall be followed except that the word white wash colour wash shall be substituted with water proofing cement paint. The surface shall be thoroughly wetted with clean water before cement water proofing paint is applied.

2.3. **Preparation of paint:** Portland cement paint shall be prepared by adding paint powder to water and stirring to obtain a thick paste, which shall then be diluted to a brush able consistency. Generally, equal volumes of paint powder and water make a satisfactory paint. In all cases, The manufacture's instructions shall Site followed. The paint shall be mixed in such quantities as can used up within an hour of mixing as otherwise the mixture will set and thickness, affecting flowing and finish. The lids of cement paint drums shall be kept tightly when not in use.

2.4. Application of Paint:

2.4.1. No painting shall be done when the paint is-likely to be exposed to a temperature of below 7⁰ c within 48 hours after application.

2.4.2. When weather conditions are such as to cause be carried out in the shadow as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

2.4.3. To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.

2.4.4. For undecorated surfaces, the surface shall be treated with minimum two coats of water proof cement paint. Not less than 24 hours shall be allowed between two coats. Next coat shall not be started until the proceeding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather, the proceeding coat shall be slightly moistened before applying the subsequent coat.

2.4.5. The finished surface shall be even and uniform in shade, without patches, brush marks, paint drops etc.

2.4.6. The cement paint shall be applied with a brush with relatively short stiff hog or fiber bristles. The paint shall be brushed in uniform thickness and shall be free from excessively heavy brush marks. The lamps shall be brushed out.

2.4.7. Water proof cement paint shall not be applied on surface already treated with white wash, colour wash, distemper dry or oil bound varnishes, paint etc. It shall not be applied on gypsum, wood and metal surfaces.

2.5. **Curing** : Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the point has hardened so as not be damaged by the sprinkling of water say about 12 hours after the application.

2.6. Protection measures shall be taken as per item No. 18.11 Para 2.6.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 18.11. shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

18.53. Extra over item 18.51 for every subsequent coat of water proofing cement paint of approved brand and manufacture.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.51 shall be followed except that the work is for applying subsequent coat of cement water proofing paint.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.51 shall be followed except that the extra rate shall be paid for applying every subsequent coat of cement water proofing paint over and above the rate of item No. 18.51.

2.2. The rate shall be for a unit of One Sq. meter.

18.54. Extra over item 18.51 for finishing with cement paint on ceiling/sloping roofs.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.51 shall be followed except that the cement water proofing paint shall applied on ceiling and sloping roofs.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.51 shall be followed except the extra shall be paid for applying cement water proofing paint on ceiling and sloping roofs, over and above the rate of item No. 18.51.

2.2. The rate shall be for a unit of One sq. Meter.

18.56. Extra over 18.53 for every subsequent coat of finishing with cement paint on ceiling and sloping roofs.

1.0. Materials and Workmanship

1.1. The relevant specification of item No. 18.51 shall be followed except that the work shall be carried out for subsequent coat on ceiling and sloping roofs.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.53. shall be followed except that extra rate shall be paid for every subsequent coat applied with cement water proofing paint over and above the rate of item No. 18.53.

18.57. Wall painting (two coats) with plastic emulsion paint of approved brand of manufacture on undecorated wall surfaces to give an even shade including thoroughly brushing the surface free from mortar droppings and other foreign matter and sand paper smooth.

1.0. Materials

Water shall be conform M-1. The plastic emulsion shall conform to I.S.: 5411-1969 (part-I).

2.0. Workmanship

2.1. Scaffolding : The relevant specifications of item-No. 18.11 Para 2.1 shall be followed.

2.2. Preparation of surface : The relevant specification of item No. 18.44 Para 2.2 shall be followed.

2.3. Preparation of Mix :

This shall be done as per manufacture's instructions. The thinning of emulsion is to be done with water and not with turpentine. The quantity of thinner to be added shall be as per manufacturer instructions.

2.4. Application :

2.4.1. Before pouring into small containers for use, the paint shall be stirred thoroughly in item container. When applying also, the paint shall be continuously stirred in the smaller container, so that its consistency is kept uniform.

2.4.2. The paint shall be laid on evenly and smoothly by means of crossing and laying off the crossing and consist of covering the area over with paint, brushing the surface hard for the first time over and then, brushing alternately in opposite direction two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush Marks shall be left after the laying off is finished. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings, etc. shall be left on the work. The full process of crossing and laying off will constitute one coat.

2.4.3. The paint shall be applied with brush or rollers. For undecorated surfaces, the surface shall be treated with minimum two coats of cement water proofing paint. The second or subsequent coat shall not

be started until the proceeding coat as become sufficiently hard to resist marking by brushing being used.

2.4.4. The surface on finishing shall present a flat velvety smooth finish. It shall be even and uniform in shade without patches, brush marks, paint drops etc.

2.5. Precautions :

(a) Old brushes if they are to be used with emulsion paints, shall be completely dried of turpentine or oil paint by washing in warm soap water. Brushes shall be quickly washed in water immediately after use and kept immersed in water fusing break periods to prevent the paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base petals shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing or surfaces treated with emulsion paint shall not be done within 3 to 4 weeks of application

2.6. Protective payment : The relevant specifications of item No. 18.11 shall be followed.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 18.11 shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

18.59. Extra over item No. 18.57 for every subsequent coat of wall painting with plastic emulsion paint of approved brand.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.57 shall be followed except that the painting work shall be for subsequent coat of plastic emulsion paint.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.57 shall be followed except that the extra payment shall be done on ceiling and sloping roofs.

2.2. The rate shall be for a unit of One sq. meter.

18.60. Extra over item 18.57 for painting with plastic emulsion paint of approved brand on ceiling and sloping roofs.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.57 shall be followed except that the painting shall be done on ceiling and sloping roofs.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.57 shall be followed except that the extra payment shall be made for applying plastic emulsion paint on ceiling and sloping roofs over and the rate of item No. 18.57.

2.2. The rate shall be for a unit of One sq. meter.

18.62. Extra over item 18.59 for paint ceiling and sloping roofs.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 18.57 shall be followed except that the work for subsequent coat of plastic emulsion paint shall be carried out on ceiling and sloping roofs.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 18.57 shall be followed except that the extra rate shall be paid for carrying out painting on sloping roofs and ceiling with plastic emulsion paint over and above the rate of item No. 18.59

2.2. The rate shall be a unit of One sq. meter.

SECTION-19
Paintings & Polishing

19.7. Painting two coats (excluding priming coat) on new steel and other metal surfaces with enamel paint, brushing, interior to give an even shade including cleaning the surface of all dirt, dust and other foreign matter.

1.0. Materials

The enamel paint shall conform to M-44 B.

2.0. Workmanship

2.1. General : The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums; kegs. etc. with seal unbroken.

2.1.2. All materials not in actual use shall be kept properly protected, lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become state or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins. When not in use the containers shall be kept properly closed.

2.1.3. If for any reasons, things is necessary, the brand of thinner recommended by the manufacturer shall be used.

2.1.4. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed part o the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.

2.2. Application of paint:

2.2.1. Brushing operations are to be adjusted to the spreading capacity advised by the manufacture of particular paint. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the -laying off is finished. The full process of crossing and laying off will constitute one coat.

2.2.2. Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand-paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved from Engineer-in-charge before next coat is started.

2.2.3. Each coat the last shall be lightly rubbed down with sand paper of fine pumice stone and cleaned of dust before the next coat is applied. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work.

2.2.4. Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc. Approved best quality brushes shall be used.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 19.12 shall be followed for mode of measurements and payment. The rate is excluding priming coat.

3.4. The rate shall be for a unit of One sq. meter.

19.15. Extra over item No. 19.7 and 19.11 for every subsequent coat of paint.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 19.7 shall be followed except that the work of painting shall be carried out for subsequent coat.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.7 shall be followed except that the extra rate shall be paid for every subsequent coat of paints applied over and above the rate of item No. 19.7 and 19.11.

2.2. The rate shall be for a unit of One sq. meter.

19.11. Painting one coats Excluding priming coat) on previously painted steel and other metal surface with enamel paint, brushing to give an even shade including cleaning the surface of all dirt, dust and other foreign matter.

1.0. Materials and Workmanship'

1.1. The relevant specification of item No 19.7 shall be followed except that painting shall be carried out in one coat with enamel paint on previously painted steel and metal surface.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No, 19.7 shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

19.12. Applying priming coat over new steel and other metal surfaces after and including preparing the surface by thoroughly cleaning oil, grease, dirt and other foreign matter and secured with brushes, fine steel, wool scrapers and sand paper, with ready mixed priming paint, brushing red lead.

1.0. Materials

1.1. The ready mixed primer, brushing red shall conform to I.S. 102-1962.

1.2. The thinner (linseed oil) shall conform to I.S. 75-1973. If for any reason, thinning is necessary in case of ready mix paint the brand of thinner recommended by manufacturer shall be used.

2.0. Workmanship

2.1. Preparation of surfaces : The surfaces painting shall be cleaned of all rust, scale, dirt and other foreign matter sticking to it with wire brushes, steel wool, scrapers, sand paper etc. This surface shall then be wiped finally with mineral turpentine which shall also remove grease and perspiration of hand marks. The surface shall then be allowed to dry.

2.2. Application of primer :

2.2.1. After the preparation of the surface, the priming coat shall be applied immediately. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer of the particular primer. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing alternately in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

2.2.2. During painting, every time, after the priming coat has been worked out of the brush bristles or after the brush has been unloaded, the bristles of the brush shall be opened up by striking the brush against portion of the unpainted surface with the end of the bristles, held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again in to a paint container. The primary coat shall be allowed to dry completely before painting is started.

2.2.3. No hair marks from the brush or clogging at paint puddles in the corner of panels angles of molding etc. shall be left on the work

2.2.4. Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

2.2.5. The container when not in use shall be kept close and free from air so that paint does not thicken and also shall be kept guarded from dust.

3.0. Mode of measurements & payment

3.1. The new steel and other metal surface shall be measured under this item.

3.2. All the work shall be measured net in the decimal system, as executed subject to the following limits unless otherwise stated hereinafter.

(a) Dimensions shall be measured to the nearest 0.01 meter.

(b) Areas shall be worked out to the nearest 0.01 sq. meter.

3.3. No deductions shall be made for openings not exceeding 0.5 sq. mt. each and no addition shall be made for painting to beddings, moldings, edges, jambs, soffits, sills etc. of such opening.

3.4. In case of fabricated structural steel and iron work, priming coat of paint shall be included with

frabation. In case of trusses if measured in sq. m. compound girders, stanchions, lattices, grader and similar work, actual area shall be measured in sq. m. and no extra shall be paid for painting on bolts heads, nuts, washers etc. No addition shall be made to 1 he weight calculated for the purpose of measurements of steel and iron works for paint applied on shop or at site.

3.5. The different surfaces shall be grouped into one general item, areas of uneven surfaces being converted into equivalent plain areas in accordance with the table given as per Annexure-II for payment.

3.6. The rate shall be for a unit of One sq. meter.

19.19. Painting two coats (excluding priming coat) on new steel and other metal surfaces with synthetic enamel paints, brushing to give an even shade including cleaning the surface of all dirt, dust and other foreign matter.

1.0. Materials

Synthetic enamel paint shall conform to I.S. 1932-1964.

2.0. Workmanship

2.1. The relevant specifications of item No. 19.7 shall be followed except that the painting shall be carried out with synthetic enamel paint.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 19.7 shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

19.21. Painting one coat (excluding priming coat) on previously painted steel and other metal surfaces with synthetic enamel paint brushing to give an even shade including cleaning the surface of all dirt, dust and other foreign matter.

1.0. Materials and Workmanship

2.1. The relevant specifications of item No. 19.19 shall be followed except that the painting shall be carried out on previously painted steel and other metal surfaces using synthetic enamel paint in one coat.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.19 shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

19.13. Extra over item No. 19.19 and 19.21 for every subsequent coat of paint.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 19.19 shall be followed except that the extra rate shall be paid for out for subsequent coat of point.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 19.19 shall be followed except-that the work shall be paid for applying subsequent coat of oil paint over and above the item No. 19.19 and 19.21.

19.50.(B) Painting two coat (excluding priming coat) on external of new rain water, soil, waste and vent pipe and fittings with ready mixed bituminous paint, brushing, black anticorrosive to give an even shade including cleaning of all dirt, dust and other foreign matter (75 mm. dia.)

1.0. Materials

1.1. Ready mixed bituminous pain shall conform to I.S. 158 : 1968.

2.0. Workmanship

2.1. The relevant specifications of item No. 19.7 shall be followed except that the paining work of external surfaces of 75 mm. dia rain water pipe, soil, waste, and vent pipe and fittings with ready mixed bituminous paint snail be earned out.

3.0. Mode of measurements and payment

3.1. The rate is excluding the cost o priming coat but including painting of all fittings coming in line.

3.2. The rate shall be for a unit of one running meter,

19.50.(C) Painting two coats (excluding priming coat) on external of rain water, soil, waste and vent pipe and fittings with ready mixed bituminous paint brushing black anticorrosive to give an even shade including cleaning off all dirt, dust and other foreign matter : 100 mm. dia.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 19.50 (B) shall be followed except that the pipes to be painted on is 100 mm. dia. meter.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 19.50(B) shall be followed. The rate is excluding the cost of priming coat but including cost of painting all fittings coming in line.

2.2. The rate shall be for a unit of one running meter.

19.59.(B) Applying priming coat over wood and wood based surfaces after and including preparing the surface by thoroughly oil, grease, dirt and other foreign matter, sand papering and knotting : Ready mixed paint, brushing wood primer pink.

1.0. Materials

1.1. The ready mixed paint, brushing, wood primer pink shall conform to I.S. 3536-1966

2.0. Workmanship**2.1. Preparation of Surfaces :**

2.2.1. AH wood work shall be dry and free from any foreign matter incidental to building operations. Nails shall be punched well below the surface to provide a film key for stopping. Moldings shall be carefully smoothed with abrasive paper and projecting fibers shall be removed. Flat portions shall be smoothed off with abrasive paper used across the grain prior to painting and with the grain prior to staining or if the wood is to be left in its natural colour, wood work which is to be stained may be smoothed by scraping instead of by glass papering if so required.

2.2.2. Any knots, resinous, streaks or bluefish sap wood that are not large enough to justify cutting out shall be treated with two coats of pure shellac knotting applied thinly and extended about 25 mm. beyond the actual area requiring treatment.

2.2. Application of primer :

2.2.1. The relevant specifications of item No. 19.12(A) shall be followed for application of primer.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 19.12 shall be followed except that work done on wood and wood based surfaces shall be paid under this item.

3.2. The rate shall be for a unit of One sq. meter.

19.59.(D) Applying priming coat over new wood and wood based surface after and including preparing the surface by thoroughly cleaning oil, grease, dirt and other forging matter sand papering and knotting : Ready mixed paint brushing priming, for enamel.

1.0. Materials

1.1. The ready mixed paint for brushing priming for enamels wood shall conform to I.S. 106-1962.

2.0. Workmanship

2.1. The relevant specifications of item No. 19.59 (B) shall be followed except that ready mixed paint brushing priming for enamel shall be used instead of ready mixed paint brushing wood primer pink.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 19.12 shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

19.62.(B) Extra over item 59.59 (B) for every subsequent coat of priming coat. Ready mix paint, brushing wood primer work.

1.0. Materials and workmanship

1..1. The relevant specifications of item No. 19.59 (B) shall be followed except that the painting work shall be carried out with ready mix paint instead of wood primer pink for subsequent coat.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.59 (B) shall be followed except that the extra rate shall be paid for every subsequent coat applied with Ready mix paint, brushing wood primer pink over and above the rate of item No. 19.59 (B).

19.62.(D) Extra over item No. 19.59 for every subsequent coat of priming coat ready mix paint brushing priming for enamel.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 19.59(D) shall be followed except that the painting work shall be carried out with ready mix paint brushing priming for enamel.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.59(D) shall be followed except that the extra rate shall be paid for every subsequent coats of priming coat with ready mixed paint, brushing priming for enamel.

2.2. The rate shall be for a unit of One sq. meter.

19.71. Painting two coats (excluding priming coat) on new wood and wood based surfaces with enamel paint interior to give an even shade including the surface off all dirt, dust and other foreign matter and papering and stopping.

1.0. Materials

1.1. The enamel paint shall conform to I.S. 133-1975.

2.0. Workmanship

2.1. The relevant specifications of 19.7 shall be followed for general and application of paint, except that the enamel paint shall be used for painting on new wood/wood based surfaces.

2.2. In painting doors and windows, the putty, round the glass panes also be painted but care shall be taken to see that no paint, stain etc. are left on the glass. Top of shutters and surfaces in similar hidden locations shall not be left out in painting.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 19.12 shall be followed, for mode of measurements and payments. The rate excludes cost of priming coat.

3.2. The rate shall be for a unit One sq. meter.

19.73. Painting one coat (excluding priming coat) on previously painted wood and wood based surfaces with enamel paint to give even shade including cleaning of all dirt, dust and other foreign matter.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 19.71 shall be followed except that the painting work shall be carried out on previously painted wood and wood based surfaces with enamel paint to give even shade in one coat.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.7t shall be followed

2.2. The rate shall be for a unit of One sq meter.

19.75. Extra over item 19.71 and 19.73 for every subsequent coat of paint.

1.0. Materials and Workmanship

1.1. The relevant specifications of item 19.71 shall be followed except that painting work shall be for subsequent coat with paint.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 13.71 shall be followed except that the extra rate shall be paid.

2.2. The rate shall be for a unit of One sq. meter.

19.77. Painting two coats (excluding priming coat) on new wood and wood based surfaces with ready mixed paint brushing, oil gloss, semi-gloss, to give an even shade including cleaning of all dust, dirt and other foreign matter sand papering and stopping.

1.0. Materials

The ready mixed paint shall conform to M-44. The ready mixed paint brushing gloss, semi-gloss shall conform to KS. 129-1962 and I.S. 117-1364.

2.0. Workmanship

2.1. The relevant specification of item 19.71 shall be followed for general and application of paint, except that ready mixed paint brushing, oil gloss and semi-gloss shall be used of approved colour and shade instead of enamel paint.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item 19.12 shall be followed for measurements and payment. The rate excludes cost of priming coat.

3.2. The rate shall be for a unit of One sq. meter.

19.84. Varnishing two coats (excluding priming coat) on new wood and wood based surfaces undercoating with flattening varnish and finishing coat with varnish to give an even surface cleared of all dirt, dust and sand papering so as to produce a smooth dry surface.

1.0. Materials

The varnish shall conform to I.S. 338-1962.

2.0. Mode of measurements & payment

2.1.1. The surface to be varnished shall be prepared to produce a smooth, dry neat surface. The previous coat of paint, if any shall be allowed to dry and rubbed down slightly whipped off and allowed to dry.

2.1.2. The operation of varnishing calls for careful attention to cleanliness. All dust and dirt shall be removed from the surface to be varnished and also from the neighborhood. If surfaces are dampened to avoid razing of dust, they shall be allowed to dry thoroughly before varnishing is commenced. Damp Exposure to extreme of heat or cold, or to a damp atmosphere will spoil the work.

2.1.3. In handling and applying varnish care should be taken to avoid forming forth or air bubbles. Brushes and containers shall be kept scrupulously clean.

2.2. Application

2.2.1. The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with a short light strokes to avoid froth in. It shall be allowed to flow out while the next section is being laid in. Excess varnish then be scrapped out of the brush and the first section be crossed, re crossed and the laid of lightly. Too much or too little varnish left on the surface will mar the appearance of the finish. The varnish, once it has begun to set, shall not be retouched. If a mistake is made, the varnish shall be removed and the work started afresh.

2.2.2. In case of two coats of varnish work, the first shall be hard drying, under coating or flattening varnish, this shall be allowed to dry hard and then be flattened down before applying the finishing coat. If two coats are applied, sufficient time shall be allowed between two coats.

2.2.3. When flat varnish is used for finishing a preparatory coat of hard drying under coating or flattening varnish shall be first applied and shall be allowed to harden thoroughly, It shall then be lightly rubbed down before the flat varnish is applied. Section of the work such as panels, shall be cut in clearly, so as to avoid any overlapping during applications, as this is likely to impart some measure, of gloss to partially dried area, worked up in lapping. On larger area the flat varnish shall be applied rapidly and the edges of each patch applied shall not be allowed to set but shall be followed up whilst in free working conditions-

3.0. Mode of measurements & payment

3.1. The relevant specifications of item 19.71 shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

13.86. Extra over item No. 19.84 for every subsequent coat of varnish.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No.19.84 shall be followed except that the work shall be for subsequent coat of varnishing.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item 19.84 shall be followed except that the extra rate shall be paid for every subsequent coat of varnishing done over and above the rate of item No. 19.84.

2.2. The rate shall be for a unit of One sq. meter.

19.87. Polishing with polish on new wood and wood based surface to give an even surface including cleaning the surface of all dirt, dust and sand papered smooth and including a coat of wood filler

1.0. Materials

1.1. The French polish required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials : (i) Chandra (ii) Shellac (ic) Pigment. The French polish so prepared shall conform to I.S. 348-1968.

2.0. Workmanship**2.1. Preparation of surface :**

2.1.1. All unevenness shall be rubbed down to smoothness with sand paper and the surface shall be well dusted. The proper in the wood shall be filled up with a filler made of a paste of whiting in water or methylated spirit (with a suitable pigment like burnt sienna or umber if required) : otherwise the French polish will get absorbed and a good gloss will be difficult to obtain.

2.2. Application

2.2.1. A pad of wooden cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil on the face of the pad may be added which shall facilitate this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh pieces of clean fine cloth, slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall present a uniform texture and high loose.

3.0. Mode of measurements and payment

3.1. The relevant specification of item 19.12 shall be followed for mode of measurements and payment.

3.2. The rate includes cost of wood filler etc. complete.

3.3. The rate shall be for a unit of One sq. meter.

19.88. Polishing with French polish on previously polished wood and wood based surface to give an even surface including cleaning the surface of all dirt, dust and sand papered smooth including a coat of wood filler.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 19.87 shall be followed that the French polish shall be applied on previously polished wood and wood based surface.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.87 shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

19.91. Applying wax polish on new Wood work and wood based surfaces with bees wax polish in proportion 2 : 1.5 : 1 : 0.5 (2 Bees Wax : 1.5 linseed oil: 1 Turpentine oil : 0.5 Varnish by weight) by give an surface including cleaning the surface of all dist, dust and sand papered smooth.

1.0. Materials

Bee's Wax shall conform to I.S. : 1504-1968. Linseed oil shall conform to I.S. : 75-1967. Turpentine shall conform to I.S. 83-1950. Varnish shall conform in I.S. 337-1952.

2.0. Workmanship**2.1. Preparation of bees wax :**

2.1.1. In case of, bees wax it shall be prepared locally with following specification.

2.1.2. Pure bees wax free from paraffin on strain adulterants shall be used. The polish shall be prepared from mixture of bees wax, linseed oil, turpentine, and varnish in proportion 2:1.5:1:0.5 by weight. The bees wax and boiled linseed oil shall be heated of a slow fire, when the wax is completely dissolved the mixture shall be cooled till it is just warm and turpentine and varnish added to it in the required proportions and entire mixture shall be well stirred.

2.2. Preparation of surfaces .

2.2.1. The surface to be waxed shall he prepared to produce a smooth, dry, matt surface. Previous coat of paint of stain if any shall be allowed to dry and be rubbed down lightly wiped off and allowed to dry ail dust and dirt shall be removed from the surface to waxed and also from the neighborhood. Damp atmosphere and draughts shall be avoided, for waxing, normal dry day snail be chosen.

2.3. Application :

2.3.1. The polish shall be applied evenly with clean soft pad of cotton cloth in such a w«y that the surface is completely and fully covered. The surface shall then be rubbed continuously for half an hour After well rubbing in one coat of wax polish, the work shall be covered with dust proof sheet. (Cloth for preventing dust falling on the work). Subsequent coat shall be applied after the surface is quite dry arid shall be rubbed off with soft flannel until the surface has assumed a uniform gloss and in dry showing no sign of Stickiness.

2.3.2. The final polish depends on the amount of rubbing which shall be continuous and with uniform pressure with frequent changes in the direction.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 19.12 shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

19.92. Applying wax polish on previous wax polished wood and wood based surfaces with bees wax polish in proportion of 2:1.5;1:0.5 (2 Bees wax 1.5 linseed oil : 1 Turpentine : 0.5 Varnish by weight) to give an even surface including cleaning the surface of all dirt, dust and sand papered smooth.

1.0. Materials and workmanship

1.1. The relevant specifications of item No. 19.91 shall be followed except that the wax polishing shall be carried out on previously wax polished wood and wood based surfaces with bees wax polish.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.91 shall be followed.

2.2. The rate shall be for a unit of One sq. meter.

19.98. Coat tarring two coats on new wood and wood based surfaces using 0.15 and 0.12 liters of coal tar per sq. m. in the first and second coat respectively to give an even shade including cleaning of all dirt, dust and other foreign matter ;

1.0. Material : The coal tar shall conform to I.S. 290-1961.

2.0. Workmanship

2.1. 200 cms. of unslaked lime shall be added to every liter of coal tar and heated till it begins to boil. It shall then be taken off the fire and kerosene oil added to it slowly the rate of 1 part kerosene oil and 6 parts or more parts of coal tar by volume and stirred thoroughly. The addition of lime is for preventing the tar from running.

2.2. Preparation of Surface :

2.2.1. The surface to be painted shall be allowed to dry sufficiently. Any existing fungus or mould growth shall be completely removed. All major cracks or defects in the plaster shall be cut out and made good. Before primer is applied holes and undulations shall be filled up with plaster of paris and rubbed smooth.

2.3. Application of paint:

2.3.1. The coal tar shall be applied as per relevant specifications of applying mixed paint item No. 19.7 except coal tarring is used instead of enamel paint.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 19.12 shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

19.119.(I) Writing letter of figures on any surface with black Japan paint (stops, commas, hyphens and the like not to be measured and paid for separately) : block (Letters/figures).

1.0. Materials

1.1. Ready mixed the black Japan paint shall conform to I.S. 341-1952.

2.0. Workmanship

2.1. The letters and figures shall be to the heights and widths as per approved drawings or as directed. These shall be stenciled or drawn in pencil and got approved before painting. They shall be of uniform size and finished neatly. The edges shall be straight or in pleasant smooth curves,

3.0. Mode of measurements and payment

3.1. Letters, figures and similar items etc. stops, commas, hyphens and the like shall be deemed to be included in the item. 9

3.2. The rate per cm. height of letter shall hold good irrespective of width of the letters of figures or the thickness of the lettering.

3.3. The rate shall be for a unit of per letter cm. height.

19.119(II) Writing letter of figure? on any surface with black Japan paint (stops, commas, hyphens and the like not to be measured and paid for separately ; Indian (Letters/figures).

1.0. Materials and Workmanship

The relevant specifications of item No. 19.119 (I) shall be followed except the writing of letter shall be Indian letters/figures.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.119 (I) shall be followed.

2.2. The rate shall be for a unit of per letter per cm. height.

19.126(1) Painting lines, dashes, arrows, letters etc. on roads, airfields and like in two coats with road marking paint, brushing including cleaning the surface of all dirt, dust and other foreign matter : Over 10 cms. in width.

1.0. Materials

1.1. The road marking paint shall conform to. I.S. 164-1951.

2.0. Workmanship

2.1. The relevant specifications item No. 19.119(1) shall be followed except that the painting lines, dashes, arrows and letters on roads, air fields and like shall be carried out with road marking paint in two coats : over 10 cms. in width.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 19.119 (I) shall be followed.

3.2. The rate shall be for a unit of One sq. meter.

19.126.(II) Painting lines, dashes, arrows, letters etc. on roads, fields and like in two coats with road marking paint brushing including cleaning the surface of all dirt, dust and other foreign matter: Up to 10 cms. in width.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 19.126 (I) shall be followed except that painting work shall be up to 10 cms. width.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.119 (I) shall be followed.

2.2. The rate shall be for a unit of one running meter.

19.127.(A) Painting lines, dashes, arrows letters etc. on roads, airfields, and like in one coat with road marking paint, brushing including cleaning the surface of all dirt, dust and other foreign matter : over 10 cms. in width.

1.0. Materials and workmanship

The relevant specifications of item No. 19.126(1) shall be followed except that the painting shall be done in one coat over 10 cms. in width.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item No. 19.126 (I) shall be followed.

2.2. The rate shall be for a unit of One Sq. meter.

19.127. (B) Painting lines, dashes, arrows, letters etc. on roads, air fields and like in one coat with road marking paint, brushing including cleaning the surface of all dirt, dust and other foreign matter : Up to 10 cms. in width.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 19.126 (I) shall be followed except that the painting shall be done in one coat upon 10 cms. in width.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 19.126 (I) shall be followed.

2.2. The rate shall be for a unit of one running meter.

SECTION-20
Demolition & Dismantling

20.1.(i) Demolition and disposal of unserviceable materials with all leads and lifts : Lime Concrete.

1.0. Workmanship

1.1. The demolition shall consist of demolition of one or more parts of the building as specified or shown in the drawings. Demolition implies taking up or down or breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown in the drawings.

1.2. The demolition shall always be planned before hand shall be done in reverse order to the one in which the structure was constructed. This scheme shall be got approved form the Engineer-in-charge before starting the work. This however will not absolve the contractor from the responsibility of proper and safe demolition.

1.3. Necessary propping, shoring and under pinning shall be provided for the safety of the adjoining work or property, which is to be left intact, before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining property.

1.4. Wherever required, temporary enclosures or partitions shall also be provided. Necessary precautions shall be taken to keep the dust nuisance down as and where necessary.

1.5. Dismantling shall be commenced in a systematic manner. All materials which are likely to be damaged by dropping from a height or demolishing roof, masonry etc. shall be carefully dismantled first. The dismantled articles shall be properly stacked as directed.

1.6. All materials obtained from demolition shall be the property of Government unless otherwise specified and shall be kept in safe custody until handed over to the Engineer-in-charge.

1.7. Any serviceable materials, obtained during dismantling or demolition shall be separated out and stacked properly as directed with all lead and lift. All unserviceable materials, rubbish etc., shall be stacked as directed' by the Engineer-in-charge.

1.8. On completion of work, the site shall be cleared of all debris rubbish and cleaned as directed.

2.0. Mode of measurements and payment

2.1. Measurements of all work except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed. The demolition of lime concrete shall be measured under this item. Specification for deduction for voids, openings etc. shall be on same basis as that employed for construction of work,

2.2. All work shall be measured in decimal system as fixed in its place subject to the following limits; unless otherwise stated hereinafter : (a) Dimensions shall be measured to the nearest 0.01 mt. (b) Area shall be worked out to the nearest 0.01 sq. mt.(c) Cubical contents shall be worked out to the nearest 0.01 Cu.m.

2.3. The rate shall include cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable materials properly and disposing the unserviceable materials with all lead and lift. The rate also includes for temporary shoring for the safety of the portion not required to be pulled down or of adjoining property and providing temporary enclosures or portions where considered necessary.

2.4. The rate shall be for a unit of one cubic meter.

20.1.(ii) Demolition and disposal of unserviceable materials with all leads and lifts : Un reinforced cement concrete.

1.0. Workmanship

The relevant specifications of item 20.1.(i) shall be followed except that the un reinforced cement concrete work is to be demolished instead of lime concrete.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 20.1(i) shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

20.3. Demolition including of serviceable materials and disposal of unserviceable materials with all leads and lifts : R.C.C. work.

1.0. Workmanship

1.1. The relevant specifications of item 20.1 (i) shall be followed except that demolition of R.C.C. work is to be done.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 20.(i) shall be followed except that the demolition of reinforced concrete structure is to be done. The unserviceable materials shall be disposed of at all leads and lifts. The rate excludes scraping straightening of reinforcement but includes cutting of reinforcement.

2.2. The rate shall be for a unit of one cubic meter.

20.11 (ii) Demolition of brick work and stone masonry including stacking of serviceable materials and disposal of unserviceable materials with all leads and lift : in lime mortar.**1.0. Workmanship**

1.1. The relevant specifications of item No. 20.1.(i) shall be followed except that demolition of brick or stone masonry in lime mortar is to be done.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 20.1(i) shall be followed except that the wall and independent piers or columns of brick or stone masonry shall be measured in cubic meters. All copings, corbels, combs and other projections shall be included with the wall measurements.

2.2. In measuring thickness of plastered walls, the thickness of plaster shall be included. The unserviceable materials shall be disposed off with all lead and lift. Ashlars face stones dressed stone etc., if required to be taken down intact shall be dismantled and measured separately in cubic meters.

2.3. The rate is exclusive of cleaning of bricks or stones. Honey comb works or hollow block walling shall be measured as solid.

2.4. The rate shall be for a unit of one cubic meter.

20.11. (iii) Demolition of brick work and stone masonry including stacking of serviceable materials and disposal of unserviceable materials with all leads and lift : in cement mortar.**1.0. Workmanship**

1.1. The relevant specifications of item 20.1.(i) shall be followed except demolition of brick or stone masonry in cement mortar is to be done.

2.0. Mode measurements and payment

2.1. The relevant specifications of item 20.11 (ii) shall be followed. The unserviceable materials shall be stacked as directed by Engineer-in-charge with all leads and lifts.

20.22. Demolition in terrace including stacking or serviceable materials and disposal of unserviceable materials with all lead and lift : Brick tiles covering.**1.0. Materials**

1.1. The relevant specifications of item No. 20.1 (i) shall be followed except that the demolition of terrace brick tiles is to be done.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 20.1(i) shall be followed except that the brick tiles covering of terrace shall be measured in sq. mt. The unserviceable materials shall be stacked as directed at all leads and lifts.

2.2. The rate shall be for a unit of one sq. meter.

20.23. Dismantling tiled or stone floors laid in mortar including stacking of serviceable materials and disposal of unserviceable materials with all lead and lifts.**1.0. Workmanship**

1.1. The relevant specification of item 20.1 (i) shall be followed except the dismantling of tiled or stone floors laid on mortar shall be done. Dismantling implies carefully taking up or down or removing without damage. The articles shall be passed by hand where necessary and lowered and where these are fixed by nail, screws, bolts etc., these shall be taken out with proper tools.

2.0. Mode of measurements and payment

2.1. The supporting materials such as joints, beams if any etc. shall be measured separately. The relevant specifications of item No. 20.1 (i) shall be followed, The rate shall include staking the unserviceable materials as directed with all lead and lift.

2.2. The rate shall be for a unit of one sq. meter.

20.25. Dismantling of wooden floors, including, stacking of serviceable materials and disposal of unserviceable materials with all lead and lifts.

1.0. Materials

1.1. The specifications of item 20.1(i) shall be followed except that wooden floors shall be dismantled.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 20.1 (i) same shall be followed. The supporting members such as joints, beams etc. shall be measured separately. The rate shall include disposal of unserviceable materials as directed for and with all lead and lift.

2.2. The rate shall be for a unit of one sq. meter.

20.27.(i) Dismantling of sheet including ridges, hips, valleys gutters etc. stacking of serviceable materials and disposal of unserviceable materials with leads with lifts : G.I. sheet roofing.**1.0. Materials**

1.1. The relevant specifications of item 20.1.(i) shall be followed except that G.I. sheet roofing shall be dismantled instead of concrete work.

2.0. Mode of measurements and payment

2.1. The area of G.I. sheets roofing shall be measured in sq. meter. Ridges, hips and valleys shall be girded and included with roof area. Corrugated and semi-corrugated surfaces shall be measured flat and not girthed.

2.2. Supporting members such as rafters, purlins, beams, joints, trusses etc. shall be measured separately.

2.3. The rate shall include disposal of unserviceable materials with all leads and lifts and stacking the serviceable materials as directed.

2.4. The rate shall be for a unit of one sq. meter.

20.27 (ii) Dismantling of sheet roofing including ridges, hips, valleys gutters etc. stacking of serviceable materials and disposal of unserviceable materials with all leads and lifts : A.C. Sheet roofing.**1.0. Workmanship**

1.1. The relevant specifications of item 20.27 (i) shall be followed except that dismantling work of A.C. sheet roofing is to be done.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item 20.27 (i) shall be followed except that the A.C. sheets .roofing shall be measured in this item.

2.2. The rate shall be for a unit of one sq. meter.

20.28. Dismantling Manglore or country tile roofing with battens, boarding etc. including stacking of serviceable materials and disposal of unserviceable materials with all lead and lifts.**1.0. Workmanship**

1.1. The relevant specifications of item 20.1 (i) shall be followed except that the country tile roof or Mangalore roof shall be dismantled.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 20.1 (1) shall be followed.

2.2. The supporting members shall be measured separate item.

2.3. The rate includes labour required for disposal of unserviceable item with ail leads and lifts.

2.4. The rate shall be for a unit of one sq. meter.

20.30. Dismantling cement asbestos/hard board in ceiling or partition walls, wooden trellis work including frames, stacking of to serviceable material and disposal of unserviceable materials with all leads and lifts.**1.0. Workmanship**

1.1. The relevant specifications of item 20.1 (i) shall be followed except that the cement asbestos hard board in ceiling or partition walls, wooden trellis, work etc. shall be dismantled.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 20.1 (i) shall be followed. The serviceable materials shall be stacked as and where directed and the unserviceable materials shall be disposed off with leads and lifts.

2.2. The rate shall be for a unit of one sq. meter.

20.35 Dismantling wood wrought, framed and fixed in frames, trusses including stacking the materials with all lead and lift.

1.0. Workmanship

1.1. The relevant specifications of item No. 20.1 (i) shall be followed except that the wood work, wrought framed and fixed in frames, trusses etc. shall be dismantled.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 20.1 (i) shall be followed.

2.2. The materials shall be stacked as and where directed with all leads and lifts.

2.3. The rate shall be for a unit of one cubic meter.

20.39. Dismantling expanded metal or I.R.C. fabric with necessary battens and beading including frame work and stacking the serviceable materials with all lead and lift.**1.0. Workmanship**

The relevant specifications of item No. 20.1 (i) shall be followed except that the dismantling of expanded metal or I.R.C. fabric shall be done

2.0. Mode of measurements & payment

2.1. The relevant specifications of in item No. 20.1 (i) shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

20.43. Dismantling steel work including dismembering and stacking the materials with air leads and lifts.**1.0. Materials**

1.1. The relevant specifications of item No. 20.1 (i) shall be followed except that the dismantling of steel work shall be carried out.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 20.1 (i) shall be followed.

2.2. The weight of the member shall be computed from standard table unless the actual weight can be readily determined.

2.3. Riveted works where rivets are required to be cut. the same shall be carried out under this item and nothing extra shall be paid.

2.4. In framed still gate, the weight of any covering material or filling such as iron sheets and expanded metal shall be added to the weight of the main articles if such covering is not ordered to be taken out separately.

2.5. The rate includes stacking the materials as and where directed with all leads and lifts.

2.6. The rate shall be for a unit of one Kg.

20.49.(i) Dismantling doors, windows, ventilators etc. (wood or steel) shutters including chowkhats, Architraves, hold fasts and other attachments etc. complete and stacking them within all leads & lift. No exceeding 3 sq. meters in area.**1.0. Workmanship**

The relevant specifications of item No. 20.1 (i) shall be followed except that the door, windows, ventilators etc. (wood or steel) shutters including chowkhats, architraves, hold fasts and other attachments etc. are to be dismantled.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 20.1 (i) shall be followed.

2.2. The doors, windows, ventilator etc. not exceeding 3 sq. mt. in area (each) including shutters and chowkhats. Architraves, hold fasts and other attachments to frames etc. will be dismantled and measured under this item.

2.3. The rate includes stacking the serviceable materials as and where directed with all leads and lifts.

2.4. The rate shall be for a unit of One number.

20.49.(II) Dismantling doors, windows, ventilators etc. (wood or steel) shutters including chowkhats. Architraves, hold fasts and other attachments etc. complete and stacking them within all leads and lift : Exceeding 3 sq. meters in area.**1.0. Workmanship**

The relevant specifications of item No. 20.49(I) shall be followed except that the area of doors, windows, ventilators, exceeding 3 sq. meters are to be dismantled under this item.

2.0. Mode of measurements of payment

2.1. The relevant specifications of item No. 20.49 (l) above shall be followed.

2.2. The rate shall be for a unit of One number.

20.51. Dismantling barber wire fencing including making rolls and also including dismantling facing posts including all earth work, concrete in the base and making good the disturbed ground stacking useful materials as directed and disposing all the unserviceable materials with all leads and lifts.

1.0. Workmanship

The relevant specifications of item No. 20.1 (i) shall be followed, except that the dismantling of barbed wire fencing shall be carried out.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 20.1. (i) shall be followed.

2.2. The rate includes making rolls of dismantled wires and including dismantling fencing posts, concrete work, in base and making good the disturbed ground etc. complete.

2.3. The serviceable materials shall be stacked as and where directed and end unserviceable materials shall be disposed with all leads and lifts.

2.4. The rate shall be for a unit of One running meter.

20.56. Dismantling (C.I. Pipes, G.S.W. Pipes and A.C. rain water pipes with fittings and clamps, including stacking the materials with all lead and lift, (for any dia. of pipe).

1.0. Workmanship

The relevant specifications of item No. 20.23 shall be followed except that the dismantling work of pipes lines of C.I., G.S.W. & A.C. Pipes with fitting shall be carried out.

2.0. Mode of measurements and payment

2.1. The relevant specifications of No. 20.1 (i) shall be followed.

2.2. Water pipe lines, including rain water pipes, with clamps and specials, swear pipe lines, (Salt glazed ware or concrete) etc. shall be measured in running meter inclusive of joints. (The measurements shall be taken along the centre line of pipe and fittings).

2.3. The rate shall be for a unit of One running meter.

20.00.1. Dismantling sanitary fittings like wash basin, W.C. Pan, Indian & European Type flushing tank, etc. including stacking the materials with all lead lift.

1.0. Workmanship

The relevant specifications of item No. 23.23 shall be followed except that the dismantling work of sanitary fittings such as wash basin, W.C. Pan (all type of pans), Flushing tanks etc. shall be carried out.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 20.1 (i) shall be followed.

2.2. The rate shall be for a unit of one number.

20.00.2. Scraping oil paint steel and other metal surfaces and making the surface even (with hand scraping).

1.0. Workmanship

The old paint from steel and other surface shall be scraped thoroughly with hand scraper followed by wire brushing (first with coarse and then with fine brushes) and finally sand papering with coarse and paper (No.3) steel wood (No.2) or emery paper (No.3) or with emery clothes. This shall then be wiped finally with mineral turpentine to remove grease and perspiration of hand marks etc. and allowed to dry. The surface shall be made even and smooth.

2.0. Mode of measurements and payment

2.1. The work shall be measured in actual area of work done.

2.2. The rate shall be for a unit of one sq. meter.

SECTION-21

Repairs to Buildings

21.8. Providing and fixing M.S. fan clamps of shape and size as specified in existing R.C.C. slab including cutting chase and making good.

1.0. Materials

1.1. M.S. Bar shall conform to M-18.

2.0. Workmanship

2.1. The shape and size of fan clamp shall be directed!

2.2. The fixing M.S. fan clamp in existing R.C.C. slab a chase of size 150 mm. x 75 mm. shall be cut from the ceiling so as to expose the reinforcement and up to 25 mm. clear round the reinforcement bar. This shall be done without any damage to adjoining portion of ceiling. The two arms of the ends of the clamp shall be passed through the space over reinforcement bar from the bottom of the slab. Then the two arms shall be bent down about 15 mm. by means of crow bar. The clamp shall be held in position and the chase in ceiling filled with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size). The ceiling shall be then finished to match the existing surface and properly cured.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all materials and labour required for satisfactory completion of this item as described above.

3.2. The rate shall be for a unit of One number.

21.23. Cutting our cracks, of roof terrace to V. section, Cleaning out, wetting, grouting with cement and sand slurry 1:3 (1 cement : 3 sand)

1.0. Materials

(1) Water shall conform to M-1. (2) Cement shall conform to M-3. (3) Sand shall conform to M-6.

2.0. Workmanship

2.1. The cracks shall be cleaned out and trimmed to V shaped cuts at least 6 mm wide on top. The cracks shall be cleaned off and then cracks shall be thoroughly flooded with water, water allowed to a soak in cracks, and then grouted with cement and sand slurry in proportion 1:3. The required cracks shall be cured at least 7 days.

3.0. Mode of measurements and payment

3.1. The rate shall includes cost of all materials and labour required for satisfactory completion of item as described above.

3.2. The rate shall be for a unit of One running meter.

21.24. Cutting out cracks of roof terrace to V-Section out, and filling solidly with a hot mixtures of bitumen and clean dry sand (1:1 weight).

1.0. Materials

(1) Bitumen shall be 85/25 penetration (2) Sand shall conform to M-6.

2.0. Workmanship

2.1. The relevant specifications of item No. 21.23 shall be followed for opening cracks and cleaning.

2.2. The cracks shall be absolutely dried and cleaned and filled solidly with a hot mixtures of 85/25 penetration and sand in ratio of 1; 1 by weight. The filler shall be well filled into cracks with the edges of a trowel and left flush with surface of roof. Repaired cracks shall cause no ridges the direction of the slope of roof.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 21.23 shall be followed.

3.2. The rate shall be for a unit of One running meter.

SECTION-22

Misc. Building Items

22.20. Providing and fixing 1.20 meter fencing with 2 meter long M.S. angle posts 40 mm. x 40 mm. x 6 mm. and oil painting 3 coats fixed at 2.5 M C/C with five horizontal lines, and two diagonals of galvanised steel barbed wire weighing 9.38 Kg. per 100 meter. (Min.) stained and fixed to posts with G.I. staples including fixing the posts in ground with 0.5 x 0.5 x 0.5 M block in C.C. 1:5:10 (cement : 5 sand : 10 graded brick aggregate 40 mm. nominal size) etc. complete.

1.0. Materials

(1) Water shall conform to M-1. (2) Cement shall conform to M-3. (3) Sand shall conform to M-6. (4) Brick bats aggregate shall conform to M-14, (5) Oil paint shall conform to M-44. (6) Barbed wire shall conform to M-78.

2.0. Workmanship

2.1. The pits of the size 0.5 x 0.5 m. x 0.5 shall first be excavated, true to line and level to receive the post at 2.5 C/ C. The relevant specifications of item 4.00.1 shall be followed for excavation work.

2.2. The pits shall be filled with a layer 0.15 m. thick with lean concrete 1:5:10 (1 cement: 5 sand : 10 graded brick bat aggregate 40 mm. nominal size). The M.S. angles 40 mm. x 40 mm. x6 mm shall be filled in with lean concrete 1:5:10 and rammed properly so as to form total 0.5 m. x 0.5 m. x 0.5 m, concrete block. The concrete shall be cured for 7 days to allow it to set.

2.3. The barbed wire shall be stretched and fixed in 5 horizontal rows and two diagonals. The bottom row shall be 140 mm. above ground and the rest at 125 mm. centre to centre. The diagonal shall be stretched between adjacent post from top wire of one post to the bottom wire of 2nd post. The wires shall be fixed to posts by means of staples. The M.S. Angle posts shall be painted with 3 coats of old paint of approved tint and shade.

3.0. Mode of measurements and payment

3.1. The work shall be measured for the finished work from centre to centre of the posts.

3.2. The rate shall include the cost of labour and materials involved in the operations described above.

3.3. The rate shall be for a unit of One running meter.

22.00.1. Construction of B.B. masonry paniara 23 cm x 75 mm wall including fixing pre cast R.C.C. marble Mosaic (Terrazzo) slab of 75 mm. thickness on top and smooth finishing to walls in cement plaster in C.M. 1:3 curing etc. complete including drainage out, waste water arrangements.

1.0. Materials

(1) Water shall conform to M-1. (2) Cement shall conform to M-3. (3) Sand shall conform to M-6. (4) Burnt bricks shall conform to M-15. (5) Pre cast marble mosaic terrazzo paniara of 75 mm thickness shall be of best quality. The width of paniara shall be directed.

2.0. Workmanship

2.1. The brick masonry shall be constructed for paniara for the size as directed in C.M. 1 :6. The thickness of wall shall be 23 cms. thick and height shall be 75 cms. The relevant specifications of B.B. masonry at item 6.13 (b) shall be followed for B.B. masonry work.

2.2. The B.B. masonry shall be covered with pre cast marble terrazzo paniara at top, of width and length as specified or as directed. The terrazzo mosaic paniara shall be T'S mm, thickness.

2.3. The whole masonry work shall be finished smooth with C.M. 1:3 on both sides the relevant specifications of item No. 1.7.59 (l) shall be followed.

2.4. The drainage outlet and water arrangement shall be made as directed.

3.0. Mod& of measurements and payment

3.1. The work shall be measured for the finished work.

3.2. The rate shall be include the cost of labour and materials involved in the operations described above.

3.3. The rate shall be for a unit of One Running meter.

22.00.2. Constructing a chowkadi with C.Q. over 12 cm. thick B.B. masonry in front and dwarf wall 1 M high and 23 cms. thick cement plaster to masonry in C.M. (1:3) and cement concrete flooring in 1:2:4 with 5 cm. dia. A.C. Drain pipe etc. complete

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Burnt bricks shall conform to M-15. Stone aggregate 20 mm. nominal size shall conform to M-2. (a) A.C. Drain pipe of 5 cms. dia shall conform to M-74.

2.0. Workmanship

2.1. The chowkadi shall be constructed of specified size and as directed. The slab shall be cast on B.B. masonry wall 12 cms. thick and dwarf wall 1 M high and 23 cms, thick shall be constructed in proportion of C.M. 1:6. The relevant specifications of item 6.3. (I) shall be followed for masonry partition work and 5.4.1. (c) shall be followed for reinforced concrete work.

2.2. The whole masonry work shall be finished with cement mortar 1:3 and finished smooth. The relevant specifications of item No. 17.59 (I) shall be followed for plastering work,.

2.3. The A.C. pipe of 5 cms. dia shall be fixed as drainage pipe. The bottom shall be finished with C.C. 1:2:4 finished with cement slurry.

3.0. Mode of measurements and payment

3.1. The work shall be measured for finished work.

3.2. The rate includes cost of all materials, labour etc. required for carrying out satisfactory completion of work.

3.3. The rate shall be for a unit of one square meter.

22.00.3.(I) Constructing cooking platform 60 cm. width and 70 cm. height resting on B.B. Masonry wall 23 cms. thick in C.M. 1:6 with fixing of pre cast 1:2:4. R.C.C. 0.0 M. thick slab with marble mosaic chips set in GM. (Terrazzo) with plastering on exposed faces to wall in C.M. 1:4 etc. complete.

1.0. Materials

Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Burnt brick shall conform to M-15. Marble Mosaic chips shall conform to M-46. Stone aggregate 20 mm. nominal size shall conform to M-12. (a) M.S. Bars shall conform to M-18.

2.0. Workmanship

2.1. The cooking platform of size as directed shall be constructed in 60 cms. width and 70 cms. height. The brick masonry wall, in C.M. 1 :6 shall be constructed in 23 cms. thickness up to full depth. The relevant specifications of item 6.13 (B) shall be followed for masonry work.

2.2. The R.C.C. slab of 8 cms. thickness and of adequate design and size shall be precast and the same shall be put up on the B.B. masonry work.

2.3. The top and exposed sides of the R.C.C. slab shall be finished with marble mosaic terrazzo 8 mm. thick with required colour pigment. The work of terrazzo shall be carried out as per relevant specifications of item 14.4 (E).

2.4. The whole masonry work shall be finished with cement mortar in C.M. 1 :4. The relevant specification of item 17.59 (II) shall be followed.

3.0. Mode of measurements and payments

3.1. The work of cooking platform shall be measured for finished work.

3.2. The rate includes cost of all labour and materials, etc. required for satisfactory completion of this item as described above.

3.3. The rate shall be for a unit of One running meter.

22.00.3.(II) Constructing cooking platform of 60 cm. width and 70 cms. height resting on B.B. masonry walls 23 cm thick in C.M. 1:1 with fixing black kadapa stone surface laid on pre cast R.C.C. slab 1:2:4 with plastering on exposed faces to wall in C.M. 1:4 etc. complete.

1.0. Materials and Workmanship

1.1. The relevant specification of item No. 22.00.3 (I) shall be followed except that the cooking platform shall be constructed by providing black kadapa stone of 25 mm. to 30 mm. thickness on pre cast R.C.C. 1:2:4 slab 8 cms. thick. The black stone shall be provided in single piece up to 1.8 M in length and specified width. All the exposed edges of stone shall be machine cut.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item 22.00.3.(I) shall be followed.

2.2. The rate includes providing machine cut edges on exposed face of kadapa stone.

2.3. The rate shall be for a unit of One running meter.

22.00.4. Providing and fixing Rajula stone 75 mm. thick 60 cm x 45 cms. size including fixing in cement mortar as directed.

1.0. Materials

Water shall conform to M-1. Cement mortar shall conform to M-11. Rajula stone of specified, size shall be of best quality and free from any defects. The stone shall not be less than 75 mm in thickness.

2.0. Workmanship

2.1. The Rajula stone of size 60 x 45 cms. size shall be fixed as and where directed in cement mortar in 1:3. All the edges of the stone shall be fixed with cement mortar in C.M. 1:3 and sloped at 45° and finished smooth. The work shall be cured for 7 days after fixing.

3.0. Mode of measurements and payment

3.1. The work shall be measured for finished work.

3.2. The rate includes cost of all labour and materials required for satisfactory completion of this item.

3.3. The rate shall be for a unit of one number.

22.00.5. Providing and laying Bilimora type brick facing in C.M. 1:1 laid over bedding of cement mortar 1:3 (13 mm. thickness) including cleaning, watering, scaffolding etc. complete.**1.0. Materials**

1.1. Water shall conform to M-1. Cement mortar of specified proportion shall conform to M-11. Bilimora type bricks shall be approved before collection the same on site.

2.0. Workmanship

2.1. The surface on which the Bilimora type bricks is to be provided shall be cleaned of all dust, dirt, etc. and finished with CM 1:3 in 13 mm, thickness. The relevant specifications of item 17.59 (I) shall be followed except that the thickness of finishing shall be 13 mm. The top surface shall be roughened by wire brushes to give proper grip to the tiles to be fixed.

2.2. The Bilimora type bricks shall be fixed with CM 1:1. The tiles shall be properly wetted before fixing. The horizontal and vertical joints shall be maintained in true line and level by providing 12 mm or 20 mm. sq. bars as directed. The tiles shall be tamped by trowel so that there shall not be any hollows left behind the tiles.

2.3. The tiles shall be cut to the required size on ends of at top bottom of beams in best workman like manner.

2.4. The whole work shall be cured for 7 days.

3.0. Mode of measurements and payment

3.1. The work shall be measured as per relevant specification of item No. 17.58(1)

3.2. The rate includes cost of all materials, wastage etc. occurring due to cutting of tiles and ends as top and bottom of beams etc. including base coat.

3.3. The rate shall be for unit of One sq. meter.

22.00.6. Providing and fixing teakwood rail of 60 mm. x 20 mm. size and 50 cms. length incl. 3 coats of oil paint to wood work with set of 3 pegs.

1.0. Materials : Teak wood battens of specified size shall conform to M-29. Oil paint shall conform to M-44. Wall pegs of aluminum 3 Nos. of approved quality and make shall be provided.

2.0. Workmanship

2.1. The teakwood battens of size 60 mm. x 20 mm. and 50 cms. long be planed on all sides. The anodized aluminum wall pegs of approved 'make shall be fixed on wooden batten prepared with screws as directed. The wall pegs unit shall be fixed on wall with wooden gut ties and screws as directed. The wooden battens shall be painted with 3 coats of ready mix paint of approved colour and shade.

3.0. Mode of measurements and payment

3.1. The work shall be measured for finished work.

3.2. The rate shall be for a unit of one number.

22.00.7. Treating the bottom and sides (up to a height of 300 mm.) of the excavations made for the masonry foundations and basement with chemical emulsion at the rate of 5 liters per Sq. meter of the surface area.

1.0. Materials : The chemicals used for the soil treatment shall be only one of the following with concentration shown against each in aqueous emulsion.

	Chemicals	Concentration
1.	Aldrin	0.50% (by weight)
2.	Heptachlor	0.50% (by weight)
3.	Chlordane	1.00% (by weight)

2.0. Workmanship

2.1. The chemicals barrier shall be complete and continuous under whole of the structure to be protected.

2.2. The bottom and the sides of foundations up to a height of 30 cms. from the bottom of excavation made for masonry foundation and for basement column pits shall be treated with the chemical emulsion at the rate 5 liters/ sq. meter of the surface area.

2.3. The chemical treatment shall be-carried out when the surfaces is quite dry. Chemical treatment shall not be carried out when it is raining or when the soil wet with rain or sub soil water.

2.4. Once formed, treated soil berries shall be not disturbed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuing and compactness of the barrier system

2.5. The treatment against termite infection shall remain fully effective for a period not less than 10 years from date of issue of the final certificate to completion of work. If at any time during this period, any defects in treatment are revealed or any evidence of infection in any part of the building or structure is noticed, the contractor shall be rectify the concerned defects within 14 days on receipt of notice from Engineer-in-charge. On contractor's failure to do so, the Engineer-in-charge may get the same rectified through any other agency at contractor's risk and cost, and decision of Engineer-in-charge as to the cost payable by contractor for the same shall be final and binding to the contractor.

2.6. A guarantee bond on appropriately stamped paper shall be given by the contractor to the department in the manner and form prescribed below:

FORM OF GUARANTEE BOND

I/We..... (Contractor) hereby guarantee that work will remain unaffected and will not be any way damaged by termite or any other germs of similar types, for a period for 10 years after completion of the work of anti-termite as per the terms and conditions of the contract and or damage that might be caused on account of termite and or other similar type of germs and hereby Guarantees to make good any loss of damages suffered by the Government of Gujarat and further guarantee to redo effective work without claiming any extra cost.

2.7. This guarantee shall remain in force for the period of 10 years from the completion of the work under the contract and it shall remain binding to the contractor for period of 10 years.

2.8. The deposit at the rate of 50% of the cost of this item from the running and final bills shall be recovered and retained for the first one year after completion of the work and 10% shall be retained for the balance of guarantee period and shall be refunded only after the completion of the guarantee period.

3.0. Mode of measurements & payment

3.1. The length and breadth shall be measured correct to a cm. as per the dimensions of sanctioned plans. No deduction shall be made nor extra paid for any opening for pipes etc. up to 0.1.sq. mt. The rate shall include the cost of all labour and materials required for the operation involved for satisfactory completion of this item. The sides of the trenches 30 cms, each side and bottom shall be measured under this item.

3.2. The rate shall be for a unit of One sq. meter.

22.00.8. Treating the backfill immediately in contact with foundation structure with chemical emulsion at the rate 7.5 liters per sq. mt. of vertical surface of the sub structure of each side (In case of R.C.C. columns, beams and R.C.C. basement walls, treating the sides of 50 cms. from ground level with chemical emulsion at the rate of 7.5 Liters/sq. meter).

1.0. Materials

1.1. The specifications of the item 22.00.7. shall be followed.

2.0. Workmanship

2.1. After masonry foundations and retaining walls of basement come up , the backfill immediate in contact with foundation shall be treated with the chemical emulsion at the rate of 7.5 liters per sq. m. of the vertical surface of the sub structure for each side. The filling of earth is usually carried out in layers and the treatment shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth contact with these surfaces is well treated with chemical.

2.2. In case of R.C.C. framed structure with columns and plinth beams and R.C.C. basements the treatments shall start at the depth of 50 cms. below ground level from this depth backfill around the columns, beams, and R.C.C. basement walls shall be treated at 7.5 lit/sq. m. of vertical surface. The relevant specifications shall be followed same as item 22.00.7.

3.0. Mode of measurements and payment

3.1. The area of substructure in contact with backfill to be measured. The length and breadth shall be measured correct to a cm. dimension of sanctioned plans for the surfaces in contact with backfill.

- 3.2. No deduction shall be made nor extra paid for any opening for pipes, etc. up to 0.1 sq. m.
- 3.3. The rate includes cost of all labour, materials required for satisfactory completion of this item.
- 3.4. The rate shall be for a unit of One sq. meter.,
- 22.00.9. Treating the top surface of the plinth filling with chemical emulsion at rate of 5 liters sq. meter, before the sand bed or sub grade is laid.**
- 1.0. **Materials** : The relevant specifications of item 22.00.7. shall be followed.
- 2.0. **Workmanship**
- 2.1. The relevant specifications of item 22.00.7 shall be followed that the top surface of the consolidated earth within the walls, shall be treated with the chemical emulsion at the rate of 5 liters/sq. metre of the surface before the sand bed or sub-grade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes up to 50 to 75 mm. deep at 150 mm. centers both ways may be made with 12 mm. dia. M.S. rod on the surface to facilitate absorption of the emulsion.
- 3.0. **Mode of measurements & payment**
- 3.1. The length and breadth shall be measured clear for the area actually treated.
- 3.2. No deduction shall be made nor extra paid for any opening for pipes, etc. up to 0.1 sq. m.
- 3.2. The rate shall be for a unit of One sq. meter.
- 22.00.10. Treating the junctions of wall and floor area with chemical emulsion at the rate of 7.5 liter/sq. mt. by making holes at junction of walls, and columns, with the floor before laying sub grade to a depth to 15 cms. by making holes.**
- 1.0. **Materials** : The relevant specifications of item 22.00.7 shall be followed,
- 2.0. **Workmanship**
- 2.1. The relevant specifications of item 22.00.7 shall be followed except that the junction of walls columns with floor shall be treated with the chemical emulsion at the rate 7.5 liters/sq. meter. Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surface from the ground level be taken to establish continuity of the vertical chemical barriers on inner wall surfaces from the ground level up to the level of filled earth surface. To achieve this, a small channel 3x3 cm. shall be made at the junctions of the wall and columns with floor (before laying the sub 2 grade) and rod holes made in the channels up to the ground level 15 cms. apart and the rod moved back ward and forward to breakup the earth an chemical emulsion poured along the channel at the rate of 7.5 liters per sq. m, of the vertical wall or column surfaces of sub-structures so as to soak the soil right to the bottom. The soil should be tamped back into place after this operation.
- 3.0. **Mode of measurements and payment**
- 3.1. The relevant specifications of the item 22,00.7. shall be followed.
- 3.2. The vertical area of sub-structure in contact with filled up earth above ground level to top filled up earth shall be measured for payment.
- 3.3. The rate shall be for a unit of One sq. meter.
- 22.00.11. Treating the earth along the external perimeter of the building by making holes 15 cms., apart up to a depth of 30 cms. with chemical emulsion at the rate of 7.5 liters per sq. meter along the wall.**
- 1.0. **Materials** : The relevant specification of item 22.00.7 shall be followed.
- 2.0. **Workmanship**
- 2.1. The relevant specifications of the item 22.00.7. shall be followed except that the external perimeter of the building shall be treated with chemical emulsions. After building is complete, the earth along the . external perimeter of the building should be treated at intervals of 15 cms. and to a depth of 30 cms. The rods shall be moved backward and forward parallel to the wall to breakup the earth and chemical emulsion poured along the wall at the rate of 7.5 liters per sq. meter of vertical surfaces. After the treatment the earth shall be tamped back into place the earth out side of the building should be graded on compaction of building, this treatment shall be carried out on the completion of such grading. In event of filling being more than 30 cms. the external perimeter and treatment shall be extended to the full depth of filling up to ground level so as to ensure continuity of the chemical barrier.
- 3.0. **Mode of measurements and payment**
- 3.1. The relevant specifications of item No. 22.00.7 shall be followed.
- 3.2. The vertical surfaces area so sub-structure 30 cms. in depth from finished ground level in external periphery only shall be measured and paid under this item. The depth of wall treated under back filled shall not be included in this item.

3.3. The rate shall be for a unit of One sq. meter.

22.0.12. Providing treatment along outside of foundation using chemical emulsion at 7.5 liters per sq. m. of vertical surface (for each side) of sub-structure.

1.0. **Materials** : The chemical used for the soil treatment shall be any one of the following with concentration shown against each in aqueous emulsion :

	Chemicals	Concentration
1.	Aldrin	0.50% (by weight)
2.	Heptachlor	0.50% (by weight)
3.	Chlordane	1.00% (by weight)

2.0. Workmanship

2.1. The surface of consolidated earth around the existing building shall be treated with chemical emulsion at the rate 7.5 liters/sq. m. of vertical surface of sub-structure. The minimum height to substructure shall be considered 60 cms. for treatment. If the earth along the perimeter does not allow emulsion to seep through, holes up to 300 mm. deep at 150 mm. centers both ways be made by 12 mm. dia. mild steel rod on the surface to facilitate saturation of the soil with chemical emulsion.

2.2. The chemical barrier shall be complete and continuous under whole on the structure to be protected.

2.3. The chemical treatment shall be carried out when the surface quite dry. Chemical treatment shall not be carried out when it is raining or when the soil is wet with rain or sub soil water.

3.0. Mode of measurements and payment

3.1. The length shall be measured along the periphery of the sub-structure. The depth shall be taken 0.60 m.

3.2. No deduction shall be made not extra paid for any opening for pipes etc. up to 0.1 sq. m.

3.3. The rate includes cost of all labour and material required for the operations involved for satisfactory completion of this item.

3.4. The rate shall be for a unit of One sq. meter.

22.0.13. Providing treatment along external wall perimeter below concrete or masonry apron using chemical at 5. lit/linear including drilling and plugging etc.

1.0. **Materials** : The relevant specifications of item No. 22.0.12 shall be followed.

2.0. Workmanship

2.1. The relevant specification of item No. 22.0.12 shall be followed except that the treatment shall be carried out along external wall perimeter below concrete or masonry apron, using chemical at rate of 5 lit/ running meter.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No. 22.0,12 shall be followed.

3.2. The rate including drilling and plugging holes in apron etc. complete.

3.3. The rate shall be for a unit of One running meter.

22.0.14. Treatment of soil below existing floor using chemical at 1 liter per hole at 300 mm. a part including drilling plugging holes etc.

1.0. **Materials** : The relevant specifications of item No. 22.0.12. shall be followed.

2.0. Workmanship

2.1. The relevant specifications of item No. 22.00.9. shall be followed except that the termite control treatment shall be carried out in soil below existing floors.

2.2. The holes of 12 mm. dia rod shall be drilled in floor up to 150 mm. depth at 300 mm. part both ways. The chemical shall be then injected with pressure at the rate of 1 liters/hole of the surface area.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item 22.0.9 shall be followed.

3.2. The rate shall includes cost of drilling holes and plugging.

3.3. The rate shall be for a unit of One sq. meter.

22.0.15. Treatment of voids in masonry using chemical at 1 Lit/hole at 300 mm. apart including drilling holes and plugging.

1.0. **Materials** : The relevant specifications of item 22.0.12 shall be followed.

2.0. Workmanship

2.1. The walls affected by termite shall be cleaned off all live forms binding inside and the holes of voids in masonry wall surface shall be treated by chemical emulsion at rat 1 Lit. hole. The holes in cracks in surface of wall shall be drilled at 300 mm. apart.

3.0. Mode of measurement & payment

3.1. The rate shall be for a unit of One number of voids treated.

22.0.16. Treatment to wood work by chemical emulsion in oil or kerosene based including 6 mm. dia downward slanted holes 150 mm. C/C. and plugging the same with cement mortar.

1.0. Materials : The relevant specifications of item No. 22. 00.7 shall be followed.

2.0. Workmanship

2.1. The wood work effected by Ants shall be cleaned of lives form hiding inside. The whole wood surface shall be then treated with oil or kerosene based chemical emulsion. The holes in 6 mm. dia. shall be drilled slanted downwards at 150 mm. centers to centers and chemical emulsion shall be poured into holes by means of funnels specifically prepared for the same and allowed to seep. After finales become empty, another dose of chemicals shall be poured in them. This process shall be done repeatedly till the whole wood work is fully saturated with chemical.

2.2. The holes drilled in wood work shall be filled in with putty and other similar materials as directed and the whole wooden surface shall be made good as before.

3.0. Mode of measurements & payment

3.1. The work shall be measured for the finished work in sq. meter, including frame.

3.2. The out of frame shall be measured as width ad form top of flooring to top of frame shall be as height. This area includes for treating frame and shutters both.

3.3. The rate includes cost of all labours and materials, required for satisfactory completion of this item.

3.4. The rate includes drilling holes plugging the same after treatment completed and making good as before.

3.5. The rate shall be for a unit One sq. meter.

SECTION-23

Water Supply, Plumbing and Sanitary Fittings

23.2. Providing and fixing to wall, ceiling and floor galvanised mild steel tube (Medium grade) of the following nominal bore, tube fittings and clamps including making good the wall ceiling and floor (A) 15 mm. dia (B) 20 mm. dia (C) 25 mm. (D) 32 mm. (E) 40mm. (F) 50 mm.

1.0. Materials

1.1. Galvanised mild steel tubes of specified dia nominal bore shall conform to I.S. 1239-1968.

1.2. The galvanised fittings, clamps, etc. required for specified dia. bore pipes shall be of best quality and makes as approved by the Engineer-in-charge.

2.0. Workmanship

2.1. Cutting, Laying & Jointing

2.1.1. When the tubes are to be cut or rethreaded, the ends shall be carefully filed out so that no obstruction to bore is offered. The ends of the tubes shall then be threaded conforming to the requirements of I.S. 554-1955 with pipe dies and taps carefully in such a manner that it will not result in slackness of joints when the two pieces are screwed together.

2.1.2. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack as the latter procedure may not result in the watertight joint. The screw threads for tube and fitting shall be protected from edge until they are fitted.

2.1.3. In jointing the tubes, the inside of the socket and the screwed end of the tubes shall be oiled and smeared with white or red lead and wrapping around with a few turns of fine spun yarn round the screwed end of the tube. The end shall then be tightly screwed in the socket, tees, etc. with a pipe wrench. Care shall be taken that all times free from dust, and dirt during fixing. Burr from the joints shall be removed after screwing. After laying the open ends of the pipes shall be temperately plugged to prevent access of water, soil, or any other foreign matter.

2.1.4. Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anti-corrosive paint to prevent corrosion.

2.2. Fixing of tube fittings to wall ceiling & floors.

2.2.1. In case of fixing of tubes and fittings to the walls or ceilings, these shall run on the surface of the wall, or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern, holder clamps keeping the pipes about 15 mm. clear of the wall. When it is found necessary to pattern, holder clamps keeping the pipes about 15 mm. clear of the wall. When it is found necessary to conceal the pipes and when specified so, chasing may be adopted or pipe fixed in ducts or recesses etc. provided that there is sufficient space to work on the pipe with usual tools. The pipe shall not ordinarily be buried in walls or solid floors, where unavoidable, pipe may be buried for short distances provided that adequate protection is given against damage and where so required joints are not buried. Where required M.S. tube sleeve shall be fixed at a place a pipe is passed through a wall or floor for expansion and contraction and other movements. In case the pipe is embedded in walls or floors, it should be painted with anti-corrosive bitumastic paint of approved quality. The pipe should not come in contact with lime mortar or lime concrete as the pipe is affected by lime. Under the floors, the pipe shall be laid in layer of sand filling.

2.2.2. All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern clamps of required size and shape, one end of which shall be properly plugged or cemented into walls with cement mortar 1:3 (1 cement : 3 coarse sand) and the other tightened round the pipes to hold it securely. These clamps shall be spaced at regular intervals in straight lengths at 2 MC/C interval in horizontal run and 2.5 m. interval in vertical run. For pipe of 15 mm. dia. up to 25 mm. dia the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However for bigger diameter pipes the holes shall be carefully made cement : 3 coarse sand), and properly finished to match the adjacent surface.

2.3. Testing of joints :

2.3.1. After laying and jointing, the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joints found leaking shall be redone, and all leaking pipes removed and replaced without extra cost.

2.3.2. The pipes and fittings after they are laid shall be tested to hydraulic pressure of 6 Kg./Sq cm. The pipe shall be slowly and carefully charged with water allowing all air to escape and avoiding all shocks and water hammer. The draw off takes and stop cock shall then be closed and specified hydraulic pressure shall be applied gradually. The pressure gauge must be accurate. The pipes and fittings shall be tested in sections as the work laying proceeds, keeping, the joints exposed for inspection during the testing.

3.0. Mode of measurements and payment

3.1. The description of e, item shall, unless otherwise stated be held to include where necessary, conveyance, and delivery, handling, unloading, storing fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting in position straight, cutting and waste return of packing etc.

3.2. The length shall be measured on running meter basis of finished work. The length shall be taken along the centre line of the pipe and fittings. The pipes fixed to wall, ceiling, floors etc shall be measured and paid under this item.

3.3. All the work shall be measured in decimal system as fixed in its place, subject to tolerance given below unless otherwise stated.

(i) Dimension shall be measured to the nearest 0.01 meter. (ii) Area shall be worked out to the nearest 0.01 sq. meter.

3.4. All measurements of cutting shall unless otherwise stated by held to include the consequent waste

3.5. In case of fitting of unequal bore, the targets bore shall be measured for the test.

3.6. Testing of pipe lines fittings, and joints include for providing all plant appliances necessary for obtaining access to the work to be tested and carrying out the tests

3.7. The rate includes galvanised steel tubing with screwed socket joints. to gather with all fittings (such as bends, sockets springs, elbows, test, crosses, short pieces, clamps and plugs, unions etc.) and fixing complete with clamping wall hooks, wooden plug etc. and also curing, screwing and waste and for making forged (or hand made) bends on piping as required. Connector shall be inserted where required or directed. The rate also includes cutting through walls, floors etc. and their making good and painting exposed threads with anti-corrosive paint as above and testing where tubes are to be fixed to wall ceiling and flooring, the rates shall not include painting of pipes, providing sleeves and sand filling under floor for which separate payment shall be made.

3.8. The rate shall be for a unit of one running meter.

23.4. Providing and laying in trenches galvanised mild steel tubes (Medium grade) of the following nominal bore and tube fittings-earth work in trenches to be measured and paid for separately ; (A) 15 mm. dia. (B) 20 mm. (C) 25 mm. (D) 40 mm. (E) 60 mm. (F) 80 mm.

1.0. Materials

1.1. Galvanised mild steel tube of specified dia. nominal bore and fittings shall conform to I.S. 1239-1968

2.0. Workmanship

2.1. The relevant specifications of Item 23.2 (A) shall be followed for cutting laying and jointing testing of joints except that the fixing of tube shall be done in trenches,

2.2. The width and depth of the trenches for different diameters of the tubes shall be as under, For 15 to 80 mm. dia tube width of trenches shall be 30 cms. and depth of trenches 60 cms,

2.3. All joints, the trench width, shall be widened where necessary. The work of excavation and refilling shall be done true to line, and gradient in accordance with general specifications of earth work in trenches

2.4. The pipes shall be painted with two coats of anti-corrosive bitumastic paint of approved quality. The pipe shall be laid on a layer of 75 mm. sand filled upto 150 mm. above the pipe of so specified. The remaining portion of trench shall be then filled with excavated earth. The surplus shall be disposed off as directed.

2.5. When the excavation is done in rock the bottom shall be cut deep enough to permit the pipe to be laid and cushion of sand 75 mm. in case of bigger diameter of tube where the pressure is very high thrust block of cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 grade stone aggregates of 20 mm nominal size) shall be constructed on all bends to transmit the hydraulic thrust without impairing the ground and spreading it over a sufficient area if so specified.

3.0. Mode of measurement

3.1. The relevant specifications of item No. 23.2 (A) shall be followed. The authorised quantities shall be

3.2. For purpose of calculating cubic content cross section shall normally be taken at suitable intervals i.e. at manhole or wall chamber intervals except in abnormal cases like sudden change in strata or undulating ground etc., when they may be taken at closer intervals as approved by the Engineer-in charge whose decision shall be final, conclusive and binding.

3.3. Authorised width :

(a) Up to the meter depth, the width of the trenches for the purpose of measurements of excavation shall be arrived at by adding 40 cms. to the external diameter of the tube (not the socket) where a pipe is laid on concrete bed/ Cushioning layer, the authorised width shall be the external diameter of tube plus 40 cms. or the width of the concrete bed cushioning layer whichever is more.

(b) For depths exceeding one meter an allowance of 5 cms. per meter of depth for each side of the trench shall be added to the authorised width (i.e. external diameter of pipe of plus 40 cms) This allowance shall apply to the entire depth of the trench. The authorised width in such cases shall therefore be, equal to the depth of trench, plus external diameter or tube plus 40 cms.

(c) Where more than one tube is laid, the diameter shall be reckoned as the horizontal distance of outside to outside of the outermost pipes.

(d) Where sheeting etc. has been provided the authorised width of the trenches at bottom shall be increased to accommodate for sheeting etc. so that the clear width available between faces of sheeting is as per previous ness of (a), (b) & (c) above.

(e) If the sides of the trench are not vertical, the tones of side slopes shall end at the top of the pipe and vertical sided trench of authorised width as per (a), (b), (c) and (d) above shall be excavated from these down to the bed of trenches.

3.4. Where the tubes are laid in trenches, the work of excavation and refilling and round tubes for which separate payment shall be made, the length shall be measured on running meter, basis.

3.5. The rate shall be-for a unit of One running meter.

23.6. Marking connection of galvanised M/S. distribution branch with galvanised mild steel main 80 mm. nominal bore by providing and fixing tee including, cutting and threading the pipes etc. complete.

1.0. Materials The fittings required of specified dia. of pipe shall conform to I.S. 1237-1986.

2.0. Workmanship

2.1. A pit of suitable dimensions shall be dug at the point where the connection is to be made with the main and earth removed up to 150 mm. below the main. The flow of water in water main shall also be disconnected by closing the sluice or wheel valves on the main. The main shall first be cut. Water if any, collected in the pit shall be bailed out and ends of the pipe threaded.

2.2. The connections of distribution pipe shall be made by fixing malleable galvanised mild steel tee of the required size and fitting such as jam nut, socket, connecting piece etc,

2.3. The testing of the joints shall be done as per relevant specifications of item No. 23.2 (A).

3.0. Mode of measurements and payment

3.1. The rate includes cost of all labour, materials, tool and plant required for satisfactory completion of 'this item.

3.2. The rate shall be for a unit of One number.

23.8. Providing and fixing to wall ceiling and floor 6 Kgs/Sq. Cm. working pressure polythene pipes of the following outside diameter, low density complete with special flag compression type fittings wall clips etc. including making good the wall/ceiling and floor. (A) 20 mm. dia. (B) 25 mm. dia (C) 32 mm. dia. (D) 40 mm. dia. (E) 50 mm. dia.

1.0. Materials

1.1. The low density polythene pipe of specified diameter with 6 Kg/Sq. Cm, working pressure shall conform to I.S. 3076-1968. The specials and fittings required shall be of best quality.

2.0. Workmanship

2.1. The P.V.C. pipes of specified diameter shall be fixed as directed. Due to thermal expansion of rigid ' P.V.D. pipes, due allowance shall be made particularly in over ground pipe lines for any change in length of pipe line which may occur during installation or when pipe line which may occur during installation or when pipe line is in service.

2.2. Above ground installation of rigid P.V.C. pipe should be under taken after preparations are observed for their protection against direct sun rays and mechanical damage.

2.3. The rigid P.V.C. pipe lines should not be kept exposed above ground when it passes through public places, railway lines, road side and foot paths.

- 2.4. P.V.C. pipes shall be supported at the following intervals :
 -20 mm. dia 500 mm. -25 mm. dia 750 mm. -32 mm. dia.900 mm.
- 2.5. Closer support spacing shall be provided if recommended by the manufacture.
- 2.6. The guide lines indicated by the manufacturer regarding handling, transportation, storing, laying and jointing pf pipes shall be kept in view during execution.
- 2.7. P.V.C. pipes shall be fixed on wall with wooden plugs and suitable plastic clamps.
- 2.8. Jointing the pipes :**
- 2.8.1. The pipes and sockets shall be accurately cut. The ends of the pipes and fittings should be absolutely free from dirt and dust. The outside surface of the pipes and the inside of the fittings shall then be roughened with emery paper, and then solvent cement joint. Since solvent cement is aggressive to P V.C. care must be taken to avoid applying excessive cement to the inside of pipe sockets as any surplus cement cannot be wiped of after jointing. Empty solvent cement tins, brushes, rags, or paper impregnated with cement should not be buried in the trenches. They should be gathered not left scattered about, as-they can prove to be a hazard to animals, which may chew them.
- 2.8.2. If any manufacturer recommends its own methods of jointing the same shall be adopted after necessary approval from the Engineer-in-charge.
- 2.9. Laying pipes in Trenches :**
- 2.9.1. The pipes shall be laid over uniform relatively soft fine trained soil found to be free of presence of hard object such as large flints, rocky projections, large tree roots etc. The width of the trenches shall be minimum width required for working.
- 2.9.2. The pipes laid underground shall not be less than one meter from the ground level. The pipe shall be positioned in the trenches so as to avoid any induced stressed due to deflection. Any deviation required shall be obtained by using proper type of rubber ring joints.
- 3.0. Mode of measurements & payment**
- 3.1. The relevant specifications of item 23.2. (A) shall be followed except that the P.V.C. pipes of specified dia. shall be paid under this item.
- 3.2. The unit rate shall be for a unit of One running meter.
- 23.111.(A)(I) Providing and fixing water closet squatting pan (Indian type W.C. Pan) size 580 mm. (Earth work, bed concrete, foot-rests and trap to be measured and paid for separately). Vitreous china. Long pattern white colour.**
- 1.0. Materials**
- 1.1. Water closet squatting pan (Indian type W.C. Pan) shall conform to M-62. Cement mortar shall conform to M-11
- 2.0. Workmanship**
- 2.1. The pan shall be sunk into the floor and embedded in a cushion of average 15 cm. cement concrete 1:5:10 (1 cement : 10 graded stone aggregate or brick aggregate 40 mm. nominal size) or and its bed concrete, the floor should be left 115 mm.-below the top level of the pan so as to allow for flooring and its bed concrete. The floor should be suitably stopped so that the .waste water is drained into the pan. The shall be provided with 100 mm. 'P' or 'S' trap as specified in the item No. 23.113 with approximately 50 mm seal-The joints between the pan and the trap shall be made leak-proof with cement mortar 1:1 (1 cement : 1 fine sand).
- 3.0. Mode of measurements and payment**
- 3.1. The rate shall include the cost of all materials and labours involved in the operations described under workmanship.
- 3.2. The rate shall be for a unit of One number.
- 3.3. The 'P' or S¹ trap unit of One number.
- 23.79. Providing and fixing cast spigot and sockets soil, waste, and ventilating pipes of the following normal size (B) 75 mm. dia. (C) 100 mm. dia.**
- 1.0. Materials**
- 1.1. The specified dia. C.I. Spigot and socket soil or waste pipe shall conform M-68.

2.0. Workmanship

2.1. The fixing of C.f. spigot and sockets soil, waste and ventilating pipe shall be carried out as per relevant specifications of item 15.93 (B) except the C.I. spigot and socket shall be fixed. The joints shall be filled with cement mortar 1:2 (1 cement : 2 sand) spun yarn. The joints shall be filled with cement mortar 1.2 (1 cement : 2 sand) and spun yarn. The pipes without care shall be fixed to wall with M.S. clamps The pipes will earn shall be secured with 40 mm before steel or iron barrel distance pieces or boils and stout galvanised iron nails 10 cms long into hand wool plug fixed in walls. Access doors to fittings shall be provided with 3 mm. rubber insertion packing and secured without screws to made air and water tight

2.2. All soil pipes shall be earned up above the roof and shall have a wire ball on guarded or a cowl.

2.3. The ventilating pipe or shaft shall be carried out to a height of at least one meter above the outer covering of the roof of the building or in the case of windows in a gable wall or a dormer windows, it shall t carried up to a ridge of the roof or at least tow meters above the top of the windows. In case of flat roof to which access for use is provided, it shall be carried out up to a height of at least on meter above the parapet or two meters measured vertically from the top of any windows or opening which any exist up to a horizontal distance of five meters from the vent pipe into such building and in no case shall be carried out to a height less then three meters.

2.4. Where ventilating pipes are carried in pipe shafts, the shaft shall be of a minimum size of one meter. If !he shells are also used to give fight and air to rooms, the ventilating pipes must be carried out to a horizontal distance at root level not loss than five meter from the site of the shaft.

2.5. The sand cast iron pipes above parapet shall be fixed with M.S. clamps and stays. The clamps shall be made from 1.5 mm. thick MS flat or 3 mm. width band to the required shape and size to fit tightly one the sockets when tightened with screw bolts. It shall be formed of two semi circular pieces with flanged ends on both sides, with holes to fit in the screw bolts and nuts 40 mm. dia. M.S. Bars, One end of the stay shall be bent to form a hook to be fixed with clamps by means of bolts and the other end shall be bent for embedding in wall in cement concrete block of size 200 mm. x 100 mm. x 100 mm. in 1:2:4 mix. The concrete shall be finished to match the surrounding surfaces.

2.6. The connection between the main pipe and branch pipes shall be made by using branches and bends with access doors for cleaning

2.7. The waste from lavatories, kitchens basins, sinks, baths and other floor traps shall be separately connected to respective stacks of upper floor. The waste stack of lavatories shall be connected directly to main hole while the waste stack of other shall be separately discharged over gulley trap.

3.0. Mode of measurements and payment

3.1. The length of pipe shall be measured including all fittings along its length in running meters correct to a centimeter. No allowance shall be made for the portion of pipe length entered in the sockets of the adjacent pipe of fittings.

3.2. The rate includes all labour, and materials, tools and plant etc. required for satisfactory completion of this item.

3.3. The rate shall be for a unit of One running meter.

23.87. Providing and fixing cast iron (spun) Nahni trap of the following nominal diameter of self cleaning design with C.I. Screwed down or hinged grating including cost of cutting and making good the waifs and floors : 100 mm. Inlet and 50 mm. outlet.

1.0. Materials

1.1. The cast iron (spun) Nahni trap shall conform to M-69. The C.I. hinged or screwed down cover shall be of best quality

2.0. Workmanship

2.1. The Nahni trap with 100 mm. dia inlet and 50 mm. dia. outlet shall be fixed as per drawing or as directed.

2.2. The Nahni trap shall be jointed with C.I. Pipe, 75 mm. dia. with lead joints. The lead joints shall be done in conformation with I.S. 782.-1976.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all labour, materials, tools and plants etc. required for satisfactory completion of this item including lead, jointing and testing.

3.2. The rate shall be for a unit of one number.

23.112.(A)(I) Providing and fixing wash down water closet (European type W.C. Pan) with integral 'P' or 'S' trap including jointing the trap with soil pipe in C.M. 1:1 (1 cement : < fine sand) (seat and cover to be measured and paid for separately) ; Vitreous china pattern : In white colour,.

1.0. Materials

Wash down water closet (European type W.C. Pan) shall conform to M-60. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. The closet shall be fixed to the floor by means of 75 mm. long 6.5 mm. diameter counter sunk bolts and nuts embedded in the floor concrete using rubber or before washers so as not to allow any lateral displacement The joint between the trap of W.C. and soil pipe shall be made with C M. 1:1 (1 cement : 1 fine sand).

3.0. Mode of measurements and payment

3.1. The rate shall include the cost of all materials and labour involved in all the operations described under workmanship.

3.2. The rate includes cost of all labour for fixing pans and seat and cover, inlet, connections etc. complete including testing the same. The payment of seat and cover shall be made separately.

3.3. The rate shall be for a unit of One number.

23.113.(A) Providing and fixing 100 mm. size 'P' or 'S' trap for water closet squatting pan including jointing the trap with the pan and soil pipe in cement mortar 1:1 (1 cement : 1 fine sand) Vitreous China.

1.0. Materials : The 100 mm. size 'P' or 'S' trap for water closet shall conform to M-62. Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. The 'P' or 'S' trap shall be fixed with pan cast iron pipe with C.M. 1:1. The pan shall be provided with a 100 mm. 'P' or 'S' trap as specified in the item with an approximately 50 mm. seal The joint between the pan and the trap shall be made leak-proof with cement mortar 1:1(1 cement : 1 fine sand).

3.0. Mode of measurements and payment

3.1. The rate shall include the cost of all materials and labour involved in the operations described under workmanship including testing.

3.2. The rate shall be for a unit of one number.

23.114. Providing and fixing in C.M. 1:3 (1 cement : coarse sand) a pair of white vitreous china 250 mm. x 130 mm. 30 mm. foot rest for long pattern squatting pan water closet.

1.0. Materials

1.1. The pair of white vitreous china foot-rests shall conform to M-62 Cement mortar shall conform to M-11.

2.0. Workmanship

2.1. After laying the floor, the floor shall be suitably sloped so that the waste water is drained into the pan A pair of foot-rests of size 250 mm. x 130 mm. x 30 mm. of white vitreous china shall be set in cement mortar 1:3 (1 cement ; 3 coarse sand). The foot-rests shall be fixed at a distance of 175 mm. from the inner edge of the back side of the pan and shall be fixed at convenient angle.

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials and labours involved in all the operations described under workmanship.

3.2. The rate shall be for a unit of One pair.

23.115.(A)(I) Providing and fixing 12.5 liters low level flushing cistern with a pair of C.I. or mild steel brackets complete with fittings such as lead valve less syphon, 15 mm. nominal size brass ball valve with polythene float, C.P. brass ball handle, unions and couplings for connections with inlet, outlet and overflow pipes, 40 mm. dia. porcelain enameled flush bend including cutting holes in walls and making good the same and connecting the flush bend with cistern and closet (overflow pipe to be measured and paid for separately) : Vitreous China. In white colour.

1.0. Materials

1.1. The low level vitreous china (Enamel) flushing tank shall conform to M-65 except that the flushing cistern shall be 12.5 liters low level type as mentioned in the item.

2.0. Workmanship

2.1. The low level cistern shall be firmly fixed on two C.I. or mild steel, brackets which shall be firmly embedded in the wall in C.M. 1:4 (1 cement : 4 fine sand).

2.2. The height of the bottom of the cistern from the top of the pan shall be 30 cms of low level flushing cistern shall be connected to the closet by means of 40 mm. dia, white porcelain enameled flush bend using Indian rubber adapts joints. The flush pipe shall be securely connected to the cistern outlet by means of coupling nut made of any non-corrosive materials, non-ferrous metal or galvanised steel. The flush pipe from the cistern shall be connected to the closet by means of cement of red-lead.

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials fitting and labour involved in all the operations described under workmanship including testing.

3.2. The rate shall be for a unit of One number.

23.116. Providing and fixing 12.5 liters level C.I. flushing with a pair C.I. or mild steel brackets, complete with fittings such as syphonic arrangement, 15 mm. nominal size brass ball valve with polythene flat, lever. G.I. China (60 cms.) and pull unions and couplings for connections with inlet, outlet and overflow pipes etc. including cutting holes in walls and making good the same (overflow pipe to be measured and paid for separately).

1.0. Materials

1.1. The high level C.i. flushing cistern shall conform to M-66, except that the flushing cistern shall be of 12.5 liters high level C.I. cistern as mentioned in the item.

2.0. Workmanship

2.1. The cistern shall be fixed on two C.I. or mild steel brackets which shall be firmly embedded in the wall in cement mortar 1:4 (1 cement : 4 fine sand).

2.2. The height of the bottom of the cistern from the top of the pan shall be two meters.

2.3. The W.C. Pan shall be connected to the cistern by galvanised steel flush pipes of 32 mm. nominal internal diameter. The flush pipe shall be fixed to wall by using clamps. The flush pipe from the cistern shall be connected to the closet by means of cement of red-lead. The flush pipe shall be securely connected to the cistern outlet by means of coupling nut made of any non-corrosive materials non-ferrous metal or galvanised steel.

2.4. The chain and the pull union shall be fixed to the protruding level arm of the flushing cistern.

2.5. The whole installation shall be tested for leak-proof joints and satisfactory functioning.

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials, fittings, and labour involved in all the operations described under workmanship including testing.

3.2. The rate shall be for a unit of One number.

23.117. Providing and fixing in position with clamps etc. 32 mm. nominal internal dia. galvanised steel tube flush pipe for high level flushing cistern including connecting the flush pipe with cistern and closet and making good the walls and floors.

1.0. Materials

1.1. The 32 mm. nominal internal dia, galvanised steel tube flush pipe shall conform to M-56.

2.0. Workmanship

2.1. The W.C. pan shall be connected to the cistern by galvanised steel flush pipe of 32 mm nominal internal diameter. The flush pipe shall be fixed to wall by using clamps.

2.2. The flush pipe from the cistern shall be connected to the closet by means of cement or red-lead.

2.3. The flush pipe shall be securely connected to the cistern outlet by means of coupling nut made of any non-corrosive materials, non-ferrous metal or galvanised steel.

3.0. Mode of measurements and payment

3.1. The rate shall include the cost of all materials, fittings and labour involved in all the operations described under workmanship including testing.

3.2. The rate shall be for a unit of One running meter.

23.120. Providing and fixing G.I. inlet connection for flush pipe with W.C. Pan.

1.0. Materials

1.1. The G.I. inlet connection for flush pipe shall conform to M-56.

2.0. Workmanship

2.1. The flush pipe from the cistern shall be connected to the closet by means of cement or red-lead.

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials, fittings and labour involved in all the operations described under workmanship including testing.

3.2. The rate shall be for a unit of One number.

23.127. Providing and fixing wash basin with single hole for pillar top white C.I. or M.S, brackets painted white including cutting holes, and making good the same but excluding fittings, vitreous china flat back wash basin 550 mm. x 400 mm. in white colour.

1.0. Materials

1.1. The white glazed earthenware wash basin shall be 550 mm. x 400mm. of 1st quality and make as approved by the Engineer-in-charge. The wash basin shall conform to M-59.

2.0. Workmanship

2.1. The washbasin shall be fixed on the wall as and where directed. The wash basin shall be supported on a pair of M.S. or C.I. brackets fixed in C.M. 1:3 (1 cement : 3 sand). The bracket shall conform to I.S. : 775-1962. The wall plaster on the rear shall be cut to rest the top edge of the washbasin. After fixing the basing, plaster shall be made good and surface finished to match the existing one.

2.2. The brackets shall be painted white with ready-mixed paint.

2.3. The C.I. brass trap and union shall be connected to 32 mm. dia. waste pipe which shall be suitably bent towards the wall and which shall discharge into an open drain leading to a gully trap or direct in to gully-trap on the ground floor and shall be connected to a waste pipe through a floor trap on the upper floors. C.P. brass trap and union may not be provided where the surface drain or a floor trap is placed directly under the basin and the waste is discharged in to vertically.

2.4. The height of the front edge to the wash basin from the floor level shall be 80 cms.

2.5. The necessary inlet, outlet connections and fittings such as pillar cocks, CP dress waste trap waste pipe, stop cock, chain wish rubber plug etc. shall be fixed.

2.6. The payment of fittings shall be made separately under separate items.

3.0. Mode of measurements & payment

3.1. The rate includes cost of all labour, materials, tool3 and plant etc. required for satisfactory completion of this item as specified in workmanship.

3.2. The rate shall be for a unit of One number.

23.130.(C) Providing and fixing kitchen sink with C.I. or M.S. brackets painted white including cutting holes in walls and making good the same of but excluding fittings. Vitreous china sink 600 mm. x 450 mm. x 150 mm. size.

1.0. Materials

1.1. White glazed vitreous china sink 600 mm. x 450 mm. x 150 mm. size shall conform to M-63.

2.0. Workmanship

2.1. The kitchen sink shall be supported on a pair of M.S. or C.I. brackets fixed in cement mortar 1:3 (1 cement : 3 coarse sand). The M.S. or C.I. brackets shall conform to I.S. 775-1962. The wall plaster on the rear shall be cut to rest over the top edge of the sink. After fixing the sink, plaster shall be made good and he surface finished to match with the existing one.

2.2. The C.P. brass trap and union shall be connected to 40 mm. nominal bore galvanised mild steel waste pipe which shall be suitably bent towards the wall and which shall discharge into an open drain leading to gully-trap or direct into the gully-trap on the ground on floor and shall be connected to a waste pipe through a floor trap on the upper floors. C.P. brass trap and union may not be provided where surface drain or a floor trap is placed directly under the sink and the waste is discharged to it vertically.

2.3. The height of front edge of the wash basin from the floor, level shall be 80 cms.

3.0. Mode of measurements & payment

3.1. The rate includes cost of all labour, materials, tools and plant and other equipment required for satisfactory completion of this item as described in workmanship.

3.2. The rate shall be for a unit of One number.

23.135 (A) Providing and fixing 32 mm, dia. C.P. brass waste for wash basin or sink.

1.0. Materials

1.1. The C.P. brass trap and unions shall be of 32 mm. dia. and of best quality and make as approved by the Engineer-in-charge

2.0. Workmanship

2.1. C.P. brass waste trap and union shall be connected to 32 mm dia waste pipe which shall be suitably bent towards the wall which shall discharge into drain through a floor trap The C.P brass waste trap shall be provided for wash basin or sink as the case may be.

3.0. Mode of measurement & payment

3.1. The rate includes all labours and providing C.P. brass waste trap and union including waste couplings of 32 nun fin. The rate excludes the cost of waste pipe of 32 mm. dia.

3.2. The idle shall be for a unit of One number.

23.135.(B) Providing and fixing 40 mm dia. C.P. Brass waste for wash basin or sink.

1.0. Materials & Workmanship

1.1. The relevant specifications of item 23.135 (A) shall be followed except that the diameter of C.P. brass waste is 40 mm dia.

2.0. Mode of measurements & payment

2.1. Thu rate shall be for a unit of One number.

23.136.(A) Providing and fixing 32 mm. dia. M.I. union for wash basin or sink.

1.0. Materials

1.1. Tho 32 mm dia M.1. Fisher union shall be of best quality and made as approved by the Engineer-in-charge.

2.0. Workmanship 2.1. The 32mm dia M I. Fisher union shall be fixed to wash basin or sink in best workman like manner.

3.0. Mode of measurements and payment

3.1. The rate includes all labours .and materials, tools and plants etc. required for satisfactory completion of the item.

23.136.(B) Providing and fixing 40 mm, dia. M.I. fisher union for wash basin or sink.

1.0. Materials and Workmanship

1.1. The relevant specifications of item No. 23, 136 (A) shall be followed except that the diameter of M I fisher union shall be 40 mm. dia.

2.0. Mode of measurements of payment

2.1. The rate shall be for a unit of One number

23.139. Providing and fixing 100 mm. dia, sand cast iron grating for gulley floor or Nahni tarp.

1.0. Materials

1.1. The- 100 mm. dia. sand cast iron gratings for gulley, floor or Nahni trap shall be of best quality and make as approved.

2.0. Workmanship

2.1. The CAST IRON grating shall he provided to gulley trap floor or Nahni trap as the case may be in best workmen like manner.

3.0. Mode of measurements and payment

3.1. The rate shall includes cost of all labour, materials, tools and plants, etc. required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

23 :141.(A) Providing and fixing 100 mm. dia, C.P, brass shower rose with 15 mm or 20 mm. inlet.

1.0. Materials

1.1. 100 mm. dia C P. brass shower lose shall confirm to I S. 2556-1972 part - XI and of best quality and makes as approved by engineer-in-charge. The inlet of shower rose shall be 15 mm dia. or 20 mm dia. as directed.

2.0. Workmanship

2.1. The C.P. brass shower rose shall be fixed as directed with 15 mm. dia. or 20 mm. dia. G.I. inlet pipe as the case may be.

3.0. Mode of measurements and payment

3.1. The rate includes all labours and materials, tools and plant etc. required for satisfactory completion of this item

3.2. The rate shall be for a one number.

23.143. Providing and fixing 600 mm. x 450 mm. beveled edge mirror of superior glass mounted on 6 mm. thick A.C. Sheet or plywood sheet and fixed to wooden plugs with C.P brass screws and washers,

1.0. Materials

1.1. The 600 mm. x 450 mm. size mirror shall be of superior glass with edge rounded over beveled as specified. It shall be free from flaws specks, or bubbles and its thickness shall not be less than 6 mm. The glass for the mirror shall be uniformly silver plated at the back and shall be free from silvering defects Silvering shall have a protective uniform covering of red lead paint. The 6 mm thick plywood shall conform to M-37. The 6 mm. thick A.C. sheets shall conform to M-24.

2.0. Workmanship

2.1. The mirror of 600 mm. x 450 mm. size mounted on A.C. Sheet or plywood 6 mm thick with C.P. brass clips shall be fixed as directed, by fixing wooden plugs in wall and C.P brass screws and washers. The work shall be carried out in best workman like manner.

3.0. Mode of measurements & payment

3.1. The rate includes cost of all labour and materials, tools and plant etc. required for satisfactory completion of this item. The rate shall be for a unit of One number.

23.144.(B) Providing and fixing 600 x 20 mm. C.P. brass towel rail complete with C.P. brass brackets fixed to wooden plugs with and C.P. brass screws.

1.0. Materials

1.1. The C.P. brass towel rail shall be 600 x 20 mm. of best quality as approved by the Engineer-in-charge The brackets shall be of C.P. brass. The rail shall conform to I.S. 1068-1958.

2.0. Workmanship

2.1. The brackets of the towel rail shall be fixed by means of C.P. brass screws to wooden plugs firmly embedded in the wall with C.M. 1:3 (1 cement : 3 coarse sand). The towel rail shall be fixed as and where directed.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all labour and materials, tools and plant etc. required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

23.145. Providing and fixing 600 mm. x 120 mm. glass shelf with C.P. brass brackets and guard rail complete, fixed to wooden plugs with C.P. brass screws.

1.0. Materials : The glass shelf of 600 mm. x 120 mm. size shall be of 5 mm. thick plate glass. The edge of the glass shall be ground. The C.P. over brass guard rail shall be best quality and make.

2.0. Workmanship

2.1. The C.P. brass brackets of the glass shelf shall be fixed with C.P. screws to wooden plugs firmly embedded in the wall C.M. 1:3 (1 cement : 3 coarse sand). The C.P. guard rail shall be fixed to glass shelf as directed.

3.0. Mode of measurement and payment

3.1. The rate includes all labour and materials tools and plant etc. required for satisfactory completion of this item,

3.2. The rate shall be for a unit of One number.

23.146.(A) Providing and fixing C.P. brass toilet paper holder.

1.0. Materials : The toilet paper holder shall be of best quality and make, chromium plating shall be of grade 'B' type conforming to I.S. 1068-2958.

2.0. Workmanship

2.1. The toilet paper holder shall be fixed in position by means of screws and wooden plugs embedded in wall with cement 1:3 (1 cement : 3 coarse sand).

3.0. Mode of measurements and payment

3.1. The rate includes cost of all labour and material, tools and plant etc. required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

23.92.(A)(I) Providing and fixing brass screw down bib taps of following size. Polished bright : 14 mm. dia.

1.0. **Materials** : 15 mm. dia. brass screw down with bright polished finished shall conform to I.S. 781-1977. The bib cock shall be best Indian make and quality.

2.0. Workmanship

2.1. The screw down bib cock 15 mm. as specified above shall be fixed as directed. The threaded portion shall be smeared with white or red lead and around with a few turns of fine spun yarn round the screwed end of the pipe. The bib cock shall be then screwed and fixed to water tight position.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all labour, materials, tools and plant etc. required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One Number.

23.92.(A)(II) Providing and fixing brass screw down bib taps of following size : Polished bright: 20 mm. dia.**1.0. Materials and Workmanship**

The relevant specifications of item 23.92 (A) (i) shall be followed except that the bib taps of 20 mm. dia shall be fixed.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item 23.92 A(i) shall be followed.

2.2. The rate shall be for a unit of One number.

23.92.(B)(I) Providing and fixing chromium plated brass screw down bib taps of the following size : 15 mm. dia.**1.0. Materials and workmanship**

The relevant specification of item No. 23.92 (A) (I) shall be followed except that the brass chromium plated screw down tap of 20 mm. dia. shall be fixed.

2.0. Mode of measurements & payment

2.1. The rate of shall be for a unit of One number.

23.92.(B)(II) Providing and laying chromium plated brass screw down bib taps of following size : 20 mm. dia.**1.0. Materials and workmanship**

The relevant specifications of item No. 23.92 (A) shall be followed except that the brass chromium plated screw down tap of 20 mm. dia. shall be fixed.

2.0. Mode of measurements & payment

2.1. The rate shall be for a unit of One number

23.92.(C)(I) Providing and fixing gun metal screw down bib taps of the following size : 15 mm. dia.**1.0. Materials and workmanship**

1.1. The relevant specification of item No. 23.9*3 (A) (I) shall be followed except that the 15 mm. dia. gun metal screw down bib tap shall be fixed.

2.0. Mode of measurements & payment

2.1. The rate shall be for a unit of One number,

23.92.(C)(II) Providing and fixing gun metal screw down bib taps of following size : 20 mm. dia.**1.0. Materials & Workmanship**

1.1. The relevant specifications of item 23.92 (A) (i) shall be followed except that the 20 mm. dia. gun screw down bib tap shall be fixed.

2.0. Mode of measurements & payment

2.1. The rate shall be for a unit of One number.

23.95(A) Providing and fixing pillar tap capstan head screw down high pressure with screw shank and back nuts : (A) 14 mm. dia. (B) 20 mm. dia.

1.0. **Materials** : The capstan head pillar tap of specified dia. of C.R over brass shall be best quality and shall conform to I.S. : 1975 - 1961. The pillar taps shall be tested quality.

2.0. Workmanship

2.1. The capstan head pillar tap of specified dia. shall be fixed as directed with required washers of selected leather or rubber asbestos composition or of plastic as directed. The cock shall fixed with pipe line white Zink end spun yarn, to make joint water tight. The work shall be carried out in best workman like manner.

3.0. Mode of measurements and payment

3.1. The rate shall be for a unit of one number.

23.96(A) Providing and fixing brass screw down stop cock (A) 15 mm. dia. (B) 20 mm. dia. (C) 25 mm. dia.

1.0. Materials : The brass screw down stop cock of specified dia shall conform to IS. : 781 -1977 The stop cock shall be of tested quality.

2.0 Workmanship

The stop cock shall be fixed in position by means of Jam nut and socket. The stop cock shall be fixed near the inlet of the water meter or as directed. The joints shall be done with white zinc and spun yarn. The joint shall be tested for leak proofing.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all labours, materials, tools and plant etc. required for satisfactory completion of this item.

23.99. Providing and fixing gunmetal check or non-return valve. (A) 15 mm. dia. (B) 20 mm. dia. (C) 25 mm. dia. (D) 32 mm. dia. (E) 40 mm. dia.

1.0. Materials : The gun metal check or not return full way wheel valve or specified dial, shall conform to I.S. : 778-1964. The non-return valve shall be of tested quality.

2.0. Workmanship

2.1. The gun metal check or non return valve shall be fully cleared of all foreign matter before fixing. The fixing of shall be done by means of bolts nuts and 3 mm. rubber insertions with flaps of spigot and socketed tail pieces, drilled to the same specifications as in case of socket and spigot flanges in case of flanged pipes. The joining shall be done leak proof.

3.0. Mode of measurements and payment

3.1. The rate includes all labours, **materials, tools and plant etc. required for** satisfactory completion of this item.

3.2. The rate shall be for a unit of **One number.**

23.00. Providing and fixing chromium plated brass half turn flush cock of approved quality including fixing in pipe line etc. complete (I) 20 mm. dia. (II) 25 mm. dia. (III) 32 mm. dia.

1.0. Materials : Chromium plated brass half turn flush cock shall conform to M-67.

2.0. Workmanship

The half turn flush cock of specified diameter shall be fixed as directed. The flush cock shall be fixed in G.I. pipe line with necessary fittings. The joints shall be made leak proof by using spun yarn and white Zink. The fixing work shall be carried out as per relevant specifications of item No. 23.2(4).

3.0. Mode of measurements and payment

3.1. The rate includes cost of all materials and labour required for satisfactory completion of this item including fittings.

3.2. The rate shall be for a unit of One number.

23.00.4. Providing and fixing chromium plated bottle trap with necessary coupling of approved quality for wash basin.

1.0. Materials : The chromium plated bottle trap shall be approved make and of best quality. The bottle trap shall be provided with coupling.

2.0. Workmanship

The bottle trap shall be fixed on wash hand basin with wooden gullies and screws as directed. The work shall be carried out in best workman like manner.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all materials and labour involved for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

23.122.(A) Providing and fixing urinal of approved quality including connecting the urinal with waste pipe trap etc. complete : whit earthenware flat back or corner type size 430 mm. x 260 mm. x 350 mm.

1.0. **Materials:** The white earthenware flat back or corner type urinal of size 430 mm. x 260 mm. x 350 mm. shall conform to M-64.

2.0. Workmanship

2.1. The urinals shall be fixed in position by using wooden plugs and screws and shall be at a height 65 cms. from the Moor level to the top of the lip of urinal, unless otherwise directed. The wooden plugs shall be of 50 mm. x 50 mm. at base tapering to 38 mm. x 38 mm. at top 50 mm. in length shall be fixed in wall in steel waste pipe which shall discharge in the channel or floor a tap. The connection between the urinal and flush or waste pipe shall be made by means of putty or white lead mixed with chopped hemp.

3.0. Mode of measurements and payment

3.1. The rate shall includes cost all labours, materials, tools and plants etc. required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

23.124.(A) Providing and fixing urinal of approved quality including connection with trap and with integral longitudinal flush pipe squatting plate pattern white earthenware 550 mm. x 300 mm.

1.0. **Materials :** The squatting plate pattern, white glazed earthenware urinal of 550 mm x 300 mm shall conform to I.S. 771-1063. It shall be test India make.

2.0. Workmanship

2.1. The squatting plate urinal shall be fixed as directed.

2.2. The top edge of the squatting plate shall be flush with the finished floor level adjacent to it. It shall be embedded on a layer of 25 mm. thick cement mortar 1:8 (1 cement: 8 fine sand) laid over a bed of burnt brickbat cement 1:5 :10(1 cement: 5 fine sand, 10 graded brick aggregate 20 mm. nominal size). There shall be 100 mm. dia. glazed earthenware or vitreous china channel as specified with stop and outlet pieces suitably fixed in floor in cement mortar 1:3 (1 cement: 3 coarse sand) and joint finished with white cement. The earthenware vitreous china shall discharge into 65 mm. C.P. brass outlet grating. The trap and fitting shall be fixed as directed.

3.0. Mode or measurements and payment

3.1. The rate includes .cost of all materials, tools and plants and labour required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number

23.134 Providing and fixing rubber plug for sink or wash basin.

1.0. **Material:** The rubber plug for sink or wash hand, basin shall be best quality and make as approved by the Engineer-in-charge.

2.0. Workmanship -

2.1. The rubber plug with plain shall be fixed in wash basin or sink as directed.

3.0. Mode of measurements and payment

3.1. The rate shall be for a unit of One number.

23.00.5.(A) Providing and fixing ball cock of approved quality as directed {Copper metal} : (I) 25 'mm. dia. (II) 50 mm. dia;**1.0. Materials :**

The ball cock of specified diameter shall conform to M-75

2.0. Workmanship

The ball cock of specified diameter shall be fixed as directed. The fixing of ball cock shall be carried out as per relevant specification of item No. 23 (A) for joints etc.

3.0. Mode of measurement & payment

3.1. The rate includes-cost of all materials and labour involved for carrying out satisfactory work.

3.2. The rate shall be for a unit of One number.

23.00.5.(B) Providing and fixing ball cock of approved quality as directed : Ebonite. (I) 25 mm. dia. (II) 50 mm. dia.)

1.0. **Materials & Workmanship** : The relevant specifications of item No. 23.00.5 (A) shall be followed except that the ball cock of specified dia of Ebonite shall be fixed.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item NO. 23.00.5 (A) shall be followed.

2.2. The rate shall be for a unit of One number.

23.00.6. Providing and fixing C.I. Manhole cover 0.60 C.M. x 0.45 C.M. size having weight not less than 35 kg.**1.0. Materials**

C. I. Manhole cover of 0.60 x 0.45 Cms. size shall be of best quality. The eight of C.I. cover and frame shall into be less than 35 Kg. The C.I. manhole cover shall be of light duty and conform relevant I.S.

2.0. Workmanship

2.1. The C.I. Manhole cover shall be fixed as per relevant specifications of item No. 24.44 except that the C.I. cover shall be fixed ad and where directed.

3.0. Mode of measurements and payment

3.1. The rate includes cost of all laobur and materials required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

23.00.7. Providing and fixing G.I. water spout of 50 mm. dia. and 30 cms length.

1.0. **Materials** : G.I.M.S. type of 50 mm. dia. shall conform to M-56.

2.0. Workmanship

2.1. The G.I. pipe of 30 cms. fixed as rain water pipe as directed. The pipe shall be fixed about 1/4 dia. below the floor level so as to make approach of water easy. The inlet of pipe shall be rounded off for easy entry of rain water pipe. The pipe shall be fixed in C.M. 1:3.

3.0. Mode of measurements & payment

3.1. The rate includes of all labour and materials required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

23.8. Providing and fixing to wall ceiling and floor 6 Kg/ Sq. cm, working pressure outside diameter, low density completion with special flange compression type fittings wall clips etc. including making good the wall, ceiling and floor. (A) 20 mm. dia. (B) 25 mm. dia. (C) 32 mm. dia. (D) 40 mm. dia. (E) 50 mm. dia.

1.0. **Materials** : The low density polythene pipe of specified diameter with 56 Kg/f. Sq. Cm. working pressure shall conform to I.S. 3076-1968. The specials and fittings required shall be of best quality.

2.0. Workmanship

2.1. The P.V.C Pipes of specified diameter shall be fixed as directed. Due to thermal expansion of rigid P-V.C. Pipes, due allowances shall be made particularly in over-ground pipe line for any change in length of pipe line which may occur during installation or when pipe fine is in service.

2.2. Above ground installation of rigid P.V.C. pipe should be undertaking after precautions are observed for their protection again dirt, sun rays and mechanical damage.

2.3. The rigid P.V.C. tines should not be kept exposed above ground when it passes through public places, railway lines, roads, road side and foot paths.

2.4. P.V.C. pipe shall be supported at the following intervals ;
 -20 mm dia 500 mm. -25 mm. dia. 750 mm. -32 mm. dia. 900 mm.

2.5. Close support spacing shall be provided if recommended by the manufacturer.

2.6. The guide lines indicated by the manufacturer regarding handling, transportation, storing, laying and jointing of pipes shall be kept in view during execution.

2.7. P.V.C. pipes shall be fixed on wall with wooden plugs suitable plastic clamps.

2.8. Jointing the pipes :

2.8.1. The pipes and socket s shall be accurately cut. The ends of the pipes and fittings should be absolutely free from dirt and dust. The outside surface of the pipes and the inside of the fittings shall then be roughened with emery paper, and then solvent cement shall be applied to the matching surface and pushed home and joint. Since solvent cement is aggressive to P.V.C. care must be taken to avoid applying excessive cement to the inside of pipe sockets as any surplus cement cannot be wiped off after jointing. Empty solvent cement tins, brushes, rags of paper impregnated with cement should not be buried in the trenches. They should be gathered, not left scattered about, as they can prove to be a hazard to animals, which may chew them.

2.8.2. If any manufacturer recommends its own methods of jointing the same shall be adopted after necessary approval from the Engineer-in-charge.

2.9. Laying pipes in trenches:

2.9.1. The pipes shall be laid over uniform relatively soft fine grained solid found to be free of presence of hard object such as large feints, rocky projections, large tree roots etc. The width of the trenches shall be minimum width required for working.

2.9.2. The pipes laid underground shall not be less than one meter from the ground level. The pipe shall be positioned in the trenches so as to avoid any inducted stresses due to retraction. Any deviation required shall be obtained by using proper type of rubber ring joints.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item No. 23.2. (A) shall be followed except that the P.V.C. pipes of specified dia. shall be paid under this item.

3.2. The unit rate shall be for a unit of One running meter.

SECTION-24

24.1.(A) Providing any laying (two level or slopes) and jointing with stiff mixture of cement mortar in proportion 1:1 salt glazed stone-ware pipes, following nominal internal diameters including testing of pipes and joints complete : 100 mm. dia.

1.0. Materials

(I) Water shall conform to M-1(2) Cement mortar of proportion 1:1 shall conform to M-11. (3) 100 mm. dia. glazed stoneware pipe shall conform to M-71.

2.0. Workmanship

2.1. The trenches for stoneware pipe drains shall be carried out as per relevant specifications of item No. 23.4 (A) except that the work is for stoneware pipes of 100 mm. dia.

2.2. Laying:

2.2.1. The pipes shall be laid accurately and perfectly true to line, levels and gradients, Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation. All junctions and changes in direction and diameter shall be made inside manholes by means of curved tapered channels formed in Cement concrete finished smooth and benched on both sides. The body of the pipe shall rest for its entire length, on a even level bed grips being made or left on the bed to receive the sockets of the pipes.

2.3. Jointing:

2.3.1. Tarred gask in or yarn soaked in neat cement slurry shall first be placed around the spigot to each pipe and the spigot shall then be placed well home into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and gaskin caulked home so as to fill not more than 1/4th of the total depth or (13 mm. in depth) of the socket.

2.3.2. The remainder of the sockets shall be filled with stiff mixture of cement mortar in proportion of one part of cement and one part of sharp sand. When the socket is fillet, a filled shall be formed round the joints with a trowel, forming an angle of 45° with the barrel of the pipe.

2.3.3. The mortar shall be mixed as necessary for immediate use.

2.3.4. After the joint is made, any extraneous materials shall be removed from the inside of the joints with a suitable scraper or "badger". The newly made joints shall be protected, until set, from the sun, dry winds, rain or frost, sacking or other suitable materials which shall be used for the purpose.

2.3.5. The mortar shall be cured for 10 days.

2.4. Testing of Joints:

2.4.1. If any leakage is visible the defective part of the work shall be made good at no extra cost. The pipe line shall be tested as directed.

2.4.2. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joints shall be watched for and taken as indicating a defect to be made good.

3.0. Mode of measurements and payment

3.1. Pounding or buttering of the fit trenches bed to the lower part of the pipe and "Grips" dug to take socket, collars etc. are included in the rate of laying the pipes.

3.2. The measurements shall be net without any allowance for cutting, and waste. The length of bends, junctions, and other connections shall be included in the total length of the drain pipes. Nothing extra shall be paid for the same. The rate includes necessary excavation refilling trenches etc. complete,

3.3. The rate shall be for a unit of One running meter.

24.1.(B) Providing and laying and jointing salt glazed stoneware pipes with lime concrete 1:2:4 (1 lime :2 fine sand : 4 graded brick aggregate 40 mm, nominal size)bedding with necessary form work and curing etc. complete : 150 mm. dia.

1.0. Materials & Workmanship : The relevant specifications of item 24.1.(A) shall be followed except that the diameter of pipe shall be 150 mm. dia.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No, 24.1. (A) shall be followed.

2.2. The rate shall be for a unit of One running meter.

24.2.(A) Providing and laying cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone : aggregate 40 mm. nominal size) bedding for stoneware pipe of following internal diameter with necessary form work and curing complete : 100 mm. dia. 300 mm. width (112 mm. average bed thickness).

1.0. Materials : (1) Water shall conform to M-1 (2) Cement shall conform to M-3. (3) Sand shall conform to M-6 (4) Stone aggregate 40 mm nominal size shall conform to M-12.

2.0. Workmanship

2.1. The relevant specifications of item 5.3.4. shall be followed except that the concrete work shall be carried out in trenches as bedding for stoneware pipes. The width of concrete shall be 300 mm. and average thickness of bedding shall be 112 mm The concrete shall be brought up at least to the invert level of the pipe to form a cradle and to avoid line contact between the pipe and the bed.

3.0. Mode of measurements & payment

3.1. The rate includes cost of all labour and materials required for satisfactory completion of this item.

3.2. The rate includes cost of necessary form work required if any

3.3. The rate shall be for a unit of One running meter.

24.2.(B) Providing and laying cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm. nominal size) bedding for stoneware pipe of following internal diameter with necessary form work and curing complete : 150 mm. dia. 450 mm. width (166 mm. average bed thickness),

1.1. Materials & Workmanship : The relevant specifications of item 24.2 (A) shall be followed except that the cement concrete work shall be carried out for bedding of stoneware pipe of 150 mm. dia. The average thickness of bedding shall be- 166 mm. and width shall be 450 mm.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item 24.2 (A) shall be followed.

2.2. The rate shall be for a unit of One running meter.

24.19(1) Providing and fixing S.W. gully trap with C.I. grating brick masonry chamber and watertight C.I. cover with frame of 300 mm. x 300 mm. size (Inside) with standard weight : (A) square mount taps 100 mm. x 100 mm. size P. type

1.0. Materials : (1) Water shall conform to M-1. (2) Cement mortar of proportion 1:5 shall conform to M-11. (3) Burnt brick shall conform to M-15. (4) The S.W. Gully trap of 100 mm. x 100 mm. size shall conform to M-70.

2.0. Workmanship

2.1. Excavation for gully trap shall be done true to dimensions and levels as indicated on plans or as directed. The excavation work shall generally be done as per relevant specifications of item 4.0.0. of earth work.

2.2. Fixing:

2.2.1. The gully trap shall be fixed over cement concrete 1:5:10 (1 cement : 5 sand : 10 graded brick aggregate 40 mm nominal size) foundation. 650 mm square and 100 mm. thick The depth of top of concrete below the ground level shall be 675 mm. The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipe as described in item No. 24.1 (A).

2.3. Brick masonry chamber : After fixing and testing gully and branch drain, a brick masonry 300 x 330 mm. inside with bricks in CM 1:5 (1 cement : 5 sand) shall be built with a 100 mm. brick work round OH; gully trap from the top of bed concrete up to ground level. The space between the chamber walls and

the trap shall be filled with cement concrete 1:5:10. The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 cement: 3 sand) finished with floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

2.4. C.I. cover with frame 300 mm, x 300 mm. (inside) size shall then be fixed on the top of the brick masonry with C.c. 1:2:4 (1 cement : 2 coarse sand : 4 graded aggregate 20 mm. nominal size) 40 mm. thick and rendered smooth. The finished top of the cover shall be left about 40 mm. above the adjoining ground level so as to exclude the surface water from entering the gulley trap.

3.0. Mode of measurements & payment

3.1. The rate includes cost of all labour, materials, tools and plant etc. required for satisfactory completion of this item as described above.

3.2. The rate shall be for a unit of one number basis.

24.22. Providing and laying (to level or slopes) and jointing reinforced concrete light duty non-pressure pipes I.S. class N.P. 2 of the following internal diameters with collars and butt ends prepared for collar joints including testing of joints etc. complete. (B) 150mm. (C) 250 mm. (D) 300 mm. (E) 450 mm. (F) 500 mm. (G) 600 mm. (H) 900 mm.(K) 1000mm. (M) 1200 mm.

1.0. Materials : The reinforced concrete light duty non-pressure pipes of specified diameter shall conform to I.S. 458-1971.

2.0. Workmanship

2.1. The relevant specifications of item No. 24.1. A shall be followed for work of trenches except that the excavation in trenches shall be for reinforced concrete pipes of specified diameter.

2.2. Laying

2.2.1. The pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Where necessary pipe shall be laid in straight lines or with easy curves and true to line and gradient as specified. The laying of pipe shall proceed upgrade of a slope. In the pipe spigot and socket joints, the socket ends shall face upstream. In case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid.

2.2.2. In case where the foundation conditions are unusual such as the proximity of trees or holes, under existing or proposed all round in 150 mm. thick cement concrete 1:5; 10 (1 cement: 5 fine sand : 10 graded stone aggregate 40 mm. nominal size) or compacted sand or gravel:

2.2.3. In case where the natural foundation is inadequate the pipes shall be laid either in concrete cradle, supported on proper foundations or on any other suitably designed structure. If concrete bedding is used, the depth of concrete below bottom of the pipe shall be at least 1/4th of the internal diameter of the pipe subject to a minimum of 100 mm. and a maximum 300 mm. The concrete shall be extended up the sides of the pipe at least to a distance of 1/4th of the outside diameter for pipes 300 mm. and over in diameter.

2.2.4. The pipes shall be laid in the concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far as up to the haunches of the pipe as to safely transmit the load expected from the back fill through the pipe to the bed. This shall be done either by excavating the bottom of the trenches to fit the curve of the pipe or by compacting the earth under a round curve of the pipe to form an even bed, Necessary provision shall be made for joints wherever required.

2.3. Jointing

2.3.1. The joints shall be done by slipping the collar over and clear of the end of the pipe. The recess of the end of the pipe shall be filled with jute braiding in hot bitumen. The new pipe shall then be brought forward until the bitumen ring in recess of first pipe is set into the recess of the second pipe. The process shall be repeated for two or three pipes which shall then jacked up so as to thoroughly compress the bitumen. The quantity of jute and bitumen shall be just enough to fill the recess when pressed hard by jacking, care being taken that no offset of the jute braiding shall be visible either outside or inside of pipe. The collar shall then be set up over the joints covering equally both the pipe and leaving, an even caulking space all round. Cement and sand mortar: 1: 1.1/2 shall then be well punched or pressed home with a caulking tool within this caulking space. Care shall be taken that the underside of the joints is properly filled with mortar.

2.4. Curing

2.4.1. Every joints shall be kept wet for about 10 days for maturing. The section of the pipe line laid and jointed shall be covered immediately to protect from weather effects. Minimum bore of 100 mm. is considered adequate.

2.4.2. The joints shall be left exposed for observation.

2.5. Testing of Joints :

2.5.1. The testing of joints shall be done as per relevant specifications of item No. 24.1 (A) **except that** the testing of reinforced concrete pipes shall be done.

3.0. Mode of measurements & payment

3.1. The relevant specifications of item 24.1 (A) shall be followed except that the rate includes for laying to level or slope in trenches etc. (measured separately), making the joints a; Seated and testing to stand the water test.

3.2. The measurements shall be net without any allowance for cutting and waste. The length of bends, junctions and other connections (measured along the centre line) shall be included in the total length of the pipes, the connections being numbered afterwards and paid for extra over pipes.

3.3. The size of bend, junctions, etc, shall suit the size of pipe. The bore (internal diameter of pipe) shall be the criterion for payment.)

3.4. Nothing extra shall be paid separately for the use of mechanical appliances, where necessary, as described above.

3.5. The rate shall be for a unit of One running meter.

2.4.27. Costing Manhole with R.C.C. Top slab in 1:2:4 mix (1 cement: 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) foundation concrete 1:3:6 (1 cement : 3 coarse sand : 6 bricks bats 40 to 50 mm. size) inside plastering 15 mm. thick with C.M. 1:5 (1 cement : 5 coarse sand) finished with floating coat of neat cement and making channels in C.C. 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm. nominal size) finished smooth complete including curing and testing (I) inside size 900 mm. x 120 mm. and 1.5 mm. deep, including C1 cover with frame size 560 mm. diameter, total weight of cover and frame to be not less than 128 Kgs. (Wt. of cover 64 Kg. and Wt. of frame 64 Kg.) (A) With 230 mm. thick walls of brick masonry using bricks having crushing strength not less than 35 kg/sq. cm. in C.M. 1:5 (1 cement : 5 coarse sand)

i.	A type depth	0.90 meter for	150 mm. sewer
ii.	B type depth	1.50 meter for	150 mm. sewer
iii.	C type depth	2.25 meter for	150 mm. sewer
iv.	D type depth	3.15 meter for	150 mm. sewer

1.0. Materials : Water shall conform to M-1. Cement shall conform to M-6. Burnt bricks shall conform to M-15. Brick bats of 40 to 50 mm. size shall conform to M-14. Stone coarse aggregate of 20 mm. nominal size shall conform to M-12. Grit shall conform to M-8. Cement mortar of specified proportion shall conform to M-11. The cast iron manhole cover of 560 mm. dia. with frame shall conform to I.S. 1726-1966.

2.0. Workmanship

2.1. The manholes of different types and sizes as specified shall be constructed in sewer line at such places and to such levels and dimension as shown in drawings of as directed.

2.2. The manholes shall be built on a bed of cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 brick bats) (40 to 50 mm. nominal size) to the thickness of the bed concrete shall be 15 cms. for manhole up to 1. M. depth and 20 cms. for manholes over meter and up to over meter and up to 2 meters, depth and 30 cms. for manholes o greater depth.

2.2.2. Projection of bed concrete beyond the masonry wall shall be 15 cms.

2.3. Walls

2.3.1. The walls of manhole shall be carried out with burnt bricks using having bricks. crushing strength not less than 35 Kg/Cms in C.M. 2 in C.M. 1:5 (1 cement : 5 coarse sand). The thickness of brick masonry wall shall be 230 mm. The jointing face of such .brick shall be well buttered with cement mortar before laying so as to ensure a full joints.

2.4. Plaster

2.4.1. The inside of waits shall be plastered 15 mm. thick with C.M. 1:5 (1 cement : 5 coarse sand) and finished with floating coat of neat cement. All angles shall be rounded to 7.50 cms. radius and all rendered internal surfaces shall have hard impervious finish obtained by using a steel trowel. The external joints of masonry shall be finished smooth.

2.5. Channels & Benching :

2.5.1. Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the out going pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow. The main channel shall be given.

2.5.2. The channel and benching shall be done in C.C. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) rising at a slope in line from edges of channel. The channels of the bottom of the chamber shall be plastered with C.M. 1:2 (1 cement : 2 coarse sand) and steel troweled smooth.

2.6. Cover slab:

2.6.1. The cover slab of R.C.C. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. nominal size) 15 cms. thick reinforced with 10 mm. bars at 15 cms. C/C both ways, surface and edges finished fair. Full bearing equal to the width of wall shall be given to the slab on all sides. The frame of manhole cover shall be embedded firmly in R.C.C. slab so that the top of the frame remains flush with the top of R.C.C. slab.

2.7. Testing:

2.7.1. Manhole shall be tested by filling with water to a depth not exceeding 1.2 M. as directed.

2.7.2. After completion of work, manhole cover shall be sealed by means of thick grease.

3.0. Mode of measurements and payment

3.1. The depth of manholes shall be distance between the top of the manhole cover and the invert level of the main drain. The rate includes all labours, materials, tools, and plant etc. required for satisfactory completion of this item as directed above.

3.2. The rate shall be for a unit of the One number.

24.28.(I) Extra rate for constructing B.B. masonry for every additional depth of 0.1 M. or part thereof over item 24.47 (I) for depth from 0.90 to 1.5 M.

1.0. Materials and Workmanship

The relevant specifications of item No. 24.27 (I) shall be followed for excavation same, except that the depth of manhole shall be done 0.1 M. or part thereof more than 0.90 meter up to 1.5 M. The extra payment shall be made for additional depth of 0.1 M. or part thereof manhole done over and above the depth 0.90 meter.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 24.27 (I) shall be followed except that the extra rate shall be paid for every additional depth of 0.1 M. and part thereof shall be paid over and above the rate of item No. 24.27 (I)

2.2. The rate shall be for a unit of One number.

24.28.(II) Extra rate for constructing B.B. masonry for every additional depth of 0.1 M. and Part thereof over item 24.27 (II) for depth from 1.5 M. to 2.25 M.

1.0. Materials and Workmanship : The relevant specifications of item No. 24.27 (II) shall be followed except that the depth of manhole shall be done 0.1 M. or part thereof more than 1.5 M. up to 2.25 M. The extra payment shall be made for additional depth of 0.1 M. or part thereof manhole done over and above the depth 1.50 M. up to 2.25 M.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No. 24.27 (II) shall be followed except that the extra rate shall be paid for 0.1 M. or part thereof additional depth of manhole provided over and above item 24.27 (II).

2.2. The rate shall be for a unit of One number.

24.28.(III) Extra rate for constructing B.B. masonry for every additional depth of 0.1 M. or part thereof over item 24.27 (III) for depth from 2.25 to 3.15 M.

1.0. Materials and Workmanship : The relevant specifications of item No. 24.27 (III) shall be followed except that the depth of manhole shall be done 0.1 M. or part thereof more than 2.25 M. up to 3.15 M. Extra payment shall be made for additional depth of 0.1 M. or part thereof manhole done over and above depth 2.25 M. up to 3.15 M.

2.0. Mode of measurements & payment

2.1. The relevant specifications of time No. 24.27 (III) shall be followed except that the extra rate shall be paid for every addition 0.1 M. or part thereof depth provided over and above it -m 24.27 (III).

2.2. The rate shall be for a unit of One number.

24.28.(IV) Extra rate for constructing B.B. masonry for every additional depth of 0.1 M. or part thereof over item 24.27 (IV) for depth above 3.15 M.

1.0. Materials and Workmanship : The relevant specifications of item No. 24. 27 (IV) shall be followed except that the depth of manhole shall be done 0.1 M. or part thereof more than 3.15 M above. 1.2. Extra payment shall be made for additional depth of manhole 0.1 M. or part thereof done above 3.15 M. and above depth.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 24.27 (IV) shall be followed except that extra rate shall be paid for every additional 0.1 M. or part thereof depth provided for an above item 24.27 (IV).

2.2. The rate shall be for a unit of One number.

24.33. Providing and fixing C.I. steps of sizes 500 x 150 mm. 22.5 mm. and painting with two coats of anti-corrosive paint etc. complete.

1.0. Materials : The C.I. steps of size 500 x 150 x 22.5 mm. size shall conform J.S. 5455-1969. Paint shall conform to M-44.

2.0. Workmanship

2.1. The C.I. steps of size 500 x 150 x 22.5 mm. size shall be fixed in manhole as and where directed. The steps shall be staggered in vertical runs 380 mm. apart horizontally. The top step shall be 450 mm. below the manhole cover and lowest not more than 300 mm. above the benching. The steps shall be embedded in wall of manhole with C.C. : 1:3:6 up to 200 m. depth and the surface finished with cement plaster 15 mm. thick in C.M. 1:5. The steps shall be painted with two coats of anti-corrosive paint.

3.0. Mode of measurements & payment

3.1. The rate includes all labour, materials, tools and plants etc. required for satisfactory completion of this item.

3.2. The rate shall be for a unit of One number.

24.39. Providing and erecting at the site of work steel ventilating column of 150 mm. internal dia. and 12.20 M. high from G.L. to bottom of top grill, including C.I. grill and base plate, bolts and nuts etc. and excavation in foundation of size 120 x 120 x 165 cms. and filling the pit with 1st layer of cement concrete 1:3:6 mix (1 cement: 3 coarse sand : 6 graded stone aggregate 20 mm. nominal size) of size 120 x 120 x 90 cm. and remaining pit with B.B,C.C. 1:3:6 mix (1 cement : 3 coarse sand : 6 brick bats 40 to 50 mm. size) and providing filled in cement concrete : 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) at G.L. and 3 coats of silver paint etc. complete.

1.0. Materials :

The steel ventilating column internal dia. 150 mm. 12.20 m. high shall be of standard many and best quality as approved. Stone aggregate of 20 mm. nominal size shall conform to M-12. Brick-bats-40 to 50 mm. nominal size shall conform to M-4. Cement shall conform to M-3. Water shall conform to M-1. Silver (Aluminum) paint shall conform to I.S. 2339-1963.

2.0. Workmanship

2.1. The vent shaft shall be provided at the starting point of main sewer and at such points where the flow of sewerage is disturbed i.e. at falls, siphons etc. As far as possible, the location shall be at such a place where it receive Sundays for the maximum period of the day.

2.2. A pit of 120 x 120 x 165 ms. size shall be dug The cement concrete of 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm. nominal size) shall be first laid in the pit to form 90 cms. thick

concrete foundation which shall be allowed to set for 24 hours. The vent shaft shall then be erected at the centre of the pit truly in plumb by means of such as shear legs, pullies, backless and rope etc.

2.3. The connection with sewer man-hole shall be made using 150 mm. diameter cement concrete pipe. After the connection is completed, the pit shall be filled with cement concrete : 1:3:6 (1 cement: 3 coarse sand : 6 brick bats 40 to 50 mm. nominal size) round the vent shaft up to ground level except top 150 mm. which shall be filled with C.C. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) and rendered smooth. The junction of vent shaft with cement concrete shall be grouted with cement mortar 1:1 (1 cement : 1 sand). The concrete work shall be cured for 7 days.

2.4. The steel shaft shall be painted with silver paint (aluminum paint) 3 coats. The relevant specifications of item of painting shall be followed for painting.

3.0. Mode of measurements and payment

3.1. The rate shall include the cost of all labours and materials, tools and plant etc. required for satisfactory completion of this item as directed above.

3.2. The rate shall be for a unit of One number.

24.00.1.(A) Providing and laying lime concrete 1:2:4 (1 Lime Putty : 2 fine sand : 4 graded brick aggregate 40 mm. nominal size) bedding for stoneware pipes of following internal diameters with necessary form work and curing complete : 100 mm. dia (112 mm. average, bed thickness).

1.0. Materials : Water shall conform M-1. Lime mortar shall conform to M-10. Brick aggregate 40 mm. nominal size shall conform to M-14.

2.0. Workmanship

The relevant specifications of item No 5.1.8 shall be followed except that the proportion of mix shall be 1:2:4 (1 Lime Putty : 2 fine sand : 4 graded brick bats aggregate 40 mm. nominal size) and the concrete work shall be done in trenches for bedding of stoneware pipes of 100 mm. dia. The width of concrete shall be 300 mm. and the thickness of bedding shall be 112 mm. average.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item 24.2 (A) shall be followed.

3.2. The rate shall be for a unit of One running meter.

24.00.1(B) Providing and laying lime concrete 1:2:4 (1 Lime Putty : 2 fine sand : 4 graded brick aggregate 40 mm. nominal size) bedding for stoneware pipes of following internal diameters with necessary form work and curing complete :150 mm. dia. (166 mm. average bed thickness).

1.0. Materials and workmanship : The relevant specifications of 24.00.1 (A) shall be followed except that the concrete bedding shall be carried out for 150 mm. dia. stoneware pipe. The width of concrete bedding shall be 450 mm. and the average thickness shall be 166 mm.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 24.2 (A) shall be followed.

2.2. The rate shall be for a unit of One running meter.

24.27(1) Extra over item 24.1 for providing salt glazed stoneware fittings : Bends of required degree (Any Radius) of following internal diameters : A-100 mm. dia. B-150 mm. dia.

1.0. Materials & Workmanship

The relevant specifications of item 24.1 (A) shall be followed that the salt glazed stoneware bends of any degree of specified diameter shall be provided.

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 24.1 (A) shall be followed except that extra payment shall be made for providing salt glazed stoneware bend of specified diameter or required degree of any radius over above the of item No. 24.1.

2.2. The rate shall be for a unit of One number.

24.17.(I)(A) Extra over item 24.1 for providing salt glazed stoneware fittings : Taper bend of required degree of following internal diameter. 100 mm. x 150 mm.

1.0. Materials & Workmanship : The relevant specifications of item 24.1 (A) shall be followed except that the salt glazed stoneware taper bend of required degree of 100 mm. x 150 mm. shall be fixed.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item No, 24.1 (A) shall be followed except that extra payment shall be made for providing salt stoneware taper bend of required degree of 100 mm. x 150 mm. size over and above the rate of item No. 24.1.

2.2. The rate shall be for a unit of One number.

24.17.(III) Extra over item 24.1 for providing salt glazed stoneware fittings : Single junction of required angle of following internal diameter (A) 100 mm. dia. (B) 150 mm. dia.

1.0. Materials & Workmanship

The relevant specification of item 24.1 (A) shall be followed except that the salt glazed stoneware single of junction required angle of specified diameter shall be fixed.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item 24.1 (A) shall be followed except that the extra rate shall be paid for providing salt glazed stoneware single junction of required angle for specified diameters over and above the rate of item 24.1.

2.2. The rate shall be for a unit of One number.

24.18. Providing and laying, jointing and jointing and pointing with stiff mixture of C.M. 1 : 1 (1 cement : 1 fine sand) 150 mm. internal diameter salt glazed stoneware half round channels.

1.0. Materials and Workmanship : The relevant specifications of item 24.1 shall be followed except that the half round channels of 150 mm. internal diameters shall be fixed in cement mortar 1:1.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 24.1 (A) shall be followed.

2.2. The rate shall be for a unit of One running meter.

24.35. Supplying and fixing C.I. cover 300 x 300 mm. without frame for gully trap (Standard pattern), weight of cover shall not be less than 4.53 Kg.

2.0. Workmanship

The C.I. cover 300 x 300 mm. size without frame shall be fixed on top of the brick masonry with cement concrete : 1:2:4 (1 cement : 2 sand : 4 graded stone aggregate 20 mm. nominal size) 40 mm. thick and rendered smooth. The finished top of the cover shall be left about 40 mm. above the adjoining ground level so as to exclude the surface water from entering the gully trap.

3.0. Mode of measurements and payment

3.1. The relevant specifications of item No, 24.19 shall be followed.

3.2. The rate shall be for a unit of One number.

24.40. Constructing brick masonry road gully chamber 500 mm. x 450 mm. x 600 mm. including 500 mm. x 450 mm C.I. horizontal grating with frame complete.

1.0. Materials : Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Brick shall conform to M-15. C.I. Grating of 500 x 450 mm. size of standard make shall be of approved quality. Stone aggregate 40 mm. nominal size shall conform to M-12. coal tar shall conform to relevant M-5.

2.0. Workmanship

2.1. The chamber shall be of size 500 mm. x 450 mm. internal clear dimensions between the masonry wall faces. The height of 500 mm. shall be measured from the top of the bed concrete to the top of the C.I.

frame. The size of grating indicate the clear internal dimensions of the C.I. frame of the grating.

2.2. The excavation shall be done to true dimensions and levels.

2.3. The foundation concrete shall consist of 150 Cms x 100 Cms x 15 cms thick C.C. 1:5:10(1 cement : 5 sand : 10 graded stone aggregate 40 mm. nominal size).

2.4. The wall of the chamber shall be constructed in brick work C.M. 1:5 and 23 Cms. thick as per relevant specifications of item 6.12(8).

2.5. The walls and the bed concrete of chamber shall be plastered inside with 12 mm. thick cement plaster 1 : 3 (1 cement : 3 coarse sand) finished smooth.

2.6. The gully grating cover shall be hinged to frame to facilitate its opening for cleaning and repairs. The frames of the gully grating g shall be fixed on the top of masonry wall of the chamber in 15 cms. thick C.C. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) laid over the full thickness of walls..

2.7. The chamber shall have connection pipe, the length of which in meter between the road gully chamber and the manhole of the drain shall not be less than 1/40 times the nominal diameter of the pipe in MM. i.e. for 150 mm* connection pipe the length shall not be cement plaster on the bed concrete.

2.8. Painting : After the completion of the work of exposed surface of the grating of the frame shall be painted with a thick coat of coal tar.

3.0. Mode of measurements and payment

3.1. The cost of connection pipes is not included in the item and shall be paid separately. However, fixing the connection pipes in the walls of gully chamber is included in the rate for gully chambers and nothing extra shall be paid for this separately.

3.2. The rate shall be for a unit of One number.

24.41. Constructing brick masonry road gully chamber 450 mm. x 450 mm. x 775 mm. with vertical grating complete.

1.0. Materials and Workmanship : The relevant specifications of item 24.40 shall be followed except size of road gully chamber is 450 mm x 775 mm. with vertical grating complete.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 24.40 shall be followed.

2.2. The rate shall be for a unit of one number.

24.42. Constructing brick masonry road gully chamber 1100 mm. x 500 mm. x 775 mm. including 500 mm. x 450 mm. C.I. horizontal grating with frame and vertical grating complete.

1.0. Materials and Workmanship : The relevant specifications of item 24.40 shall be followed except that the size of road gully chamber shall be 1100 mm. x 500 mm. x 775 mm. including 500 mm. x 450 mm. C.I. horizontal grating with frame and vertical grating complete.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item No. 24.40 shall be followed.

2.2. The rate shall be for a unit of one sq. meter.

24.44(1) Constructing brick masonry chamber for underground C.I. inspection chamber and bends with brick having crushing strength not less than 35 Kg/ Cm. 2 in C.M/ 1:5 C.I. cover with frame (light duty) 455 x 610 mm. internal dimensions, total weight of cover with frame to be not less than 38 Kg. (Wt of cover 23 Kg. and Wt of frame 15 Kg.) R.C.C. top slab C.C. 1:2:4 mix (1 cement : 2 coarse sand : 4 graded aggregate 20 mm. size) foundation concrete 1:5:10, inside plaster 15 mm. thick with C.M. 1:3 finished smooth with a finishing coat of neat cement on walls and bed concrete etc. complete : Inside dimensions 455 mm. x 610 mm. and 450 mm. deep for single pipe-line.

1.0. Materials : Water shall conform to M-1. Cement shall conform to M-3. Coarse sand shall conform to M-5. Brick shall conform to M-15. Stone aggregate shall conform to M-12. Brick bat shall conform to M-14. M.S. bar shall conform to M-18.

2.0. Workmanship

2.1. C.I. inspection chamber with provision of C.I. bends of specified size with bolts, nuts and felt washers for underground drain shall be enclosed in masonry chamber which shall be constructed as under:

2.2. The excavation shall be done true to dimensions and level shown in one the plans or as directed.

2.3. Bed concrete shall be 15. Cms, thick C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded brick bat aggregates. The projection of bed concrete beyond the masonry walls shall be 7.5 cms.

2.4. Masonry walls and plaster work shall be carried out as per relevant specifications of item 24.40.

2.5. The cover slab shall be constructed as per relevant specifications of 24.27 (I).

3.0. Mode of measurements and payment

3.1. The earth work in excavation, providing and laying C.I. inspection chamber and bends shall be measured and paid for separately.

3.2. The rate shall be for a unit of One number.

24.44.(II) Constructing brick masonry chamber for underground C.I. inspection chamber and bends with brick having crushing strength not less than 35 Kg/ Cm. 2 in C.M/ 1:5 C. cover with frame (light duty) 455 x 610 mm. internal dimensions, total weight of cover with frame to be not less than 38 Kg. (Wt of cover 23 Kg. and Wt of frame 15 Kg.) R.C.C. top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm size) foundation concrete 1:5:10, inside plaster 15 mm. thick with C.M. 1:3 finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete : Inside dimensions 500 mm. x 700 mm. and 450 mm. deep for pipe the with one or two inlets.

1.0. Materials and Workmanship : The relevant specifications of item 24.24 (I) shall be followed except that the inside dimension of brick masonry chamber shall be 500 mm. x 700 mm. and 450 mm. deep for pipe the with on two inlets.

2.0. Mode of measurement and payment

2.1. The relevant specifications of item 24.44 (I) shall be followed. 2.2 The rate shall be for a unit of one number.

24.44.(III) Constructing brick masonry chamber for underground C.I. inspection chamber and bends with brick having crushing strength not less than 35 Kg/ Cm. 2 in C.M/ 1:5 C.I. cover with frame (light duty) 455 x 610 mm. internal dimensions, total weight of cover with frame to be not less than 38 Kg. (Wt of cover 23 Kg. and Wt of frame 15 Kg.) R.C.C. top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. size) foundation concrete 1:5:10, inside plaster 15 mm. thick with C.M. 1:3 finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete : Inside dimensions 600 mm. x 850 mm. and 450 mm. deep for pipes line with three or more inlets.

1.0. Materials and workmanship : The relevant specifications of item No. 24 .44 (I) shall be followed except that the inside dimensions of chamber shall be 600 mm, x 850 mm. and depth 450 mm. for pipe lines with three or more inlets.

2.0. Mode of measurements & payments

2.1. The relevant specifications of item 24.44(1) shall be followed.

2.2. The rate shall be for a unit One number.

24.46. Extra over item 24.44 for every additional depth of 1 M. or part thereof beyond 450 mm. depth for brick masonry chamber, (i) For 455 mm. x 610 mm. size (ii) For 500 mm. x 700 mm. size (iii) For 600 mm. x 850 mm. size.

1.0. Materials & Workmanship : The relevant specifications of item 24.44 (i),(ii) (iii) shall **be followed** same except that **extra** depth of 0.1 M. or part thereof shall be constructed over and above the depth of respective items.

2.0. Mode of measurements & payment

2.1. The relevant specifications of item 24.44 (I) shall be followed except that the extra shall be paid for, providing additional depth of 0.1 M. or M. or part thereof over and above the item No 24.44. (I) 24.44 (II) 24.44 (III) as the case may be.

2.2. The rate shall be for a unit of One number.

24.00.2.(A) Providing soak pit of 2 cum. volume including excavating and filling brick bats with dry masonry work at top for 450 cms. height including covering, the top with stone including providing Vatas in C.M. 1:3 with finishing curing etc. complete as directed.

1.0. Materials : Water shall conform to M-1. Cement mortar con form to M-11. Burnt Bricks shall conform to M-15. Rough stone slab 40 x 50 mm. thick shall conform to M-48. Brick bat shall conform to M-14.

2.0. Workmanship

2.1. The excavation for soak pit shall be carried out as. per relevant specifications of item. 4.G0.1 (A) except that the size of soak pit such that the clear volume 'Shall* remain 2 cum. The diameter and depth shall be as directed.

2.2. The periphery of the sock pit shall be provided with dry masonry wall with burnt bricks in 23 cms. thick. The masonry wall shall be done with best workman like manner in true line and plumb.

2.3. The soak pit shall be filled in with brick bats of burn brick 40 mm. nominal size in 45 cms. height. The work of filling brick-bats shall be done in such a way that no dry masonry shall be damaged during filling of brick bats.

2.4. The top of the soak pit shall be covered with rough kotah stone slab 40 to 50 mm. thickness. The length of the stone shall be in single piece in length.

2.5. The cement mortar 1:3 shall be used to fill up the joints and preparing vata as directed.

2.6. The cement work shall be cured for 4 days.

3.0. Mode of measurements and payment

3.1. The rate includes costs of all labour and material required for satisfactory completion o this item as described above.

24.00.2.(B) Providing soak-pit of 5 cum. Volume inc. excavating and filling brick bats with dry masonry work at top for 45 cms. height including covering the top with stone including providing vatas in C.M. 1:3 with finishing curing etc. complete as directed.

1.0. Materials and workmanship : The relevant specifications of item 24.00.2 (A) shall be followed except that the volume of soak pit shall be 5 cum. clear.

2.0. Mode of measurements and payment

2.1. The relevant specifications of item 24.00.2 (A) shall be followed.

2.2. The rate shall be for a unit of One number.

EQUIVALENT PLAIN AREAS OF UNEVEN SURFACES
(Vide specifications for items relating to : Painting & Polishing)

Sr. No.	Description of work	How measured	Multiplying Factor
1.	Paneled or framed and braced on ledged and battened or ledged and braced joinery.	Measured flat (not girthed) including chowkhat or frame edges, chocks clients etc. shall be deemed to be included in item.	1.30 (For each said)
2.	Flush joinery	Measured flat (not girthed) including chowkhat or frame. Edges, Chocks, cleats, etc. shall be deemed to be included in the item.	1.20 (For each side)
3.	Fully glazed or gauzed joinery	Measured flat (not girthed) including chowkhat or frame. Edges, Chocks, cleats, etc. shall be deemed to be included in the item.	0.80 (For each side)
4.	Partly paneled and partly glazed or gauzed joinery	Measured flat (not girthed) including chowkhat or frame. Edges, Chocks, cleats, etc. shall be deemed to be included in the item.	1.00 (For each side)
5.	Fully venetioned or louvered joinery.	Measured flat (not girthed) including chowkhat or frame. Edges, Chocks, cleats, etc. shall be deemed to be included in the item.	1.80 (For each side)
6.	Weather boarding	Measured flat (not girthed) supporting frame work shall not be measured separately.	1.20.(For each side)
7.	Wood single roofing	Measured flat (not girthed)	1.10(For each side)
8.	Boarding with cover fillets at match boarding	Measured flat (not girthed)	1.05 (For each side)
9.	Tile and Slate battening	Measured flat, overall, no deduction shall be made for open space over	0.80 (For painting all over)
10.	Trellis (or Jafri) work one way or two way	Measured flat, over all, no deduction shall be made for the open spaces supporting members shall not be measured separately)	1.00 (For painting all over)

11.	Guard, bars, balustrades, gates, graying, grills, expanded metal and railings.	Measured flat over all, No deduction shall be made for the open spaces, over) supporting members shall not be measured separately.	1.00 (For painting all over)
12.	Gates and open palisade fencing including standards	Measured flat over all No. deduction shall be made of open spaces : supporting members shall not be measured separately, (see note).	1.00 painting all over
13.	Curved or enriched work	Measured flat	2.0 (For each side)
14.	Steel roller shutter	Measured flat (size of opening) over all jamb, guides bottom rails and locking arrangement etc., shall be included in the item (top cover shall be measured separately).	1.10 (For each side)
15.	Plain sheet door and windows	Measured flat (not including) frame	1.10 (For each side)
16.	Full glazed or gauze steel door and windows	Measured flat (not girthed) including Frame edges etc.	0.50 (For each side)
17.	Partly paneled and partly glazed or gauzed steel doors	Measured flat (not girthed) including frame edges etc.	0.08 (For each side)
18.	Collapsible gate	Measured flat (size of opening) no separate measurements shall be taken for the top and bottom guide rails, rollers, fittings, etc.	1.50 (For painting all over)

Note : The height shall be taken from the bottom of the lowest of rail if the palisades do not go below it (or from the lower end of palisades, if they protect below the lower rail) up to the top of palisades, but not upto the top of standards if they are higher then the palisades.

CODE OF PRACTICE C-13 (B)
SCHEDULE OF FIXTURES AND
FASTENINGS FOR DOORS,
WINDOWS, VENTILATORS,
WARDROBES AND CUPBOARDS

NOTATIONS

Da.....	Teakwood doors fully paneled or fully glazed or partly paneled : and glazed
Db.....	Bathroom and W.C. door with single shutter
Dc.....	Doors plying planked
Dd.....	Doors battened framed and braced
Wa.....	Teakwood windows fully paneled or fully glazed or partly paneled and glazed
Va-Ind.....	Teakwood ventilator (independent)
S.W.....	Steel Windows
SV-Ind.....	Steel ventilators (independent)
CB.....	Cupboard
S.1.....	Single shutter
S.2.....	Double shutter
S.4.....	Four shutter
B.....	Breadth of door shutter
T.....	Thickness of door shutter
H.....	Height of window shutter.
900.....	900 mm & below
900.....	above 900 mm
1200.....	1200 mm & below
1200.....	above

NOTE : PLEASE READ CAREFULLY :

- (1) Where detailed specification of an item provides for specific size of any fixture or fastening that shall prevail over the provisions in this schedule.
- (2) Fixtures and fastenings (except hold fasts which shall be of M.S. plate only) shall be of Brass, copper, oxidised brass, chromium plated brass, Iron, copper oxidised iron, or chromium plated iron as specified in the item of the work or detailed specifications.
- (3) External door and door failing in staircase excepting the door in balcony shall have sliding door bolt of size 300 mm. x 18 mm. in place of 250 mm. x 16 mm- as shown in this schedule.
- (4) The length of tower bolt shown is for a door having shutter height up to 2100 mm. only. For door having shutter height more than 2100 mm. the length of tower bolts to be increased to the extent of increase of door shutter height beyond 2100 mm.
- (5) 150 mm. x 150 mm. size glass vision panel shall be provided in the doors of Officers chamber in addition to the scheduled provision if so directed by the Engineering in charge.
- (6) Diamond shape chromium plated brass peeping plate of approved quality shall be provided in one entrance door in residential building in addition to the scheduled provisions.
- (7) Drawer up a wardrobe shall be provided with one furniture handle and one drawer lock (4 levers) in addition to its scheduled provision.
- (8) For door and window with steel frame, 75 mm. size screws, shall be provided both in top bottom frame for fixity as shown below:
 - (a) For width up to 1200 mm.....2 Nos.
 - (b) For width above 1200 mm. and up to 1800 mm.....3 Nos.
 - (c) For every additional width of 500 mm. over and above 1800 mm.....1 No.
- (9) When the mortise lock (6 levers) and latch is specified to be provided to a door either in the item of work itself or by a separate item, the requirement of providing sliding door bolt, door latch and handles as per this schedule shall be dispensed with.
- (10) For door/window with ventilator at top, fixtures and fastenings of door/window plus those of ventilator (excluding hold fasts) shall be used.
- (11) Where the item of the work, or its specification provides for anodised aluminum fixtures, all the fixtures except hinges and screws will be of anodised aluminum and chromium plated iron hinges and screws shall be used.
- (12) For door, window, or cupboard frame abutting concrete section, instead of hold fasts as shown in the schedule-, coach screws of size mentioned below shall be used:
 - (a) Teak wood frame..... 125 mm.
 - (b) Steel frame.....75 mm.
- (13) The locking etc. in the door latch shall be so positioned that the can be properly rocked even if part of the latch, when fully slid, remains in the frame or masonry.
- (14) Showcase cupboards having single shutter shall be provided with all catcher instead of tower bolt (barrel type) as per schedule.
- (15) The size of the handle shown in the schedule indicates grip length.
- (16) Door stopper shall be shown in the schedule indicates grip length.
- (17) Piano hinges shall be for the full height of the shutter.
- (18) Shutter with pivot arrangements shall be pivot arrangement shall be provided with two pivots of approved size instead of hinges as per the schedule.
- (19) For butt hinges, only lengths are indicated in the schedule. The width of each flap being 5 mm. less than the thickness of the shutter to which they are to be fixed and the thickness of the flap shall be as specified in the relevant I.S. for heavy, medium or light as specified in the detailed specifications of the item of work.

Schedule for Testing of Materials

For ensuring quality control and workmanship, various test prescribe below corresponding to the material concerned shall be taken as periodic intervals as stipulated below be taken.

The Material shall be got tested Govt. recognized Laboratory (R & B) or field Laboratory of GERI (R & 6) for which 1 % of the estimated amount to tender shall be recovered from the contractor from the R.A. Bill and Final Bills as the testing charges shall be paid by the Govt. to the GERI. However if the charges increase over 1 % no excess recovery shall be made from the contractor as per resolution of B&C department dated 10th May 1985, vide TNC/1085 (4) S.

Item No. as per Sch. B	Brief Description of Materials to be tested	Qty. of Material	Prescription of test which shall be carried out	Frequency @ which test shall be carried out	Total No. of Test to be taken
1.	Kapchi		- Gradation test - Impact Value - Flakiness Index of aggregate	CMT 1 to 100 – 1 test 100 to 500 – 3 tests 500 to 1500 – 5 tests 1500 to 5000 – 7 tests	
2.	Grit		- Stripping Value		
3.	Sand		- Special gravity - Water absorption - Fineness Modulus - Silt – Content - Soundness		
4.	Tiles		- Dimension Test - Transverse strength - Water Absorption - Abrasion Test		
5.	Teakwood		- Anatomy Test - Density Test - Moisture Content Test		
6.	Bricks		- Water absorption - Effluence - Size - Comprehensive Strength	1 Test @ 50,000 Bricks	
7.	Cement		- Consistency - Setting Time - Compressive Strength	1 Test @ 10.0 M.T. As per manual of Quality Control	
8.	Steel		- Tensile Strength - Yield Stress - Elongation - Size		
9.	C.C. Cube test 1:2:4		- Compressive Strength	1 to 5 Cum. 1 No. 6 to 15 Cum. 2 Nos. 16 to 20 Cum. 3 Nos. 21 to 50 Cum. 4 Nos. 51 & Above Cum. 4 + 1 for each Cum or part thereof	

The contractor shall have to pay 1% of the estimate cost put to tender towards all testing of materials & same shall be deducted from their bills for the works. The testing of various materials shall be carried out in GERI and result received shall be binding to all. i.e. contractor and Govt.

Testing Charges of GERI shall be born by Govt. No refund be made or extra charge over 1 % shall be recoverable form the contractor.

SIGN OF CONTRACTOR

MINISTRY OF ROAD TRANSPORT & HIGHWAYS

SPECIFICATIONS FOR ROAD AND BRIDGE WORKS

(Fifth Revision)

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PREFACE TO THE FIFTH REVISION

This edition of the Specifications for Road and Bridge Works marks the Fifth Revision. In the last decade and a half, significant developments have taken place in the highways sector. The massive National Highways Development Projects (NHDP) undertaken by the Government of India is in progress involving execution of a large number of high value road projects. These require adoption of latest international practices so as to achieve technical excellence and the best quality. Concrete bridges have also undergone major changes with development of new structural forms, new methods of computer based analysis and design and development of high strength materials, IRC:112 for concrete bridges based on the limit state method has come into force. Over the past few years, many IRC codes have also been completely revised necessitating extensive changes in the Ministry's specifications for road and bridge works.

Some of the important additions in this revision of Specifications for Road and Bridge Works cover stone mastic asphalt, microsurfacing, sand asphalt base course, prefabricated vertical drains (PVD), natural geo textiles, geo cells for use in base and sub base in pavement and slope protection, variable message sign boards, soil nailing, cold applied retro-reflective paints, audible and vibratory pavement markings, solar powered road markers, traffic control & safety devices in construction zone, traffic impact attenuators and advance traffic management system. Some of the new areas covered in bridges include high performance concrete, HDPE sheathings, Pot-PTFE bearings, jack down method of well sinking, dynamic testing of piles and mechanically woven wire crates for gabions.

The Fifth Revision of the Specifications for Road and Bridge Works is the result of the concerted efforts of the officers of the Roads Wing and other professionals who contributed to the drafting of this document. I wish to express my gratitude to all of them and the Indian Roads Congress for undertaking the assignment of bringing out this publication.

Feedback and suggestion for further improvement would be welcome from users of this edition.



(C. Kandasamy)
DG(RD) & SS
03-01-2013

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100

GENERAL

101 INTRODUCTION

These specifications shall apply to all such road and bridge works as are required to be executed under the Contract or otherwise directed by the Engineer-in-Charge (hereinafter referred to as the Engineer). In every case, the work shall be carried out to the satisfaction of the Engineer and conform to the location, lines, dimensions, grades and cross-sections shown on the drawings or as decided by the Engineer. The quality of materials, processing of materials as may be needed at the site, salient features of the construction work and quality of finished work, measures for safety of workers and public and traffic arrangements during execution shall comply with the requirements set forth in succeeding sections. Where the drawings and Specifications describe a portion of the work only in general terms, and not in complete detail, it shall be understood that only the sound engineering practice is to prevail, materials and workmanship of the best quality are to be employed and the instructions of the Engineer are to be fully complied with.

A list of Indian Roads Congress (IRC) Specifications and recommended Codes of Practice which have been referred in these Specifications is given at Appendix-1. The latest edition of all Specifications/Standards/Codes of IRC till 60 (sixty) days before the final date of submission of the tender, shall be adopted.

In case of any conflict or inconsistency in the provisions of the applicable Specifications/Standards/Codes of IRC, provisions contained in these Specifications shall apply.

102 DEFINITIONS

The words like Contract, Contractor, Engineer (synonymous with Engineer-in-charge), Drawings, Employer, Government, Works and Work Site used in these Specifications shall be considered to have the meaning as understood from the definitions of these terms given in the General Conditions of Contract.

The following abbreviations shall have the meaning as set forth below:-

AASHTO	:	American Association of State Highway and Transportation Officials
ASTM	:	American Society for Testing and Materials
BS	:	British Standard published by the British Standards Institution
BIS	:	Bureau of Indian Standards
BOQ	:	Bill of Quantities
CBR	:	California Bearing Ratio
IRC	:	Indian Roads Congress

- IS : Indian Standard published by the Bureau of Indian Standards
- QA : Quality Assurance

The various elements in the cross-section of a road referred to in these Specifications are shown in the cross-sections in Figs. 100.1, 100.2 and 100.3.

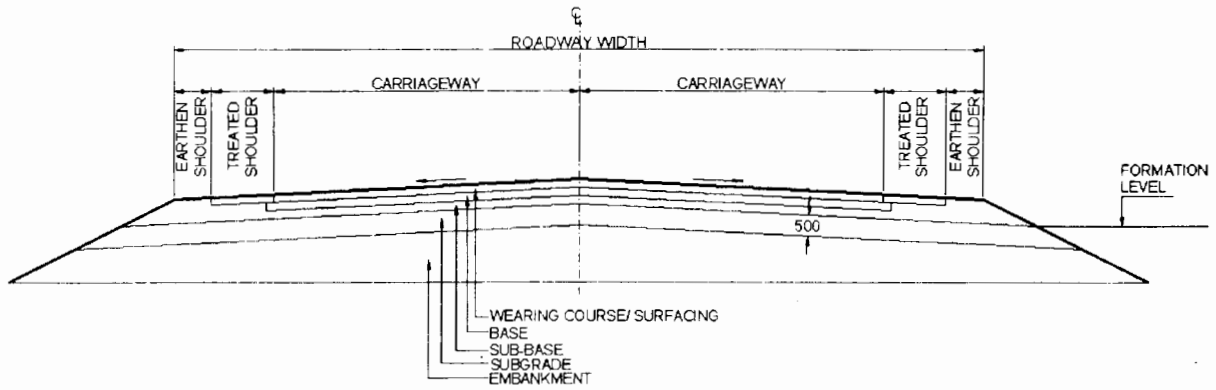


Fig. 100.1 Terms Used in the Specifications to Describe Road Cross-Section Elements with a Flexible Pavement

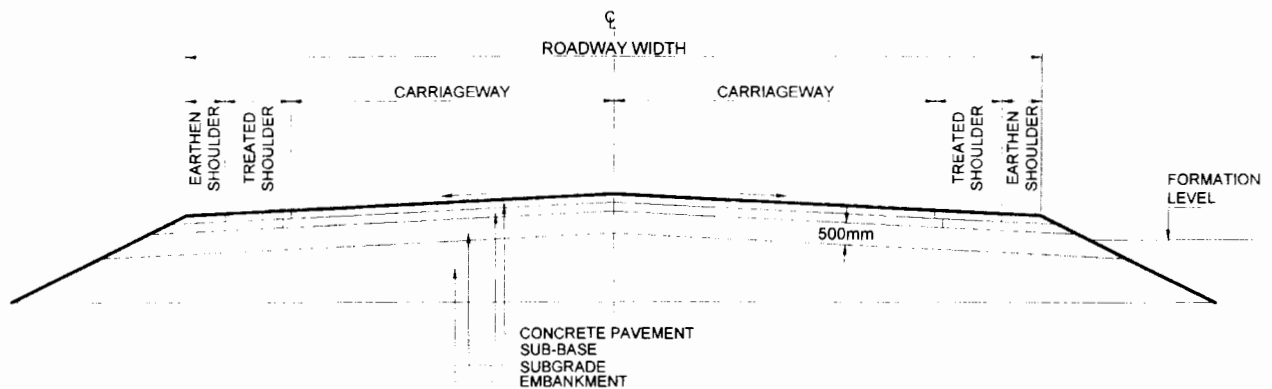


Fig. 100.2 Terms Used in the Specifications to Describe Road Cross-Section Elements with a Concrete Pavement

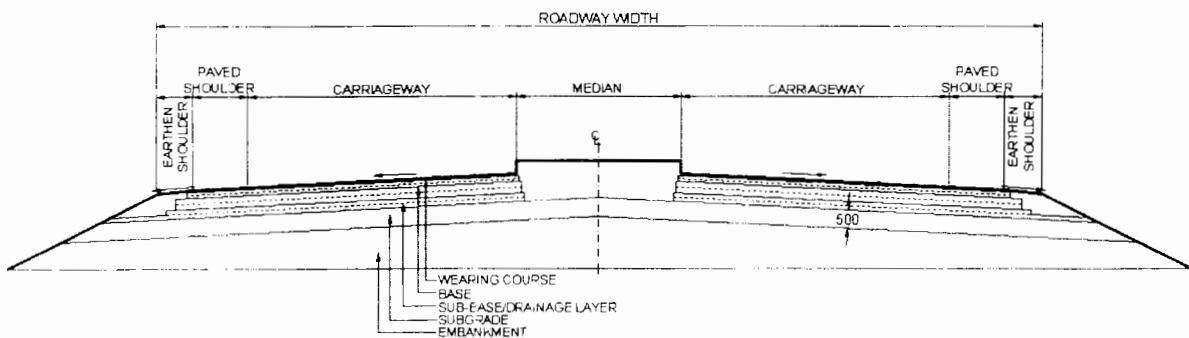


Fig. 100.3 Terms Used in the Specifications to Describe Road Cross-Section Elements of a Dual Carriageway

Treated shoulders shown in the cross-section shall be of following types:-

- i) "Hard" shoulders which have select gravel/moorum, any other compacted granular layer or bricks.
- ii) "Paved" shoulders which have a bituminous surfacing over granular layers.
- iii) "Tied" or "Widened" concrete shoulders of same thickness as the carriageway pavement

103 MATERIALS AND TEST STANDARDS

The relevant standards for materials, as well as the testing procedures, have been indicated at appropriate places in the specifications. A list of these standards with their full title are included at Appendix-2.

104 SIEVE DESIGNATIONS

The sieve designations referred to in the Specifications correspond to those specified by Bureau of Indian Standards in IS:460. Table 100-1 gives the list of the commonly used IS sieves.

**Table 100-1 : Designation of Test Sieves
IS Designation Conforming to IS:460**

(in mm)	(in Micron)
* 125 106	850
* 90 75	* 710 600
* 63 53	* 500 425 355 300
* 45 37.5	* 250 212
* 31.5 26.5	* 180 150

* 22.4	* 125
19.0	106
* 16.0	* 90
13.2	75
* 11.2	* 63
9.50	53
* 8.00	* 45
6.70	
* 5.60	5
4.75	2
* 4.00	
3.35	
* 2.80	
2.36	
* 2.00	
1.70	
* 1.40	
1.18	
* 1.00	

-
- Notes:**
- 1) '*' are the principal sizes stated in ISO-565
 - 2) Sieve sizes given in BS:410 & ASTM-E 11 are same as in IS:460
 - 3) Only sieves with square openings shall be used.

105 SCOPE OF WORK

105.1 The work to be carried out under the Contract shall consist of the various items as generally described in the Contract Documents as well as in the Bill of Quantities furnished in the Contract Documents.

105.2 Conformity with Drawings/Allowable Deviations

105.2.1 All works performed and all materials furnished shall be in conformity with the lines, grades, typical sections, dimensions, material requirements, and tolerances shown in the drawings or as indicated in the Specifications.

105.2.2 The works to be performed shall also include all general works preparatory to the construction of roads, bridges, structures, canal crossings, drainage and all other related works. The works shall include work of any kind necessary for the due and satisfactory construction, completion and maintenance of works to the intent and meaning of the drawings and these Specifications and further drawings and orders that may be issued by the Engineer from time to time. The scope of work shall include compliance by the Contractor with all Conditions of Contract, whether specifically mentioned or not in the various Sections of these Specifications, all materials, apparatus, plant, equipment, tools, fuel, water, strutting, timbering, transport, offices, stores, workshop, staff, labour and the provision of proper and sufficient protective works, diversions, temporary fencing and lighting. It shall include all works related to safety of road user. It shall also include safety of workers at construction site, first-aid equipment, suitable accommodation for the staff and workmen with adequate sanitary arrangements, the effecting and maintenance of all insurances, the payment of all wages, salaries, fees, royalties, duties or other charges arising out of the erection of works and the regular clearance of rubbish, reinstatement and clearing-up of the site as may be required on completion of works, safety of the public and protection of the works and adjoining land/structures.

105.3 The Contractor shall ensure that all actions are taken to build in quality assurance (QA) in the planning, management and execution of works. The quality assurance shall cover all stages of work such as setting out, selection of materials, selection of construction methods, selection of equipment and plant, deployment of personnel and supervisory staff, quality control testing, etc. The QA programme shall cover the details as per IRC:SP:47 and IRC:SP:57. These shall broadly cover quality assurance aspects of all services rendered, all items to be supplied and all activities to be performed under the contract including temporary structures and equipment which will influence the quality of the completed works or the progress of the contract.

As a minimum, it shall cover the following :

- i) Organisation and management responsibility,
- ii) Document and data control,
- iii) Construction programme,
- iv) Method statement,
- v) Process control,
- vi) Working, inspection, testing and documentary procedures,
- vii) Arrangement for smooth and safe traffic flow during construction and maintenance,
- viii) Control and documentation of purchasing and handling of materials,

- ix) Maintenance of records for non-conformity and timely corrective actions,
- x) Internal quality audit,
- xi) Training of staff,
- xii) Environment Management Plan (EMP).

The QA plan shall be submitted to the Engineer for approval, not later than 28 days from the date of signing of the contract agreement. The work of building in quality assurance shall be deemed to be covered in the scope of the work.

105.4 The Contractor shall furnish, at least 7 days in advance, unless otherwise stipulated in the contract, his programme of commencement of each item of work, including the method statement including deployment of plant and equipment for the works included in the contract and any other work for which the Engineer may demand the method statement. He shall provide all information to the satisfaction of the Engineer to ensure its adequacy. The sole responsibility for the safety and adequacy of the methods adopted by the Contractor will, however, rest on the Contractor, irrespective of any approval given by the Engineer.

105.5 Inspection of Materials Before Incorporation

105.5.1 All materials shall be inspected, tested and accepted by the Engineer as per these specifications, before incorporation in the work. The frequencies and methods of sampling and testing materials, including those required for definite purpose and not covered by these specifications shall be in accordance to the relevant IRC or BIS or AASHTO/ASTM/BS Standards in order of priority.

105.5.2 All materials or work not conforming to the requirements of the Specifications shall be considered unacceptable and rejected. The unacceptable materials or work that are rejected shall be immediately removed unless the defects are corrected and approved by the Engineer. If the Contractor fails to comply promptly with any order of the Engineer made under the provisions of this Clause, the Engineer has the authority to remove and replace unacceptable materials or work and to deduct from money due to the Contractor the cost of removal and replacement.

105.6 Inspection of Materials at Source

The Engineer may choose to inspect material at source. In the event, the following conditions shall be met.

- a) The Contractor and the manufacturer of material shall assist and co-operate with the Engineer in carrying out the inspection.
- b) The Engineer shall have right to enter areas of plant where the manufacture or production of material is carried out.

105.7 Delivery, Storage and Handling of Materials

105.7.1 All materials shall be handled and stored in appropriate manner to preserve their quality and fitness for the work. During the handling of all aggregates or other construction materials, special care shall be taken to prevent contamination. Furthermore, aggregate shall be handled in such a manner as to prevent segregation.

105.7.2 Vehicles used in transporting construction material shall be kept clean and in proper working condition so as to prevent the loss of materials during transportation and meet the requirements of the Specifications.

105.7.3 The Contractor may be allowed to store materials and equipment within the right-of-way at location approved by the Engineer, but shall be responsible for the restoration and repair of any damage to plantation, signs, property or any assets resulting from such operations. Any additional space that may be needed for storage purposes and for placing of plant and equipment shall be provided by the Contractor at no additional cost to the Employer.

105.8 Materials Furnished by the Employer

When the Contract provides that certain materials required to complete the work will be supplied by the Employer, such material will be delivered or made available to the Contractor at the location(s) specified in the Contract.

The Contractor shall be responsible for all damages occurring to the materials furnished by the Employer while the materials are in his possession. Any demurrage or storage charges shall also be the responsibility of the Contractor.

The Contractor shall include the cost of handling, transportation and placing all Employer-furnished materials in the Contract unit price for the relevant pay item.

105.9 Laws to be Observed

The Contractor shall observe and comply with all Central and State laws, local laws and ordinance which affect those employed on the work or affect the conduct of the work.

The Contractor shall provide all safeguards, safety devices, and protective equipment and take any other actions necessary for safety and health of employees on the project.

105.10 Patented Devices, Materials and Processes

If the Contractor is required or desires with the approval of the Engineer to use any design, device, material or process covered by trademark, patent or copyright, the Contractor shall

obtain the right for its use by legal agreement with the patentee or owner. A copy of the agreement shall be furnished to the Engineer. Contract prices shall include all royalties and costs arising from patents, trademarks and copyrights.

106 CONSTRUCTION EQUIPMENT

In addition to the conditions indicated in the Contract Documents, the following conditions regarding use of equipment in works shall be satisfied:

- a) The Contractor shall be required to give a trial run of the equipment for establishing their capability to achieve the laid down Specifications and tolerances to the satisfaction of the Engineer before commencement of the work;
- b) All equipment provided shall be of proven efficiency and shall be operated and maintained at all times in a manner acceptable to the Engineer;
- c) Plants, equipment and instruments provided shall have adequate sensitivity, facility for calibration to desired level and shall be robust;
- d) Plant, equipment and instrument provided shall have data logging arrangement and control systems to enable automatic feedback control of process;
- e) Plants, equipment and instruments provided shall have adequate safety features and pollution control devices;
- f) Plant, equipment and instruments provided shall be operated by skilled and qualified operators;
- g) All the plant/equipment to be deployed on the works shall be got approved from the Engineer for ensuring their fitness and efficiency before commencement of work;
- h) Any material or equipment not meeting the approval of the Engineer shall be removed from the site forthwith;
- i) No equipment shall be removed from site without permission of the Engineer;
- j) The Contractor shall also make available stand by equipment and spare parts; and
- k) The Contractor shall also make available equipment for site quality control work as directed by the Engineer.

107 DRAWINGS

107.1 The drawings provided in the Tender Documents shall be used as reference only. The Contractor shall study the nature and type of work and ensure that the rates

and prices quoted by him in the Bill of Quantities have due consideration of the site and complexities of work involved during actual execution/construction.

107.2 The Contractor based on his surveys and investigations, shall submit the working drawings (hard and soft copy) to the Engineer for each activity at least 45 days in advance of the scheduled date to the start of the activity as per his approved work programme. The working drawings shall clearly show the modifications, if any, proposed with reference to corresponding tender drawings. The Engineer shall review the working drawings including the modifications proposed, if any, revise the drawings, if required, approve and issue to the Contractor two copies of Good for Construction (GFC) drawings at least 28 days in advance of the scheduled date of the start of the activity.

107.3 Examination and/or approval by the Engineer of any drawings or other documents submitted by the Contractor shall not relieve the Contractor of his responsibilities or liabilities under the Contract.

107.4 The tendered rates/prices for the work shall be deemed to include the cost of preparation, supply and delivery of all necessary drawings, prints, tracings and negatives which the Contractor is required to provide in accordance with the Contract.

108 SITE INFORMATION

108.1 The information about the site of work and site conditions in the Tender Documents is given in good faith for guidance only but it shall be the responsibility of the Contractor to satisfy himself regarding all aspects of site conditions.

108.2 The location of the works and the general site particulars are as shown in the Site plan/Index plan enclosed with the Tender Documents.

108.3 Whereas the right-of-way to the bridge sites/road works shall be provided to the Contractor by the Employer, the Contractor shall have to make his own arrangement for the land required by him for site offices, field laboratory, site for plants and equipment, maintenance and repair workshop, construction workers' camp, stores etc.

109 SETTING OUT

109.1 The Contractor shall establish working bench marks tied with the Reference bench mark in the area soon after taking possession of the site. The Reference bench mark for the area shall be as indicated in the Contract Documents and the values of the same shall be obtained by the Contractor from the Engineer. The working bench marks shall be at the rate of four per km and also at or near all drainage structures, over-bridges and underpasses. The working bench marks/levels should be got approved from the Engineer. Checks must be made on these bench marks once every month and adjustments, if any, got approved

from the Engineer and recorded. An up-to-date record of all bench marks including approved adjustments, if any, shall be maintained by the Contractor and also a copy supplied to the Engineer for his record.

109.2 The lines and levels of formation, side slopes, drainage works, carriageways and shoulders shall be carefully set out and frequently checked, care being taken to ensure that correct gradients and cross-sections are obtained everywhere.

109.3 In order to facilitate the setting out of the works, the centre line of the carriageway or highway must be accurately established by the Contractor and approved by the Engineer. It must then be accurately referenced in a manner satisfactory to the Engineer, at every 50 m intervals in plain and rolling terrains and 20 m intervals in hilly terrain and in all curve points as directed by the Engineer, with marker pegs and chainage boards set in or near the fence line, and a schedule of reference dimensions shall be prepared and supplied by the Contractor to the Engineer. These markers shall be maintained until the works reach finished formation level and are accepted by the Engineer.

109.4 On construction reaching the formation level stage, the centre line shall again be set out by the Contractor and when approved by the Engineer, shall be accurately referenced in a manner satisfactory to the Engineer by marker pegs set at the outer limits of the formation.

109.5 No reference peg or marker shall be moved or withdrawn without the approval of the Engineer and no earthwork or structural work shall commence until the centre line has been referenced.

109.6 The Contractor will be the sole responsible party for safe-guarding all survey monuments, bench marks, beacons, etc. The Engineer will provide the Contractor with the data necessary for setting out the centre line. All dimensions and levels shown on the drawings or mentioned in documents forming part of or issued under the Contract shall be verified by the Contractor on the site and he shall immediately inform the Engineer of any apparent errors or discrepancies in such dimensions and levels. The Contractor shall, in connection with the staking out of the centre line, survey the terrain along the road and shall submit to the Engineer for his approval, a profile along the road centre line and cross-sections at intervals as required by the Engineer.

The construction staking shall be done by personnel who are trained and experienced in construction layout and staking of the type and kind required in the Contract.

Field notes shall be kept in standard, bound field notebooks as approved by the Engineer. Field notes shall be subject to inspection by the Engineer and shall be the property of the Employer.

The Contractor shall correct any deficient staking or construction work which resulted from inaccuracies in the staking operations or from the Contractor's failure to report inaccuracies in the plans or survey data furnished by the Department.

109.7 After obtaining approval of the Engineer, work on earthwork can commence. The profile and cross-sections as per Section 305, shall form the basis for measurements and payment. The Contractor shall be responsible for ensuring that all the basic traverse points are in place at the commencement of the contract and, if any, are missing, or appear to have been disturbed, the Contractor shall make arrangements to re-establish these points. A "survey File" containing the necessary data will be made available for this purpose. If in the opinion of the Engineer, design modifications of the centre line or grade are advisable, the Engineer will issue detailed instructions to the Contractor and the Contractor shall perform the modifications in the field, as required, and modify the ground levels on the cross-sections accordingly as many times as required.

There will be no separate payment for any survey work performed by the Contractor. The cost of these services shall be considered as being included in the rate of the items of work in the Bill of Quantities.

109.8 Precision automatic levels, having a standard deviation of ± 2 mm per km, and fitted with micrometer attachment shall be used for all double run levelling work. Setting out of the road alignment and measurement of angles shall be done by using Total Station with traversing target, having an accuracy of one second. Measurement of distances shall be done preferably using precision instruments like Distomat.

109.9 The work of setting out shall be deemed to be a part of general works preparatory to the execution of work and no separate payment shall be made for the same.

110 PUBLIC UTILITIES

110.1 Drawings scheduling the affected services like water pipes, sewers, oil pipelines, cables, gas ducts etc. owned by various authorities including Public Undertakings and Local Authorities included in the Contract Documents shall be verified by the Contractor for the accuracy of the information prior to the commencement of any work.

The Contractor shall notify all utility agencies who may have installation in the work area and secure their assistance in locating and identifying all utilities before starting any work that may cause any damage to such utilities.

The Contractor shall schedule work in such a manner as to protect existing utility facilities until they are relocated, abandoned or replaced.

The Contractor shall ensure that all utilities encountered within the Right of Way i.e. OFC Cable, telephone, power, water supply, sewerage or any others, remain operational at all

times. Any utility, if damaged, due to construction operation, shall be promptly repaired by the Contractor at his cost.

110.2 Notwithstanding the fact that the information on affected services may not be exhaustive, the final position of these services within the works shall be supposed to have been indicated based on the information furnished by different bodies and to the extent the bodies are familiar with the final proposals. The intermediate stages of the works are, however, unknown at the design stage, these being dictated by the Contractor's methods of working. Accordingly, the Contractor's programme must take into account the period of notice and duration of diversionary works of each body as given on the Drawings and the Contractor must also allow for any effect of these services and alterations upon the Works and for arranging regular meetings with the various bodies at the commencement of the Contract and throughout the period of the Works, the Contractor shall have no objection if the public utility bodies vary their decisions in the execution of their proposals in terms of programme and construction, provided that, in the opinion of the Engineer, the Contractor has received reasonable notice thereof before the relevant alterations are put in hand.

110.3 No removal of or alterations to the utility shall be carried out unless written instructions are issued by the Engineer.

110.4 Any services affected by the Works must be temporarily supported by the Contractor who must also take all measures reasonably required by the various bodies to protect their services and property during the progress of the Works.

110.5 The Contractor may be required to carry out certain works for and on behalf of various bodies, which he shall provide, with the prior approval of the Engineer.

110.6 The work of temporarily supporting and protecting the public utility services during execution of the Works shall be deemed to be part of the Contract and no extra payment shall be made for the same.

110.7 The Contractor shall be responsible to co-ordinate with the service providers for cutting of trees, shifting of utilities, removal of encroachments etc. to make site unencumbered for completion of work. This will include frequent follow-up meetings. Co-ordination for making project site unencumbered shall be deemed to be part of the Contract and no extra payment shall be made for the same.

110.8 In some cases, the Contractor may be required to carry out the removal or shifting of certain services/utilities on specific orders from the Engineer for which payment shall be made to him. Such works, however, shall be taken up by the Contractor only after obtaining clearance from the Engineer and ensuring adequate safety measures.

111 PRECAUTIONS FOR SAFEGUARDING THE ENVIRONMENT**111.1 General**

The Contractor shall take all precautions for safeguarding the environment during the course of the construction of the works. He shall abide by all laws, rules and regulations in force governing pollution and environmental protection that are applicable in the area where the works are situated.

111.2 Borrow Pits for Embankment Construction

Borrow pits shall be selected only after testing the suitability of materials for use in construction and shall not normally be dug in the right-of-way of the road. The stipulations in Section 305.2.2 shall govern. The borrow pits shall not be left in a condition likely to cause hazard to human and animal life. The Contractor shall seek prior approval from the concerned authorities for operating the borrow pits.

111.3 Quarry Operations

The Contractor shall obtain materials from quarries only after obtaining the consent of the Mining Department or other concerned authorities. The quarry operations shall be undertaken within the purview of the rules and regulations in force.

111.4 Control of Soil Erosion, Sedimentation and Water Pollution

The Contractor shall carry out the works in such a manner that soil erosion is fully controlled, and sedimentation and pollution of natural water courses, ponds, tanks and reservoirs is avoided. The stipulations in Clause 306 shall govern.

111.5 Pollution from Plants and Batching Plants

Stone crushing and screening plants, Bituminous hot-mix plants, concrete batching plants etc. shall be located sufficiently away from habitation, agricultural operations or industrial establishments. The locations shall be as permissible under the laws governed by local bodies/ administration of the area. The Contractor shall take every precaution to reduce the levels of noise, vibration, dust and emissions from his plants and shall be fully responsible for any claims or damages caused to the owners of property, fields and residences in the vicinity and violation of pollution control norms, if any.

111.6 Substances Hazardous to Health

The Contractor shall not use or generate any materials in the works which are hazardous to

the health of persons, animals or vegetation. Where it is necessary to use some substances which can cause injury to the health of workers, the Contractor shall provide protective clothing or appliances to his workers.

111.7 Use of Nuclear Gauges

Nuclear gauges shall be used only where permitted by the Engineer. The Contractor shall provide the Engineer with a copy of the regulations governing the safe use of nuclear gauges he intends to employ and shall abide by such regulations.

111.8 Environmental Protection

111.8.1 The Contractor must take all reasonable steps to minimize dust nuisance during the construction of the works along the haul roads and the worksites by sprinkling water at a frequency specified by the Engineer.

All existing highways and roads used by vehicles or equipments of the Contractor or any of his sub-contractors or suppliers of materials or plant, and similarly any new roads which are part of the works and which are being used by traffic, shall be kept clean and clear of all dust/mud or other extraneous materials dropped by the said vehicles. Similarly, all dust/mud or other extraneous materials from the works spreading on these highways shall be immediately cleared by the Contractor.

Clearance shall be effected immediately by sweeping and removal of debris, and all dust, mud and other debris shall be removed entirely from the road surface. Additionally, if so directed by the Engineer, the road surface shall be hosed or watered using suitable equipment.

Damages to existing road: Any structural damage and loss of riding surface caused to the existing roads by the Contractor's construction vehicles/ equipment shall be made good without any extra cost.

Compliance with the foregoing will not relieve the Contractor of any responsibility for complying with the requirements of any authority in respect of the roads used by him.

111.8.2 Air Quality

The Contractor shall devise and implements methods of working to minimize dust, gaseous and other air-borne emissions and carry out the Works in such a manner as to minimize adverse impacts on the air quality.

The Contractor shall utilize effective water sprays during delivery, manufacture, processing and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather. Stockpiles of friable materials shall be covered with clean

tarpaulins, with applications of sprayed water during dry and windy weather. Stockpiles of materials or debris shall be dampened prior to their movement, except where this is contrary to the Specification.

Any vehicle with open load-carrying area used for transporting potentially dust-producing material shall have properly fitting side and tail boards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards and shall be covered with clean tarpaulins in good condition. The tarpaulin shall be properly secured and extend at least 300 mm over the edges of the side and tail boards.

111.8.3 Water Sources and Water Quality

The Contractor shall provide independent sources of water supply, such as bore wells, for use in the Works and for associated storage, workshop and work force compounds. Prior approval shall be obtained from the relevant State Authorities and all installations shall be in compliance with local regulations.

The Contractor shall protect all watercourses, waterways, ditches, canals, drains, lakes, reservoirs and the like from pollution as a result of the execution of the Works. All water and other liquid waste products like petroleum products and chemicals arising on the Site shall be collected and disposed of at a location on or off the Site and in a manner that shall not cause either nuisance or pollution.

The Contractor shall at all times ensure that all existing stream courses and drains within and adjacent to the Site are kept safe and free from any debris and any materials arising from the Works. The Contractor shall not discharge or deposit any matter arising from the execution of the Works into any water course except with the permission of the Engineer and the regulatory authority concerned.

111.8.4 Construction Camps

The construction camps shall conform to the State and National building regulations as applicable. The area for the storage of polluted materials shall be stored on impervious floors and shall be surrounded by impervious ditches in order to avoid spilling of polluted material to surrounding areas.

Construction camps shall be properly arranged to avoid noise pollution to the nearby habitants and to avoid contamination of water courses from wastewater drainage. To prevent such contamination, wastewater generated at the campsites shall be discharged into soak pits. Human excreta shall be treated through septic tanks prior to discharge and shall conform to directives and guidelines of the State. Water accumulated in tyres, empty vessels and containers of all nature will be regularly cleaned to avoid the related health hazards. The Contractor shall provide and maintain in a neat and sanitary condition accommodations for

the use of the employees and workers as may be necessary to comply with the requirements of Central, State, and local regulations.

Spilling of oil and bituminous products during construction and transport shall be avoided to reduce the chances of contamination of surface as well as ground water.

111.9 Occupational Health and Safety of the Workforce

The Contractor shall prepare and submit to the Engineer the Occupational Health & Safety Procedures/Practices for the workforce in all quarry sites, plant sites, work sites, camp sites, etc., in accordance with the applicable laws.

111.10 Control and Disposal of Wastes

The Contractor shall control the disposal of all forms of waste generated by the construction operations and in all associated activities. No uncontrolled deposition or dumping shall be permitted. Wastes to be so controlled shall include, but shall not be limited to, all forms of fuels and engine oils, all types of bitumen, cement, surplus aggregates, gravels, bituminous mixtures etc. The Contractor shall make specific provision for the proper disposal of these and any other waste products, conforming to local regulations and acceptable to the Engineer.

111.11 Transport of Hazardous Materials

Transport of hazardous materials, in bulk or in sealed containers, shall meet the requirements of the State regulations. Prior to ordering transport of hazardous material in bulk, the Contractor must obtain the approval of the relevant authority as well as of the Engineer. The transport of diesel, petrol, gaseous material, chemical and explosives for quarrying shall be governed by safety laws of the local authorities. Precautionary measures and conformity with regulations shall be stated in a Method Statement for the approval of the Engineer. Sealed containers of hazardous materials shall be stored in a well-ventilated room, well guarded and secured.

111.12 Emergency Response

The Contractor shall plan and provide remedial measures to be implemented in the event of occurrence of emergencies such as spillages of oil or bitumen or chemicals, fire. The Contractor shall provide the Engineer with a statement of the measures he intends to implement in the event of such an emergency, which shall include a statement of how he intends to provide personnel adequately trained to implement such measures.

111.13 Measurement for Payment

The compliance of all provisions made in this Clause 111 shall be deemed to be incidental to the work and no separate measurement or payment shall be made. The Contractor shall

be deemed to have made allowance for all such compliance with these provisions in the preparation of his bid for items of work included in the Bill of Quantities and full compensation for such compliance shall be deemed to be covered by the bid price.

112 ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

112.1 General

The Contractor shall at all times, carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all works involving improvements to the existing highway, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement or along a temporary diversion constructed close to the highway. Before taking up any construction or maintenance operation, the Contractor shall prepare a Traffic Management Plan for each work zone and submit it to the Engineer for prior approval. This plan should include inter alia:

- i) Provision of a qualified safety officer with support staff to serve as a site safety team
- ii) Provision of traffic safety devices and road signs in construction zones as per IRC:SP:55 and other relevant IRC Codes and para 112.4:
- iii) Safety measures for the workers engaged including personal protection equipment
- iv) First aid and emergency response arrangements
- v) Details and drawings of arrangements in compliance with other sub Sections of this Section.

112.2 Passage of Traffic along a Part of the Existing Carriageway under Improvement

For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular (Wet Mix Macadam/Water Bound Macadam) base course covered with bituminous surface dressing in a width of at least 1.5 m and the treated shoulder shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length, in which such work shall be carried out, would be limited normally to 500 m at a place. However, where work is allowed by the Engineer in longer stretches passing places at least 20 m long with additional paved width of 2.5 m shall be provided at every 0.5 km interval.

In case of eccentric widening of existing two-lane to four-lane, the additional two-lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. In case of concentric widening, stipulations as in paragraph above shall apply.

After the works are completed, with the approval of the Engineer, the treated shoulder shall be dismantled, the debris disposed of and the area cleared as per the direction of the Engineer.

112.3 Passage of Traffic along a Temporary Diversion

In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 7 m carriageway and 2.5 m earthen shoulders on each side (total width of roadway 12 m) with the following provision for road crust in the 7 m width:

- i) Earthwork
- ii) 200 mm (compacted) granular sub-base
- iii) 225 mm (compacted) granular base course
- iv) Priming and Tack Coat and
- v) Premix carpet with Seal Coat/Mix Seal Surfacing

The location of such stretch, alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

112.4 Traffic Safety and Control

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as per the traffic management plan submitted by the Contractor and approved by the Engineer, referred to in Sub-Section 112.1. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.

All construction equipment working or parked on or within the traffic lanes or shoulders under "Traffic maintained" conditions shall be equipped with flashing yellow beacons.

The Contractor shall conduct all operations to minimize any drop-offs (abrupt changes in roadway) exposed to traffic. Drop-offs in the travelled way shall be protected by a wedge of compacted stable material capable of carrying traffic (the wedge being 1 vertical to 4 horizontal or flatter).

The Engineer shall authorize other methods, to protect drop-offs when conditions do not allow a wedge of compacted, stable material.

Warning signs, barricades, warning lights, and all other traffic control devices shall not be removed if the hazard has not been eliminated. Only upon receipt of specific written authorization from the Engineer, the Contractor may remove or cease to maintain warning signs, barricades, warning lights, and all other traffic control devices.

The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device to the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source including solar energy bulbs.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of approved design and of reflective type, as directed by the Engineer.

112.5 Maintenance of Diversions and Traffic Control Devices

Signs, lights, barriers and other traffic control devices, adequate lighting and other arrangements, as well as the riding surface of diversions and treated shoulders shall be maintained in a satisfactory condition till such time they are required and as directed by the Engineer. The temporary travelled way shall be kept free of dust by frequent applications of water, if necessary.

112.6 Measurements for Payment and Rate

All arrangements, as contained in this Section 112 for safety of road users, during construction including provision of temporary diversions/temporary cross drainage structures/treated shoulders shall be measured and paid as per the BOQ. However their maintenance, dismantling and clearing debris shall be considered as incidental to the Works and shall not be paid separately.

113 GENERAL RULES FOR THE MEASUREMENT OF WORKS FOR PAYMENT

113.1 General

All measurements shall be made in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant Sections read in conjunction with the General Conditions of Contract. The same shall not, however, apply in the case of lumpsum contracts.

All measurements and computations, unless otherwise indicated, shall be carried nearest to the following limits:

i)	length and width	10 mm
ii)	height, depth or thickness of	
	a) earthwork, subgrade,	5 mm
	b) sub-bases, bases, surfacing	5 mm
iii)	structural members	2.5 mm
iv)	areas	0.01 sq.m
v)	volume	0.01 cu.m

In recording dimensions of work, the sequence of length, width and height or depth or thickness shall be followed.

113.2 Measurement of Lead for Materials

Where lead is specified in the Contract for construction materials, the same shall be measured as described hereunder:

Lead shall be measured over the shortest practicable route and not the one actually taken and the decision of the Engineer in this regard shall be taken as final. Distances upto and including 100 m shall be measured in units of 50 m, exceeding 100 m but not exceeding 1 km in units of 100 m and exceeding 1 km in units of 500 m, the half and greater than half of the unit shall be reckoned as one and less than half of the unit ignored. In this regard, the source of the material shall be divided into suitable blocks and for each block, the distance from the centre of placing pertaining to that block shall be taken as the lead distance.

113.3 Measurement of Pavement Thickness for Payment on Volume Basis

The finished thickness of sub-bases, base and bituminous layers and concrete courses to be

paid on volume basis shall be computed in the following manner:

Levels shall be taken before and after construction, at the grid of points 10 m centre-to-centre longitudinally in straight reaches and 5 m centre-to-centre at curves. Normally, on two-lane roads, the levels shall be taken at four positions transversely, at 0.75 m and 2.75 m from either edge of the carriageway and on single-lane roads, these shall be taken at two positions transversely, being at 1.25 m from either edge of the carriageway. For multi-lane roads, levels shall be taken at two positions transversely for each lane. The transverse position for levels shall be 0.75 m from either edge of the carriageway and the remaining locations shall be at equi-distance in the balance portion of carriageway. For paved shoulder an additional level shall be taken at the centre of the shoulder.

Suitable references for the transverse grid lines should be left in the form of embedded bricks on both ends or by other means so that it is possible to locate the grid points for level measurements after each successive course is laid.

For pavement courses laid only over widening portions, at least one line of levels shall be taken on each strip of widening, or more depending on the width of widening as decided by the Engineer.

Notwithstanding the above, the measurements may be taken at closer intervals also, if so desired by the Engineer, the need for which may arise particularly in the case of estimation of the volume of the material for profile corrective course (levelling course). The average thickness of the pavement course in any area shall be the arithmetic mean of the difference of levels before and after construction at all the grid points falling in that area, provided that the thickness of finished work shall be limited to those shown on the drawings or approved by the engineer in writing.

As supplement to level measurements, the Engineer shall have the option to take cores/ make holes to check the depth of construction. The holes made and the portions cut for taking cores shall be made good by the Contractor by laying fresh mix/material including compacting as required at his-own cost immediately after the measurements are recorded.

113.4 Checking of Pavement Thickness for Payment on Area Basis

Where payment for any bituminous course in Section 500 is allowed to be made on the area basis, the Engineer may have its thickness checked with the help of a suitable penetration gauge at regular intervals or other means as he may decide.

113.5 Measurement of Bituminous Courses for Payment on Weight Basis

Plant-mixed bituminous materials for pavement courses, where specifically designated in the contract to be paid on weight basis, shall be weighed on accurate scales approved by the Engineer. Approved scales shall mean scales that are of size, capacity, kind and type suitable for the weighing to be done, and these shall be properly installed and maintained. Prior to

the use of the scales and as frequently thereafter as the Engineer may deem necessary to ensure accuracy, the scales shall be checked and approved by the Engineer, or the Engineer may direct the Contractor to have the scales checked by other competent agency at the cost of the Contractor.

Location of the scales shall be as designated by the Engineer. Trucks used for hauling the material to be weighed shall be weighed empty daily at such times as the Engineer directs, and each truck shall bear a plainly legible identification mark.

For materials specified to be measured by weight, the Engineer will have the option to make measurements of the finished work by volume in accordance with Section 113.3 and such volumes shall be converted into weight for payment purposes. The factor for conversion from volume measurement to weight measurement shall be computed from the representative density of the compacted material at site determined at locations approved by the Engineer.

114 SCOPE OF RATES FOR DIFFERENT ITEMS OF WORK

114.1 For item rate contracts, the contract unit rates for different items of work shall be payment in full for completing the work to the requirements of the Specifications including full compensation for all the operations detailed in the relevant Sections of these Specifications under "Rates". In the absence of any directions to the contrary, the rates are to be considered as the full inclusive rate for finished work covering all labour, materials, wastage, temporary work, plant, equipment, over-head charges and profit as well as the general liabilities, performance of other obligations, insurance and risks arising out of the Conditions of Contract.

114.2 The item rates quoted by the Contractor shall, unless otherwise specified, also include compliance with/supply of the following:

- i) General works such as setting out, clearance of site before setting out and clearance of works after completion;
- ii) A detailed programme using modern project management software for the construction and completion of the work giving, in addition to construction activities, detailed network activities for the submission and approval of materials, procurement of critical materials and equipment, fabrication of special products/equipment and their installation and testing, for all activities of the Engineer/Employer that are likely to affect the progress of work, etc., including updating of all such activities on the basis of the decisions taken at the periodic site review meetings or as directed by the Engineer;
- iii) Samples of various materials proposed to be used on the Works for conducting tests thereon as required as per the provisions of the Contract;

- iv) Design of mixes as per the relevant Sections of the Specifications giving proportions of ingredients, sources of aggregates and binder along with accompanying trial mixes as per the relevant Sections of these Specifications to be submitted to the Engineer for his approval before use on the Works;
- v) Cost of laying trial stretches;
- vi) Detailed drawings as per Clause 107.
- vii) Detailed design calculations and drawings for all Temporary Works (such as form-work, staging, centring, specialized constructional handling and launching equipment and the like);
- viii) Detailed drawings for templates, support and end anchorage, details for pre-stressing cable profiles, bar bending and cutting schedules for reinforcement, material lists for fabrication of structural steel, etc.;
- ix) Mill test reports for all mild and high tensile steel and cast steel as per the relevant provisions of the Specifications;
- x) Testing of various finished items and materials including bitumen, cement, concrete, bearings as required under these Specifications and furnishing test reports/certificates;
- xi) Inspection Reports in respect of formwork, staging, reinforcement and other items of work as per the relevant Specifications;
- xii) Any other data which may be required as per these Specifications or the Conditions of Contract or any other annexures/schedules forming part of the Contract;
- xiii) Any other item incidental to work which is necessary for complying with the provisions of the Contract;
- xiv) All temporary works, formwork and false work not included as separate item in the BOQ;
- xv) Establishing and running a laboratory with facilities for testing for various items or works as specified in Section 900 and other relevant Sections;
- xvi) Cost of in-built provisions for Quality Assurance;
- xvii) Cost of safeguarding the environment; and
- xviii) Cost of providing "as-built drawings" in original and two sets of prints.

114.3 Portions of road works beyond the limits and/or any other work may be got constructed by the Employer directly through other agencies. Accordingly, other agencies employed by the Employer may be working in the vicinity of the Works being executed by the Contractor. The Contractor shall liaise with such agencies and adjust his construction

programme for the completion of work accordingly and no claim or compensation due to any reason whatsoever will be entertained on this account. The Employer will be indemnified by the Contractor for any claims from other agencies on this account.

115 METHODOLOGY AND SEQUENCE OF WORK

115.1 Prior to start of the construction activities at site, the Contractor shall, within 28 days after the date of the agreement unless otherwise stipulated in the Contract, submit to the Engineer for approval, the detailed method statement. The method statement shall be submitted in two parts.

115.2 The general part of the method statement shall describe the Contractor's proposals regarding preliminary works, common facilities and other items that require consideration at the early stage of the contract. The general part shall include information on:

- a) Sources of materials like coarse aggregates and fine aggregates, quantity and quality of materials available in different sources;
- b) Sources of manufactured materials like bitumen, cement, steel reinforcement, pre-stressing strands and bearings etc. He shall also submit samples/test certificates of materials for consideration of the Engineer;
- c) Locations of the site facilities such as batching plant, hot mix plant, crushing plant, etc.;
- d) Details of facilities available for transportation of men/material and equipment;
- e) Information on procedure to be adopted by the Contractor for prevention and mitigation of negative environmental impact due to construction activities;
- f) Safety and traffic arrangement during construction;
- g) Implementation of activities provided in the Environmental Management Plan;
- h) Any other information required by the Engineer.

The general part of the QA programme under Section 105.3 shall accompany the method statement.

115.3 Special part of the method statement shall be submitted to the Engineer by the Contractor for each important item of work as directed by the Engineer. The statement

shall be submitted at least 4 weeks in advance of the commencement of the activity of item of work unless otherwise stipulated in the contract. The statement shall give information on:

- a) Details of the personnel both for execution and quality control of the work;
- b) Equipment deployment with details of the number of units, capacity, standby arrangement;
- c) Sequence of construction and details of temporary or enabling works like diversion, cofferdam, formwork including specialized formwork for superstructure, details of borrow areas, method of construction of embankment, sub-grade and pavement, pile concreting, proprietary processes and products and equipments to be deployed. Wherever required technical literature, design calculations and drawings shall be included in the method statement;
- d) Testing and acceptance procedure including documentation;
- e) The special part of the QA programme under Sub-Section 105.3 for the particular item of work shall accompany the method statement for the concerned activity.

The Engineer shall examine and approve the method statement with the required modifications. The modified method statement if required shall be submitted within 14 days of the receipt of the Engineer's approval. The sole responsibility for adequacy and safety of the method adopted by the Contractor shall rest on the Contractor irrespective of any approval given by the Engineer.

115.4 Approval of Proprietary Products/Processes/Systems

Within 90 days of the signing of agreement, the Contractor shall submit the following information for all proprietary products, process or any other item proposed to be used in the work, for approval of the Engineer.

- a) Name of the manufacturer and name of the product/process/system along with authenticated copies of the license/collaboration agreement;
- b) General features of the product/process/system;
- c) Details of the product development and development testing;
- d) Acceptance test and criteria;
- e) Installation procedure;
- f) Maintenance procedure and schedule;
- g) Warranty proposal.

The Engineer may order additional test for the purpose of acceptance. Additional charges for test, if any, for the product/process/system shall be borne by the Contractor.

116 CRUSHED STONE AGGREGATES

Where the terms crushed gravel/shingle, crushed stone, broken stone or stone aggregate appear in any part of the Contract Documents or Drawings issued for work, they refer to crushed gravel/crushed shingle/crushed stone aggregate obtained from integrated crushing plant having appropriate primary crusher, secondary cone crusher, vertical shaft impactor and vibratory screen unless specified otherwise. Stone retained on 4.75 mm sieve shall have at least two faces fractured.

117 SUPPLY OF QUARRY SAMPLES

Raw and processed samples of the mineral aggregates from the approved quarry shall be submitted by the Contractor at his cost.

118 APPROVAL OF MATERIALS

Approval of all sources of material for work shall be obtained in writing from the Engineer before their use on the works.

119 USE OF SURFACES BY TRAFFIC

119.1 Ordinarily, no construction traffic shall be allowed on pavement under construction unless authorized by the Engineer. Even in that case, the load and intensity of construction traffic should be so regulated that no damage is caused to the sub-grade or pavement layers already constructed. Where necessary, service roads shall be constructed for this purpose and the same shall be considered as incidental to the work.

119.2 The wheels or the tracks of plant moving over the various pavement courses shall be kept free of deleterious materials.

119.3 Bituminous base course shall be kept clean and uncontaminated as long as the same remains uncovered by a wearing course or surface treatment. The only traffic permitted access to the base/binder course shall be that engaged in laying and compacting the wearing course or that engaged on such surface treatment where the base/binder course is to be blinded and/or surface dressed. Should the base/binder course or tack coat on the base/binder course become contaminated, the Contractor shall make good by cleaning it to the satisfaction of the Engineer, and if this is impracticable, by removing the layer and replacing it to Specifications without any extra cost to the employer.

119.4 On Dry Lean Concrete sub-base, no heavy commercial vehicles like trucks and buses shall be permitted after its construction. Light vehicles, if unavoidable, may, however, be allowed after 7 days of its construction with prior approval of the Engineer. No vehicular traffic, shall be allowed on a finished concrete pavement for a period of 28 days of its construction and until the joints are permanently sealed and cured.

120 FIELD LABORATORY

120.1 Scope

The work covers the provision and maintenance of an adequately equipped field laboratory as required for site control on the quality of materials and the works.

120.2 Description

The Contractor shall arrange to provide fully furnished and adequately equipped field laboratory. The field laboratory shall preferably be located adjacent to the site office of the Engineer and provided with amenities like water supply, electric supply etc. as for the site office of the Engineer as described in this Section.

The layout and size of the field laboratory shall be as indicated in the drawings. In case no drawings is furnished, the laboratory shall include space for the storage of samples, equipment, laboratory tables and cupboards, working space for carrying out various laboratory tests, a wash basin, toilet facility and a curing tank for the curing of samples, around 4 m x 2 m x 1 m in size and a fume chamber. Wooden/concrete working table with a working platform area of about 1 m x 10 m shall be provided against the walls. Wooden cupboards above and below the working tables shall be provided to store accessories such as, sample moulds etc. At least 4 racks of slotted angles and M.S. sheets the size 1800 mm x 900 mm x 375 mm and at least 6 stools for laboratory test operators shall also be provided.

The items of laboratory equipment shall be provided in the field laboratory depending upon the items to be executed as per Table 100-2.

120.3 Ownership

The field laboratory building and equipment shall be the property of the Contractor. The Employer and the Engineer shall have free access to the laboratory.

120.4 Maintenance

The Contractor shall arrange to maintain the field laboratory in a satisfactory manner until the issue of Taking Over Certificate for the completed work. Maintenance includes all activities described in Section 120.4.

Table 100-2 : List of Laboratory Equipments

Sl. No	Name of the Project	Number
A)	GENERAL	
1)	Weigh Balances	
a)	5 – 20 kg capacity Electronic type – Accuracy 1 gm	1 No.
b)	500 gm capacity–Electronic Type Accuracy 0.01 gm	1 No.
c)	Electronic 5 kg capacity Accuracy 0.5 gm	1 No.
d)	Platform Balance scale-300 kg capacity	1 No.
e)	Chemical Balance 100 gm capacity-accuracy 0.001 gm	--
2)	Oven-electrically operated, thermostatically controlled (including thermometer), stainless steel interior	
	From 0°C to 220°C Sensitivity 1°C	1 No
3)	Sieves : as per IS:460-1962	
a)	I.S. sieves 450 mm internal dia of sieve sets as per BIS of required sieve sizes complete with lid and pan	1 set
b)	IS sieve 200 mm internal dia (brass frame and steel/or brass wire cloth mesh) consisting of sieve sets of required sieve sizes complete with lid	2 sets
4)	Sieve shaker capable of shaking 200 mm and 450 mm dia sieves-electrically operated with time switch	1 No
5)	200 tonnes compression testing machine	1 No
6)	Stop watches 1/5 sec. accuracy	1 No
7)	Glassware comprising beakers, pipettes, dishes, measuring cylinders (100 to 1000 cc capacity) glass rods and funnels, glass thermometers range 0°C to 100°C and metallic thermometers range up to 300°C.	2 No. each
8)	Hot plates 200 mm dia (1500 watt.)	1 No
9)	Enamel trays	
	a) 600 mm x 450 mm x 50 mm	2 Nos
	b) 450 mm x 300 mm x 40 mm	2 Nos
	c) 300 mm x 250 mm x 40 mm	2 Nos
	d) Circular plates of 250 mm dia	2 Nos
10)	Water Testing Kit	1 No
B)	FOR SOILS	
1)	Water still	–
2)	Liquid limit device with ASTM grooving tools as per IS:2720	1 No
3)	Sampling pipettes fitted with pressure and suction inlets, 10 ml. Capacity	1 set

Sl. No	Name of the Project	Number
4)	Compaction apparatus (Proctor) as per IS:2720 (Part 7) complete with collar, base plate and hammer and all other accessories	1 No
5)	Modified AASHTO Compaction apparatus as per IS:2720 (Part 8) 1974 or Heavy Compaction Apparatus as per IS complete with collar, base plate hammer and all other accessories	1 No
6)	Sand pouring cylinder with conical funnel and tap and complete as per IS:2720 (Part 28) 1974 including modern equipment.	2 Nos
7)	Ennore Standard Sand	As required
8)	Sampling tins with lids 100 mm dia x 75 mm ht. ½ kg capacity and miscellaneous items like moisture tins with lid 50 grams etc.	4 Nos
9)	Lab CBR testing equipment for conducting CBR testing, load frame with 5 Tonne capacity, electrically operated with speed control as per IS:2720 (Part 16) and consisting of following:	1 Set
	a) CBR moulds 150 mm dia – 175 mm ht.	6 No
	b) Tripod stands for holding dial gauge holder	4 Nos
	c) CBR plunger with settlement dial gauge holder	1 No
	d) Surcharge weight 147 mm dia 2.5 kg wt.	6 Nos
	e) Spacers disc 148 mm dia 47.7 mm ht. With handle	2 Nos
	f) Perforated plate (Brass)	2 Nos
	g) Soaking tank for accommodating 6 CBR moulds	2 Nos
	h) Proving rings of 1000 kg, 2500 kg capacity	1 No each
	i) Dial gauges 25 mm travel – 0.01 mm/division	2 No
10)	Standard penetration test equipment	1 No
11)	Nuclear moisture Density meter or equivalent	–
12)	Speedy moisture meter complete with chemicals	1 No
13)	Unconfined Compression Test Apparatus	1 No
C)	FOR BITUMEN AND BITUMINOUS MIXES	
1)	Constant temperature bath for accommodating bitumen test specimen, electrically operated, and thermostatically controlled (to accommodate minimum six Specimens)	1 No
2)	Penetrometer automatic type, including adjustable weight arrangement and needles as per IS:1203-1958	1 No
3)	Soxhlet extraction or centrifuge type apparatus complete with extraction thimbles with solvent and filter paper	1 No
4)	Bitumen laboratory mixer including required accessories (20 ltrs.)	1 No

Sl. No	Name of the Project	Number
5)	Marshall compaction apparatus automatically operated as per ASTM 1559-62 T complete with accessories (with 180 N Marshall Moulds)	1 set
6)	Furol viscometer	1 No
7)	Ductility meter	1 No
8)	Softening point (Ring and ball app)	1 No
9)	Distant reading thermometer	-
10)	Rifle box	- 1 No
11)	Automatic Asphalt content Meter	- 1 No
12)	Thin film over test apparatus for modified binder either with PMB or CRMB	-
13)	Mastic Asphalt Hardness testing equipment	-
14)	Sand Equivalent test apparatus	1 set
15)	Core cutting machine suitable for upto 150 mm dia core	1 set
16)	Thermometers	4 Nos
D)	FOR CEMENT, CEMENT CONCRETE AND MATERIALS	
1)	Water still	1 No
2)	Vicat needle apparatus for setting time with plungers as per IS:269-1967	1 No
3)	Moulds	
	a) 150 mm x 300 mm ht. Cylinder with capping component along with the capping set and compound as per IS	As req
	b) Cube 150 mm, and 100 mm (each size)	As req
4)	Concrete permeability apparatus	-
5)	High frequency mortar cube vibrator for cement testing	-
6)	Concrete mixer power driven, 1 cu.ft. capacity	-
7)	Variable frequency and amplitude vibrating table size 1 m x 1 m as per the relevant British Standard	-
8)	Flakiness index test apparatus	1 No
9)	Aggregate impact test apparatus as per IS:2386 (Part 4) 1963	1 No
10)	Los-angeles abrasion test apparatus as per IS:2386 (Part 4) 1963	1 No
11)	Flow table as per IS:712-1973	-
12)	Equipment for slump test	1 No
13)	Equipment for determination of specific gravity or fine and coarse aggregate as per IS:2386 (Part 3) 1963	1 No
14)	Compression and Flexural strength testing achine of 200 T capacity with additional dial for flexural testing	1 No
15)	Core cutting machine with 10 cm dia diamond cutting edge	1 no
16)	Needle vibrator	2 Nos

Sl. No	Name of the Project	Number
17)	Air entrainment meter	–
18)	0.5 Cft, 1 Cft cylinder for checking bulk density of aggregate with tamping rod	As req
19)	Soundness testing apparatus for cement (Lee chattlier)	1 set
E)	FOR CONTROL OF PROFILE AND SURFACE EVENNESS	
1)	Total Station	1 No
2)	Precision automatic level with micrometer attachment	1 set
3)	Distomat or equivalent	1 set
4)	Theodolite – Electronically operated with computerised output attachment	1 set
5)	Precision staff	2 sets
6)	3 meter straight edge and measuring wedge	1 set
7)	Camber template 2 Lane	
	a) Crown type cross-section	1 set
	b) Straight run cross-section	2 sets
8)	Steel tape	
	a) 5 m long	2 Nos
	b) 10 m long	2 Nos
	c) 20 m long	2 Nos
	d) 30 m long	2 Nos
	e) 50 m long	1 No
9)	Roughometer (Bump Integrator)	1 No. (when required)

Note : The items and their numbers listed above in this Section are indicative and shall be decided by the Engineer as per requirements of the Project and modified accordingly.

120.5 Rate

Provision and maintenance of the field laboratory is not a payable item as it is incidental to the work.

121 SUPPLY OF PROJECT RECORD

121.1 Scope

The work covers the supply digital record of project events in digital format (DVD/Flash Drive) including coloured photographs both in digital format as well as mounted on albums to serve as a permanent record of the work needed for an authentic documentation, as approved by the Engineer.

121.2 Description

The Contractor shall provide the following project records in digital format (DVD/Flash Drive) as directed by the Engineer :

- i) Record of work in each workfront : It shall cover the status of each workfront before start of work, during various stages of construction and after completion duly including the arrangements made (day & night) for traffic during construction (This shall be need based or as directed by the Engineer);
- ii) Record of quarry sites, plant sites, camp sites including labour camps, haul roads, access roads, etc. on quarterly basis;
- iii) Record of all accidents on project road/various sites (quarry, plant, camp, etc.)

The record shall be taken by a professional with a digital camera capable of taking still as well as video images having the facility to record the date and the background commentary. The Contractor shall keep separate discs/drives, one with the Engineer and the other with the Employer and update the data in these discs/drives on monthly basis. Separately, a video (in digital format) of maximum one hour duration covering interesting and novel features of the work duly editing the above master disc/drive shall also be maintained, one copy each kept with the Engineer and the Employer and updated on monthly basis. All recording shall be done in the presence of the Engineer's Representative who will certify in writing the recording.

121.3 Measurements for Payment

Supply of two copies of all digital records as above and colour record photographs both in digital format as well as mounted in the albums project shall be measured as one item for the project.

Supply of additional prints of colour record photograph if requested shall be measured in number of additional prints supplied.

The supply of "as-built" drawings in digital format and in hard copies is incidental to the work and shall not be a payable item.

121.4 Rate

Supply of project record in digital format in two copies (one for the Engineer and the other for the Employer) including video recordings updated on monthly basis throughout the construction period shall be measured as one single item.

200

SITE CLEARANCE

201 CLEARING AND GRUBBING**201.1 Scope**

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, rubbish, top organic soil, etc. to an average depth of 150 mm in thickness, which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials with all leads and lifts. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

201.2 Preservation of Property/Amenities

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own cost, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc., and the schedules for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3.

201.3 Methods, Tools and Equipment

Only such methods, tools and equipment as are approved by the Engineer and which will not affect any property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the bottom of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several metres, shall be suitably treated.

201.4 Disposal of Materials

All materials arising from clearing and grubbing operations shall be taken over and shall be disposed of by the Contractor at suitable disposal sites with all leads and lifts. The disposal shall be in accordance with local, State and Central regulations

201.5 Measurements for Payment

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of hectares. Cutting of trees upto 300 mm in girth and removal of their stumps, including removal of stumps upto 300 mm in girth left over after trees have been cut by any other agency, and trimming of branches of trees extending above the roadway and backfilling to the required compaction shall be considered incidental to the clearing and grubbing operations. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same.

Ground levels shall be taken prior to and after clearing and grubbing. Levels taken prior to clearing and grubbing shall be the base level and will be accordingly used for assessing the depth of clearing and grubbing and computation of quantity of any unsuitable material which is required to be removed. The levels taken subsequent to clearing and grubbing shall be the base level for computation of earthwork for embankment.

Cutting of trees, excluding removal of stumps and roots of trees of girth above 300 mm shall be measured in terms of number according to the girth sizes given below :-

- | | | |
|------|-------|-------------------|
| i) | Above | 300 mm to 600 mm |
| ii) | Above | 600 mm to 900 mm |
| iii) | Above | 900 mm to 1800 mm |
| iv) | Above | 1800 mm |

Removal of stumps and roots including backfilling with suitable material to required compaction shall be a separate item and shall be measured in terms of number according to the sizes given below:-

- | | | |
|------|-------|-------------------|
| i) | Above | 300 mm to 600 mm |
| ii) | Above | 600 mm to 900 mm |
| iii) | Above | 900 mm to 1800 mm |
| iv) | Above | 1800 mm |

For the purpose of cutting of trees and removal of roots and stumps, the girth shall be measured at a height of 1 m above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

201.6 Rates

201.6.1 The Contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 mm girth excavation and back-filling to required density, where necessary, and handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads. Clearing and grubbing done in excess of 150 mm by the Contractor shall be made good by the Contractor at his own cost as per Clause 301.3.3 to the satisfaction of the Engineer prior to taking up earthwork. Where clearing and grubbing is to be done to a level beyond 150 mm, due to site considerations, as directed by the Engineer, the extra quantity shall be measured and paid separately.

201.6.2 The Contract unit rate for cutting trees of girth above 300 mm shall include handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

201.6.3 The Contract unit rate for removal of stumps and roots of trees girth above 300 mm shall include excavation and backfilling with suitable material to required compaction, handling, giving credit towards salvage value disposing of the cleared materials with all lifts and leads.

201.6.4 The Contract unit rate is deemed to include credit towards value of usable materials, salvage value of unusable materials and off-set price of cut trees and stumps belonging to the Forest Department. The off-set price of cut trees and stumps belonging to the Forest Department shall be deducted from the amount due to the Contractor and deposited with the State Forest Department. In case the cut trees and stumps are required to be deposited with the Forest Department the Contractor shall do so and no deduction towards the off-set price shall be effected. The offset price shall be as per guidelines / estimates of the State Forest Department.

201.6.5 Where a Contract does not include separate items of clearing and grubbing, the same shall be considered incidental to the earthwork items and the Contract unit prices for the same shall be considered as including clearing and grubbing operations.

202 DISMANTLING CULVERTS, BRIDGES AND OTHER STRUCTURES/ PAVEMENTS

202.1 Scope

This work shall consist of dismantling and removing existing culverts, bridges, pavements,

kerbs and other structures like guard-rails, fences, utility services, manholes, catch basins, inlets, etc., from the right of way which in the opinion of the Engineer interfere with the construction of road or are not suitable to remain in place, disposing of the surplus/unsuitable materials and backfilling to after the required compaction as directed by the Engineer.

Existing culverts, bridges, pavements and other structures which are within the highway and which are designated for removal, shall be removed upto the limit and extent specified in the drawings or as indicated by the Engineer.

Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and any other work to be left in place.

All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.

202.2 Dismantling Culverts and Bridges

The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the part of the structure to be retained and any other properties or structures nearby.

Unless otherwise specified, the superstructure portion of culverts/bridges shall be entirely removed and other parts removed up to at least 600 mm below the sub-grade, slope face or original ground level whichever is the lowest or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent material, if required in connection with the dismantling of the structures, shall be incidental to this item.

Where existing culverts/bridges are to be extended or otherwise incorporated in the new work, only such part or parts of the existing structure shall be removed as are necessary and directed by the Engineer to provide a proper connection with the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Due care should be taken to ensure that reinforcing bars which are to be left in place so as to project into the new work as dowels or ties are not injured during removal of concrete.

Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes.

Steel structures shall, unless otherwise provided, be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawings or directed by the Engineer that the structure is to be removed in a condition suitable for re-erection, all members shall be match-marked by the Contractor with white lead paint before dismantling; end pins, nuts, loose plates, etc. shall be similarly marked to indicate their proper location; all pins, pin holes

and machined surfaces shall be painted with a mixture of white lead and tallow and all loose parts shall be securely wired to adjacent members or packed in boxes.

Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber having salvage value as is designated by the Engineer.

202.3 Dismantling Pavements and Other Structures

In removing pavements, kerbs, gutters, and other structures like guard-rails, fences, manholes, catch basins, inlets, etc., where portions of the existing construction are to be left in the finished work, the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer.

All concrete pavements, base courses in carriageway and shoulders etc., designated for removal shall be broken to pieces whose volume shall not exceed 0.02 cu.m and used with the approval of the Engineer or disposed of.

202.4 Back-filling

Holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials and compacted to required density as directed by the Engineer.

202.5 Disposal of Materials

All surplus materials shall be taken over by the Contractor which may either be re-used with the approval of the Engineer or disposed of with all leads and lifts.

202.6 Measurements for Payment

The work of dismantling shall be paid for in units indicated below by taking measurements before and after, as applicable:

i)	Dismantling brick/stone masonry/ concrete (plain and reinforced)	cu.m
ii)	Dismantling flexible and cement concrete pavement	cu.m
iii)	Dismantling steel structures	tonne
iv)	Dismantling timber structures	cu.m
v)	Dismantling pipes, guard rails, kerbs, gutters and fencing	linear m
vi)	Utility services	No.

202.7 Rates

The Contract unit rates for the various items of dismantling shall be paid in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work. The rates will include excavation and backfilling to the required compaction and for handling, giving credit towards salvage value disposing of dismantled materials with all lifts and leads.

300

**EARTHWORK, EROSION
CONTROL AND
DRAINAGE**

301 EXCAVATION FOR ROADWAY AND DRAINS**301.1 Scope**

This work shall consist of excavation, removal and disposal of materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and subgrade construction suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, with all leads and lifts, reuse of cut materials as may be deemed fit, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

301.2 Classification of Excavated Material

301.2.1 Classification : All materials involved in excavation shall be classified by the Engineer in the following manner:

a) Soil :

This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black-cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging equipment. Removal of gravel or any other modular material having dimension in any one direction not exceeding 75 mm shall be deemed to be covered under this category.

b) Ordinary Rock (not requiring blasting) This shall include :

- i) rock types such as laterites, shales and conglomerates, varieties of limestone and sandstone etc., which may be quarried or split with crow bars, also including any rock which in dry state may be hard, requiring blasting but which, when wet, becomes soft and manageable by means other than blasting;
- ii) macadam surfaces such as water bound and bitumen bound; soling of roads, cement concrete pavement, cobble stone, etc. compacted moorum or stabilized soil requiring use of pick axe or shovel or both.
- iii) lime concrete, stone masonry and brick work in lime/cement mortar below ground level, reinforced cement concrete which may be broken up with crow bars or picks and stone masonry in cement mortar below ground level; and
- iv) boulders which do not require blasting found lying loose on the surface or embedded in river bed, soil, talus. slope wash and terrace material of dissimilar origin.

c) Hard Rock (requiring blasting)

This shall comprise :

- i) any rock or cement concrete for the excavation of which the use of mechanical plant and/or blasting is required,
- ii) reinforced cement concrete below ground level and in bridge/ROB/RUB/flyover piers and abutments,
- iii) boulders requiring blasting.

d) Hard Rock (using controlled blasting) :

Hard rock requiring blasting as described under (c) but where controlled blasting is to be carried out in locations where built-up area, huts, and are situated at within 200 m of the blast site.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason like people living within 20 m of blast sites etc. and excavation has to be carried out by chiselling, wedging or any other agreed method.

f) Marshy soil

This shall include soils like soft clays and peats excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

301.2.2 Authority for Classification

The classification of excavation shall be decided by the Engineer and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer.

301.3 Construction Operations

301.3.1 Setting Out

After the site has been cleared as per Clause 201, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. Clause 109 shall be applicable for the setting out operations.

301.3.2 Stripping and Storing Topsoil

When so directed by the Engineer, the topsoil existing over the sites of excavation shall be

stripped to specified depths and stockpiled at designated locations for re-use in covering embankment slopes, cut slopes, berms and other disturbed areas where re-vegetation is desired in accordance with Clause 305.3.3. Prior to stripping the topsoil, all trees, shrubs etc. shall be removed along with their roots, with approval of the Engineer.

301.3.3 Excavation–General

All excavations shall be carried out in conformity with the directions laid here-in-under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilized as deemed fit or as approved by the Engineer.

While planning or executing excavations, the Contractor shall take all adequate precautions against soil erosion, water pollution etc. as per Clause 306, and take appropriate drainage measures to keep the site free of water in accordance with Clause 311.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or as directed by the Engineer. The Contractor shall not excavate outside the limits of excavation. Subject to the permitted tolerances, any excess depth/width excavated beyond the specified levels/dimensions on the drawings shall be made good at the cost of the Contractor with suitable material of characteristics similar to that removed and compacted to the requirements of Clause 305.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes, these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an appropriate manner.

After excavation, the sides of excavated area shall be trimmed and the area contoured to minimize erosion and ponding, allowing for natural drainage to take place.

301.3.4 Methods, Tools and Equipment

Only such methods, tools and equipment as approved by the Engineer shall be adopted/ used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

301.3.5 Rock Excavation

Rock, when encountered in road excavation, shall be removed upto the formation level or as otherwise indicated in the drawings. Where, however, unstable shales or other unsuitable materials are encountered at the formation level, these shall be excavated to the extent of

500 mm below the formation level or as otherwise specified. In all cases, the excavation operations shall be so carried out that at no point on cut formations the rock protrudes above the specified levels. Rocks and boulders which are likely to cause differential settlement and also local drainage problems shall be removed to the extent of 500 mm below the formation level in the formation width including side drains.

Where excavation is done to levels lower than those specified, the excess excavation shall be made good as per Clauses 301.3.3 and 301.6 to the satisfaction of the Engineer.

Slopes in rock cutting shall be finished to uniform lines corresponding to slope lines shown on the drawings or as directed by the Engineer. Notwithstanding the foregoing, all loose pieces of rock on excavated slope surface which move when pierced by a crowbar shall be removed.

Where blasting is to be resorted to, the same shall be carried out as per Clause 302 and all precautions indicated therein observed.

Where presplitting is prescribed to be done for the establishment of a specified slope in rock excavation, the same shall be carried out as per Clause 303.

301.3.6 Marsh Excavation

The excavation of soil from marshes/swamps shall be carried out as per the programme approved by the Engineer.

Excavation of marshes shall begin at one end and proceed in one direction across the entire marsh immediately ahead of backfilling with materials like boulders, sand moorum, bricks bats, dismantled concrete as approved by the Engineer. The method and sequence of excavating and backfilling shall be such as to ensure, to the extent practicable, the complete removal or displacement of all muck from within the lateral limits indicated on the drawings or as staked by the Engineer.

301.3.7 Excavation of Road Shoulders/Verge/Median for Widening of Pavement or Providing Treated Shoulders

In the works involving widening of existing pavements or providing paved shoulders, the existing shoulders/verge/median shall be removed to its full width and upto top of the subgrade. The subgrade material within 500 mm from the bottom of the pavement for the widened portion or paved shoulders shall be loosened and recompactd as per Clause 305. Any unsuitable material found in this portion shall be removed and replaced with the suitable material. While doing so, care shall be taken to see that no portion of the existing pavement designated for retention is loosened or disturbed. If the existing pavement gets disturbed or loosened, it shall be dismantled and cut to a regular shape with sides vertical and the

disturbed/loosened portion removed completely and relaid as directed by the Engineer, at the cost of the Contractor.

301.3.8 Excavation for Surface/Sub-Surface Drains

Where the Contract provides for construction of surface/sub-surface drains, the same shall be done as per Clause 309. Excavation for these drains shall be carried out in proper sequence with other works as approved by the Engineer.

301.3.9 Slides

If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of the Contractor as ordered by the Engineer. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material from the slips, slides etc. shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

301.3.10 Dewatering

If water is met with in the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

301.3.11 Use and Disposal of Excavated Materials

All the excavated materials shall either be reused with the approval of the Engineer or disposed off with all leads and lifts as directed by the Engineer.

301.3.12 Backfilling

Backfilling of masonry/concrete hume pipe or drain excavation shall be done with approved material with all leads and lifts after concrete/masonry/hume pipe is fully set and carried out in such a way as not to cause undue thrust on any part of the structure and/or not to cause differential settlement. All space between the drain walls and the side of the excavation

shall be backfilled to the original surface making due allowance for settlement, in layers not exceeding 150 mm compacted thickness to the required density, using suitable compaction equipment such as trench compactor, mechanical tamper, rammer or plate compactor as directed by the Engineer.

301.4 Plying of Construction Traffic

Construction traffic shall not use the cut formation and finished subgrade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the Contractor at his own cost.

301.5 Preservation of Property

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers, sub-surface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which, in the opinion of the Engineer, shall be continued in use without any change. Safety measures taken by the Contractor in this respect, shall be got approved from the Engineer. However, if any, of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his cost. If the Contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of the Engineer, the actions initiated by the Contractor to replace/restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement/restoration directly through any other agency at the risk and cost of the Contractor after issuing prior notice to the effect.

301.6 Preparation of Cut Formation

The cut formation, which serves as a sub-grade, shall be prepared to receive the sub-base/base course as directed by the Engineer.

Where the material in the subgrade has a density less than specified in Table 300-1, the same shall be loosened to a depth of 500 mm and compacted in layers in accordance with the requirements of Clause 305 adding fresh material, if any required, to maintain the formation level as shown on the drawings. Any unsuitable material encountered in the subgrade level shall be removed as directed by the Engineer, replaced with suitable material and compacted in accordance with Clause 305.

In rocky formations, the surface irregularities shall be corrected and the levels brought up to the specified elevation with granular base material as directed by the Engineer, laid and compacted in accordance with the respective Specifications for these materials. The unsuitable material shall be disposed of in accordance with Clause 301.3.11. After satisfying

the density requirements, the cut formation shall be prepared to receive the sub-base/base course in accordance with Clauses 310 and 311.

301.7 Finishing Operations

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces.

When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock (ordinary or hard) where no point shall vary more than 300 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances described in Clause 902.

Where directed, the topsoil removed and conserved (Clauses 301.3.2 and 305.3.3) shall be spread over cut slopes, shoulders and other disturbed areas. Slopes may be roughened and moistened slightly, prior to the application of topsoil, in order to provide satisfactory bond. The depth of topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 100 mm.

301.8 Measurements for Payment

Excavation for roadway shall be measured by taking cross-sections at suitable intervals before the excavation starts (after clearing and grubbing/stripping etc. as the case may be) and after its completion and computing the volumes in cu.m by the method of average end areas for each class of material encountered. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods.

At the option of the Engineer, the Contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The Contractor shall see that these remain intact till the final measurements are taken.

For rock excavation, the overburden shall be removed first so that necessary cross-sections could be taken for measurement. Where cross-sectional measurements could not be taken due to irregular configuration or where the rock is admixed with other classes of materials, the volumes shall be computed on the basis of measurement of stacks of excavated rubble allowing a deduction of 35% therefrom. When volume is calculated on the basis of measurement of stacks of the excavated material other than rock, a deduction of 16% of stacked volume shall be allowed.

Works involved in the preparation of cut formation shall be measured in units indicated below:

i)	Loosening and recompacting the loosened material at subgrade	...cu.m
ii)	Loosening and removal of unsuitable material and replacing with suitable material and compacting to required density	...cu.m
iii)	Preparing rocky subgrade	...sq.m
iv)	Stripping including storing and reapplication of topsoil	...cu.m

301.9 Rates

301.9.1 The Contract unit rates for the items of roadway and drain excavation shall be payment in full for carrying out the operations required for the individual items including full compensation for:

- i) setting out;
- ii) transporting the excavated materials for use or disposal with all leads and lifts by giving suitable credit towards the cost of re-usable material and salvage value of unusable material;
- iii) trimming bottoms and slopes of excavation;
- iv) dewatering;
- v) keeping the work free of water as per Clause 311;
- vi) arranging disposal sites; and
- vii) all labour, materials, tools, equipment., safety measures, testing and incidentals necessary to complete the work to Specifications.

Where presplitting of rock is prescribed it shall be governed by Clause 303.5.

301.9.2 The Contract unit rate for loosening and recompacting the loosened materials at subgrade shall include full compensation for loosening to the specified depth, including breaking clods, spreading in layers, watering where necessary and compacting to the requirements.

301.9.3 Clauses 301.9.1 and 305.8 shall apply as regards Contract unit rate for item of removal of unsuitable material and replacement with suitable material respectively.

301.9.4 The Contract unit rate for item of preparing rocky sub-grade as per Clause 301.6 shall be full compensation for providing, laying and compacting granular base material for correcting surface irregularities including all materials, labour and incidentals necessary to complete the work and all leads and lifts.

301.9.5 The Contract unit rate for the items of stripping and storing topsoil and of reapplication of topsoil shall include full compensation for all the necessary operations including all lifts and leads.

302 BLASTING OPERATIONS

302.1 General

Blasting shall be carried out in a manner that completes the excavation to the lines indicated in drawings, with the least disturbance to adjacent material. It shall be done only with the written permission of the Engineer. All the statutory laws, regulations, rules, etc., pertaining to the acquisition, transportation, storage, handling and use of explosives shall be strictly followed by the contractor.

The Contractor may adopt any method or methods of blasting consistent with the safety and job requirements. Prior to starting any phase of the operation, the Contractor shall provide information describing pertinent blasting procedures, dimensions and notes.

The magazine for the storage of explosives shall be built to the designs and specifications of the Explosives Department concerned and located at the approved site. The storage places shall be clearly marked "DANGER-EXPLOSIVES". The Contractor shall be liable for property damage, injury or death resulting from the use of explosives. All permits shall be obtained by the Contractor. No unauthorized person shall be admitted into the magazine which, when not in use, shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lightning conductor. The following shall be hung in the lobby of the magazine:

- a) A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar,
- b) A statement of up-to-date stock in the magazine,
- c) A certificate showing the last date of testing of the lightning conductor, and
- d) A notice that smoking is strictly prohibited.

All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be marked. Where no local laws or ordinances apply, storage shall be provided to the satisfaction of the Engineer and in general not closer than 300 m from the road or from any building or camping area or place of human occupancy. In addition to these, the Contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer and shall be responsible for damage to property and any accident which may occur to workmen or public on account of any operations connected with the storage, handling or use of explosives and blasting. The Engineer shall frequently check the Contractor's compliance with these precautions.

302.2 Materials, Tools and Equipment

All the materials, tools and equipment used for blasting operations shall be of approved type. The Engineer may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water-resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a length being cut as will permit sufficient time to the firer to reach safely before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder, explosives, detonators, fuses, etc., shall be fresh and not damaged due to dampness, moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed from the site immediately.

302.3 Personnel

The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the details of handling explosives and blasting operations.

302.4 Blasting Operations

The blasting shall be carried out during the pre-determined hours of the day preferably during the mid-day luncheon hour or at the close of the work as ordered in writing by the Engineer. The hours shall be made known to the people in the vicinity.

The Contractor shall notify each public utility company having structures in proximity to the site of the work of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury. In advance of any blasting work within 50 m of any railway track or structures, the Contractor shall notify the concerned Railway Authority of the location, date, time and approximate duration of such blasting operation.

Red danger flags shall be displayed prominently in all directions during the blasting operations. The flags shall be planted 200 m from the blasting site in all directions. People, except those who actually light the fuse, shall be prohibited from entering this area and all persons including workmen shall be kept away from the flagged area, and all persons including workmen shall be removed from the flagged area at least 10 minutes before the firing. A warning siren shall be sounded for the above purpose.

Only controlled blasting shall be resorted to along with the safeguard above at locations where built-up area, huts and structures in use lie within 200 m. Similarly excavation of hard rock without blasting is mandatory where people live within 20 m of blast site.

The charge holes shall be drilled to required depths and at suitable places. Blasting should be as light as possible consistent with thorough breakage of the material necessary for economic loading and hauling. Any method of blasting which leads to overshooting shall be discontinued.

When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped shall be gently tamped with copper rods with rounded ends. The explosive powder shall then be covered with tamping material which shall be tamped lightly but firmly.

When blasting is done with dynamite and other high explosives, dynamite cartridges shall be prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end, the detonator gently pushed into the primer leaving 1/3rd of the copper tube exposed outside. The paper of the cartridge shall then be closed up and securely bound with wire or twine. The primer shall be housed into the explosive. Boreholes shall be cleared of all debris and explosives inserted. The space of about 200 mm above the charge shall then be gently filled with dry clay, pressed home and the rest of the tamping formed of any convenient material gently packed with a wooden rammer.

At a time not more than 10 such charges will be prepared and fired. The man in charge shall blow a siren in a recognized manner for cautioning the people. All the people shall then be required to move to safe distances. The charges shall be lighted by the man-in-charge only. The man-in-charge shall count the number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go back to the work site.

After blasting operation, the Contractor shall compact the loose residual material below subgrade and replace the material removed below subgrade with suitable material.

302.5 Misfire

In case of misfire, the following procedure shall be observed:

- i) Sufficient time shall be allowed to account for the delayed blast. The man-in-charge shall inspect all the charges and determine the missed charge.
- ii) If it is the blasting powder charge, it shall be completely flooded with water. A new hole shall be drilled at about 450 mm from the old hole and fired. This should blast the old charge. In case, it does not blast the old charge, the procedure shall be repeated till the old charge is blasted.
- iii) In case of charges of gelignite, dynamite, etc., the man-in-charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge. Alternatively,

the hole may be cleared of 300 mm of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 150 mm away and parallel to it. This hole shall then be charged and fired when the misfired hole should explode at the same time. The man-in-charge shall at once report to the Contractor's office and the Engineer all cases of misfire, the cause of the same and what steps were taken in connection therewith.

If a misfire has been found to be due to defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer for inspection to ascertain whether all the remaining materials in the box are also defective.

302.6 Account

A careful and day to day account of the explosive shall be maintained by the Contractor in an approved register and manner which shall be open to inspection by the Engineer at all times.

303 PRESPLITTING ROCK EXCAVATION SLOPES

303.1 General

Presplitting is defined as the establishment of a specified excavation slope in rock by the controlled use of explosives and blasting accessories in properly aligned and spaced drill holes.

The presplitting technique shall be used for forming rock excavation slopes at locations shown on the drawings or as otherwise decided by the Engineer.

303.2 Construction Operations

Prior to starting drilling operations for presplitting, the Contractor shall furnish the Engineer a plan outlining the position of all drill holes, depth of drilling, type of explosives to be used, loading pattern and sequence of firing. The drilling and blasting plan is for record purposes only and will not absolve the Contractor of his responsibility for using proper drilling and blasting procedures. Controlled blasting shall begin with a short test section of a length approved by the Engineer. The test section shall be presplit, production drilled and blasted and sufficient material excavated whereby the Engineer can determine if the Contractor's method have produced an acceptable slope.

All overburden soil and weathered rock along the top of the excavation for a distance of about 5 to 15 m beyond the drilling limits, or to the end of the excavation, as decided by the

Engineer shall be removed before drilling the presplitting holes. Particular care and attention shall be directed to the beginning and end of excavations to ensure complete removal of all overburden soil and weathered rock and to expose fresh rock to an elevation equal to the bottom of the adjacent lift of the presplitting holes being drilled.

Slope holes for presplitting shall be drilled along the line of the planned slope within the specified tolerances. The drill holes shall not be less than 60 mm nor more than 75 mm in diameter. Drilling operations shall be controlled by the use of proper equipment and technique to ensure that no hole shall deviate from the plane of the planned slope by more than 300 mm nor shall any hole deviate from being parallel to an adjacent hole by more than two-third of the planned horizontal spacing between holes.

The length of presplit holes for any individual lift shall not exceed 9 m.

The spacing of presplit holes shall not exceed 900 mm on centres and shall be adjusted to result in a uniform shear face between holes.

Auxiliary drill holes along the presplit line, not loaded or stemmed, may be ordered by the Engineer. Except for spacing, auxiliary drill holes shall conform to the provisions for presplit holes.

The line of production holes shall be placed inside the presplit lines in such a manner as to avoid damage to the presplit face.

If necessary, to reduce shatter and overbreak of the presplit surface, the first line of the production holes shall be drilled parallel to the slope line at the top of the cut and at each bench level thereafter.

Any blasting technique, which results in damage to the presplit surface, shall be immediately discontinued.

No portion of any production holes shall be drilled within 2.5 m of a presplit plane except as approved by the Engineer. The bottom of the production holes shall not be lower than the bottom of the presplit holes.

A maximum offset of 600 mm will be permitted for a construction working bench at the bottom of each lift for use in drilling the next lower presplitting pattern. The drilling operations shall be adjusted to compensate for drift of previous levels and for the offset at the start of new levels to maintain the specified slope plane.

The maximum diameter of explosives used in presplit holes shall not be greater than one-half the diameter of the presplit hole.

Only standard cartridge explosives prepared and packaged by explosive manufacturing firms shall be used in presplit holes. These shall be fired as recommended by the manufacturer. Ammonium nitrate composition blasting agents will not be permitted in presplitting operations.

Stemming may be required to achieve a satisfactory presplit face. Stemming material shall be dry free-running material all of which passes 11.2 mm sieve and 90 percent of which is retained on 2.80 mm sieve. Stemmed presplit holes shall be completely filled to the collar.

All charges in each presplitting pattern shall be detonated simultaneously.

303.3 Tolerances

The presplit face shall not deviate more than 300 mm from the plane passing through adjacent drill holes, except where the character of the rock is such that, as determined by the Engineer, irregularities are unavoidable. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated slopes by more than 300 mm. These tolerances shall be measured perpendicular to the plane of the slope. In no case shall any portion of the slope encroach on the side drains.

As long as equally satisfactory presplit slopes are obtained, then either the slope face may be presplit before drilling for production blasting or presplitting the slope face and production blasting may be done at the same time, provided that the presplitting drill holes are fired with zero delay and the production holes are delayed starting at the row of holes farthest from the slope and progressing in steps to the row of holes nearest the presplit lines, which row shall be delayed at least 50 milliseconds. In either case the presplitting holes shall extend either to the end of the excavation or for a distance of not less than 15 m beyond the limits of the production holes to be detonated.

303.4 Measurements for Payment

The area of presplitting to be paid for, will be measured as square metres of acceptable presplit slope surface.

303.5 Rates

The Contract unit rate for presplitting work shall be payment in full for carrying out the required operations for obtaining acceptable presplit slope surfaces. The quantity of rock excavated through the production/presplit holes shall be paid for as per Clause 301.9.1.

304 EXCAVATION FOR STRUCTURES**304.1 Scope**

Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, headwalls, cutoff walls, pipe culverts and other similar structures, in accordance with the requirements of these Specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary sheeting, shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstruction, necessary for placing the foundations; trimming bottoms of excavations; backfilling and clearing up the site and the disposal of all surplus material.

304.2 Classification of Excavation

All materials involved in excavation shall be classified in accordance with Clause 301.2.

304.3 Construction Operations**304.3.1 Setting Out**

After the site has been cleared according to Clause 201, the limits of excavation shall be set out true to lines, curves and slopes to Clause 301.3.1.

304.3.2 Excavation

Excavation shall be taken to the width of the lowest step of the footing including additional width as required for construction operation. The sides shall be left plumb where the nature of soil allows it. Where the nature of soil or the depth of the trench and season of the year do not permit vertical sides, the Contractor at his own cost shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer.

The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer. Propping shall be undertaken when any foundation or stressed zone from an adjoining structure is within a line of 1 vertical to 2 horizontal from the bottom of the excavation.

Where blasting is to be resorted-to, the same shall be carried out in accordance with Clause 302 and all precautions indicated therein observed. Where blasting is likely to

endanger adjoining foundations or other structures, necessary precautions such as controlled blasting, providing rubber mat cover to prevent flying of debris etc. shall be taken to prevent any damage.

304.3.3 Dewatering and Protection

Normally, open foundations shall be laid dry. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, depression of water level by well-point system, cofferdams and other necessary works to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the Contractor but subject to the approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements for the quality and safety of the works.

Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for facilitating construction to be carried out inside them. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipments, etc., inside the enclosed area.

If it is determined beforehand that the foundations cannot be laid dry or the situation is found that the percolation is too heavy for keeping the foundation dry, the foundation concrete shall be laid under water by tremie pipe only. In case of flowing water or artesian springs, the flow shall be stopped or reduced as far as possible at the time of placing the concrete.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete and for a period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other similar means.

At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area.

The Contractor shall take all precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property.

304.3.4 Preparation of Foundation

The bottom of the foundation shall be levelled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and

rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete as per Clause 2104.1 at the cost of the Contractor. Ordinary filling shall not be permitted to bring the foundation to the design level as shown in the drawing.

When rock or other hard strata is encountered, it shall be freed of all soft and loose material, cleaned and cut to a firm surface either level or stepped as directed by the Engineer. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer. In the case of excavation in rock, annular space around footing shall be filled with lean concrete M 15 upto the top level of rock.

If the depth of fill required is more than 1.5 m in soft rock or 0.6 m in hard rock above the foundation level, the filling upto this level shall be done with M-15 concrete and portion above shall be filled by concrete or by boulders grouted with cement.

When foundation piles are used, the excavation for pile cap shall be done after driving/casting of all piles forming the group. After pile driving operations in a given pit are completed, all loose and displaced materials therein shall be removed to the level of the bottom of the pile cap.

304.3.5 Slips and Slip-Outs

If there are any slips or slip-outs in the excavation, these shall be removed by the Contractor at his own cost.

304.3.6 Public Safety

Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from IS:3764.

304.3.7 Backfilling

Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface in layers not exceeding 150 mm compacted thickness. The compaction shall be done with the help of suitable equipment such as trench compactor, mechanical tamper, rammer, plate vibrator etc., after necessary watering, so as to achieve the maximum dry density.

304.3.8 Disposal of Surplus Excavated Materials

Clause 301.3.11 shall apply.

304.4 Measurements for Payment

Excavation for structures shall be measured in cu.m for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer. Excavation over increased width, cutting of slopes, production/support to the existing structures shoring, shuttering and planking shall be deemed as incidental to the main work and shall not be measured and paid separately.

Preparation of rock foundation shall be measured in square metres.

304.5 Rates

304.5.1 The Contract unit rate for the items of excavation for structures shall be payment in full for carrying out the required operations including full compensation for:

- i) setting out;
- ii) transporting the excavated materials for use or disposal with all leads and lifts;
- iii) construction of necessary cofferdams, cribs/sheeting, shoring and bracing and their subsequent removal;
- iv) removal of all logs, stumps, grubs and other deleterious matter and obstructions, for placing the foundations including trimming of bottoms of excavations;
- v) foundation sealing, dewatering including pumping when no separate provision for it is made in the Contract;
- vi) backfilling, clearing up the site and disposal of all surplus material with all leads and lifts or as otherwise specified; and
- vii) all labour, materials, tools, equipment, safety measures, diversion of traffic and incidentals necessary to complete the work to Specifications.

304.5.2 The Contract unit rate for preparation of rock foundation shall be full compensation for cutting, trimming and cleaning the foundation surface and filling/sealing of all seams with cement grout or mortar including all materials, labour and incidentals required for completing the work.

305 EMABANKMENT CONSTRUCTION**305.1 General****305.1.1 Description**

These Specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from approved source, including material from roadway and drain excavation, borrow pits or other sources. All embankments sub-grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

305.2 Materials and General Requirements**305.2.1 Physical Requirements**

305.2.1.1 The materials used in embankments, subgrades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, reclaimed material from pavement, fly ash, pond ash, a mixture of these or any other material as approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment.

The following types of material shall be considered unsuitable for embankment:

- a) Materials from swamps, marshes and bogs;
- b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS:1498;
- c) Materials susceptible to spontaneous combustion;
- d) Materials in a frozen condition;
- e) Clay having liquid limit exceeding 50 and plasticity index exceeding 25; and
- f) Materials with salts resulting in leaching in the embankment.

305.2.1.2 Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 percent when tested as per IS:2720 – Part 40) shall not be used as a fill material. Where an expansive clay having "free swelling index" value less than 50 percent is used as a fill material, subgrade and top 500 mm portion of the embankment just below sub-grade shall be non-expansive in nature.

305.2.1.3 Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO_3) per litre when tested in accordance with BS:1377, Part 3, but using a 2:1 water-soil ratio shall not be deposited within 500 mm distance (or any other distance described in the Contract), of permanent works constructed out of concrete, cement bound materials or other cementitious material.

Materials with a total sulphate content (expressed as SO_3) exceeding 0.5 percent by mass, when tested in accordance with BS:1377, Part 3 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

305.2.1.4 The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when placed in the embankment and 50 mm when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these Specifications. The maximum particle size in such cases, however, shall not be more than two-thirds of the compacted layer thickness.

305.2.1.5 Ordinarily, only the materials satisfying the density requirements given in Table 300-1 shall be employed for the construction of the embankment and the sub-grade.

Table 300-1 : Density Requirements of Embankment and Sub-grade Materials

S. No.	Type of Work	Maximum laboratory dry unit weight when tested as per IS:2720 (Part 8)
1)	Embankments up to 3 m height, not subjected to extensive flooding	Not less than 15.2 kN/cu.m
2)	Embankments exceeding 3 m height or embankments of any height subject to long periods of inundation	Not less than 16 kN/ cu.m
3)	Subgrade and earthen shoulders/verges/backfill	Not less than 17.5 kN/cu.m

- Notes:**
- 1) This Table is not applicable for lightweight fill material, e.g., cinder, fly ash, etc.
 - 2) The material to be used in subgrade shall be non-expansive and shall satisfy design CBR at the specified dry density and moisture content. In case the available materials fail to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer shall be followed.

305.2.1.6 The material to be used in subgrade shall conform to the design CBR value at the specified dry density and moisture content of the test specimen. In case the available

materials fails to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 or by any stabilization method approved by the Engineer or by the IRC Accreditation Committee shall be followed.

305.2.1.7 The material to be used in high embankment construction shall satisfy the specified requirements of strength parameters.

305.2.2 General Requirements

305.2.2.1 The materials for embankment shall be obtained from approved sources with preference given to acceptable materials becoming available from nearby roadway excavation under the same Contract.

The work shall be so planned and executed that the best available materials are saved for the subgrade and the embankment portion just below the subgrade.

305.2.2.2 Borrow Materials

The arrangement for the source of supply of the material for embankment and sub-grade and compliance with the guidelines, and environmental requirements, in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable shall be the sole responsibility of the Contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width of a minimum of 10 m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures.

305.2.2.3 Fly-Ash

Use of fly-ash shall conform to the Ministry of Environment and Forest guidelines. Where fly-ash is used the embankment construction shall conform to the physical and chemical properties and requirements of IRC:SP:38-2001, "Guidelines for Use of Flyash in Road Construction". The term fly-ash shall cover all types of coal ash such as pond ash, bottom ash or mound ash.

Embankment constructed out of fly ash shall be properly designed to ensure stability and protection against erosion in accordance with IRC guidelines. A suitable thick cover may preferably be provided at intervening layers of pond ash for this purpose. A thick soil cover shall bind the edge of the embankment to protect it against erosion. Minimum thickness of such soil cover shall be 500 mm.

305.2.2.4 Compaction Requirements

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the subgrade material when compacted to the density requirements as in Table 300-2 shall yield the specified design CBR value of the sub-grade.

Table 300-2 : Compaction Requirements for Embankment and Sub-grade

S. No.	Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
1)	Subgrade and earthen shoulders	Not less than 97%
2)	Embankment,	Not less than 95%
3)	Expansive Clays	
	a) Subgrade and 500 mm portion just below the subgrade	Not allowed
	b) Remaining portion of embankment	90–95%

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

- i) The values of maximum dry density and optimum moisture content obtained in accordance with IS:2720 (Part 8), appropriate for each of the fill materials he intends to use.
- ii) A graph of dry density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

The maximum dry density and optimum moisture content approved by the Engineer shall form the basis for compaction.

305.3 Construction Operations

305.3.1 Setting Out

After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1 The limits of embankment/sub-grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

305.3.2 Dewatering

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate for the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.6 shall apply.

305.3.3 Stripping and Storing Topsoil

When so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily subjected to traffic either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

305.3.4 Compacting Ground Supporting Embankment/Sub-Grade

Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling in accordance with Clauses 305.3.5 and 305.3.6 so as to achieve minimum dry density as given in Table 300-2.

In case where the difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density (as given in Table 300-2), the ground shall be loosened upto a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 305.3.5 and 305.3.6 to achieve dry density not less than 97 percent relative compaction as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation (500 mm portion just below the sub-grade) shall be removed, suitably disposed and replaced by approved materials laid in layers to the required degree of compaction.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of such material types (a) to (f) in Clause 305.2.1.1 at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

305.3.5 Spreading Material in Layers and Bringing to Appropriate Moisture Content

305.3.5.1 The embankment and sub-grade material shall be spread in layers of uniform thickness in the entire width with a motor grader. The compacted thickness of each layer shall not be more than 250 mm when vibratory roller/vibratory soil compactor is used and not more than 200 mm when 80-100 kN static roller is used. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 300-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

305.3.5.2 Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, using disc harrow until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS:2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with IS:2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub-grade.

305.3.5.3 Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other construction vehicles. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength of the material before it was damaged.

Embankments and unsupported fills shall not be constructed with steeper side slopes or to greater widths than those shown in the drawings, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material,

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical to 4 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

305.3.6 Compaction

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three-wheeled roller, self propelled single drum vibratory roller, tandem vibratory roller, pneumatic tyre roller, pad foot

roller, etc., of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of self-propelled single drum vibratory roller or pad foot vibratory roller of 80 to 100 kN static weight or heavy pneumatic tyre roller of adequate capacity capable of achieving the required compaction. The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for the site trials shall be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2. Subsequent layers shall be placed only after the finished layer has been tested according to Clause 903.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and provided the gauge is calibrated to give results identical to that obtained from tests in accordance with IS:2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment/sub-grade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted using appropriate mechanical means such as light weight vibratory roller, double drum walk behind roller, vibratory plate compactor, trench compactor or vibratory tamper to the density requirements and satisfaction of the Engineer.

305.3.7 Drainage

The surface of the embankment/sub-grade at all times during construction shall be maintained at such a crossfall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

305.3.8 Repairing of Damages Caused by Rain/Spillage of Water

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to

ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

305.3.9 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The topsoil, removed and conserved earlier (Clauses 301.3.2 and 305.3.3) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirements of Clause 308.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

305.4 Construction of Embankment and Sub-grade under Special Conditions

305.4.1 Earthwork for Widening Existing Road Embankment

When an existing embankment and/or sub-grade is to be widened and its slopes are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment/sub-grade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment/subgrade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of light weight vibratory roller, double drum walk behind roller, vibratory plate compactor or vibratory tamper or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

305.4.2 Earthwork for Embankment and Sub-Grade to be Placed Against Sloping Ground

Where an embankment/subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/sub-grade material. Extra earthwork involved in benching or due to ploughing/scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings, before the fill is placed against sloping ground.

Where the Contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to Clause 309 in proper sequence with the embankment and sub-grade work as approved by the Engineer.

305.4.3 Earthwork over Existing Road Surface

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:

- i) If the existing road surface is of granular type and lies within 1 m of the new formation levels, it shall be scarified to a depth of 50 mm or as directed so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new sub-grade level is compacted to the desired density;
- ii) If the existing road surface is of bituminous type or cement concrete and lies within 1 m of the new formation level, the bituminous or cement concrete layer shall be removed completely;
- iii) If the level difference between the existing road surface and the new formation level is more than 1 m, the existing surface shall be roughened after ensuring that the minimum thickness of 500 mm of subgrade is available.

305.4.4 Embankment and Sub-Grade Around Structures

To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points, to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures upto a distance of twice the height of the road from the back of the abutment shall be carried out

independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and sub-grade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS:2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in IRC:78. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of Table 300-2.

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Clause 2504 unless otherwise specified in the Contract.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.

305.4.5 Construction of Embankment over Ground Incapable of Supporting Construction Equipment

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geosynthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

305.4.6 Embankment Construction under Water and Waterlogged Areas**305.4.6.1 Embankment Construction under Water**

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall be of GW, SW, GP, SP as per IS:1498 and consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

305.4.6.2 Embankment Construction in Waterlogged and Marshy Areas

The work shall be done as per IRC:34.

305.4.7 Earthwork for High Embankment

The material for high embankment construction shall conform to Clause 305.2.1.7. In the case of high embankments (more than 6 m), the Contractor shall normally use fly ash in conformity with Clause 305.2.1.1 or the material from the approved borrow area.

Where provided, stage construction of embankment and controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

Where required, the Contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of surcharged fill results the Contractor shall bring the resultant level up to formation level with acceptable material for use in fill.

305.4.8 Settlement Period

Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc., or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the Contract or as directed by the Engineer.

305.5 Plying of Traffic

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or sub-grade without the prior permission of the Engineer. Any damage arising out of such use shall, however, be made good by the Contractor at his own cost as directed by the Engineer.

305.6 Surface Finish and Quality Control of Work

The surface finish of construction of sub-grade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

305.7 Sub-grade Strength

305.7.1 It shall be ensured prior to actual execution that the material to be used in the sub-grade satisfies the requirements of design CBR.

305.7.2 Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on remoulded samples, compacted to the field density at the field moisture content and tested for soaked/unsoaked condition as specified in the Contract.

305.8 Measurements for Payment

305.8.1 Earth embankment/sub-grade construction shall be measured separately by taking cross sections at intervals given in Sub-Section 113.3 after completion of clearing and grubbing and after completion of embankment/sub-grade. The volume of earthwork shall be computed in cubic metres by the method of average end areas.

305.8.2 The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cu.m of suitable material brought to site from road and drainage excavation forms one cu.m of compacted fill and all bulking or shrinkage shall be ignored.

305.8.3 The embankment constructed with fly ash will be measured in cu.m, separately for the fly ash portions and for the soil cover and intervening layers of soil, unless otherwise specified in the Contract.

305.8.4 Construction of embankment under water shall be measured in cu.m.

305.8.5 Construction of high embankment with specified material and in specified manner shall be measured in cu.m.

305.8.6 Stripping including storing and reapplication of top soil shall be measured in cu.m.

305.8.7 Work involving loosening and recompacting of ground supporting embankment/sub-grade shall be measured in cu.m.

305.8.8 Removal of unsuitable material at embankment/sub-grade foundation and replacement with suitable material shall be measured in cu.m.

305.8.9 Scarifying existing granular/bituminous road surface shall be measured in square metres.

305.8.10 Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6.

305.8.11 Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in cu.m.

305.9 Rates

305.9.1 The Contract unit rates for the items of embankment and sub-grade construction shall be payment in full for carrying out the required operations including full compensation for:

- i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the Contract;
- ii) Setting out;
- iii) Compacting ground supporting embankment/sub-grade except where removal and replacement of suitable material or loosening and recompacting is involved;
- iv) Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and sub-grade as applicable;
- v) Cost of watering or drying of material in borrow areas and/or embankment and sub-grade during construction as required;
- vi) Spreading in layers, bringing to appropriate moisture and compacting to Specification requirements;
- vii) Shaping and dressing top and slopes of the embankment and sub-grade including rounding of corners;
- viii) Restricted working at sites of structures;
- ix) Working on narrow width of embankment and sub-grade;
- x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and sub-grade site with all leads and lifts unless otherwise provided for in the Contract;
- xi) All labour, materials, tools, equipment and incidentals necessary to complete the work to the Specifications;
- xii) Dewatering; and

- xiii) Keeping the embankment/completed formation free of water as per Clause 311.
- xiv) Transporting unsuitable excavated material for disposal with all leads and lifts.

305.9.2 Clause 301.9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil including reapplication of topsoil.

305.9.3 Clause 301.9.2 shall apply as regards Contract unit rate for the item of loosening and recompacting the embankment/sub-grade foundation.

305.9.4 Clauses 309.1.1 and 305.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material, respectively.

305.9.5 The Contract unit rate for scarifying existing granular/bituminous road surface shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals, necessary to complete the work. This will also comprise of handling, giving credit towards salvage value and disposal of the dismantled materials with all leads and lifts or as otherwise specified.

305.9.6 Clause 202.7 shall apply as regards Contract unit rate for dismantling and removal of existing cement concrete pavement.

305.9.7 The Contract unit rate for providing and laying filter material shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

305.9.8 The Contract unit rate for providing and compacting backfill material behind abutments and retaining walls shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to Specifications.

305.9.9 Clause 305.4.6 shall apply as regards Contract unit rate for construction of embankment under water.

305.9.10 Clause 305.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instrumentation, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

306 SOIL EROSION AND SEDIMENTATION CONTROL

306.1 Description

This work shall consist of measures as shown on drawings or as directed by the Engineer to

control soil erosion, sedimentation and water pollution, through use of berms, dikes, sediment basins, fibre mats, mulches, grasses, slope drains, and other devices.

306.2 Materials

All materials shall meet commercial grade standards and shall be approved by the Engineer before being used in the work

306.3 Construction Operations

Prior to the start of the relevant construction, the Contractor shall submit to the Engineer for approval his schedules for carrying out temporary and permanent erosion/sedimentation control works as are applicable for the items of clearing and grubbing, roadway and drainage excavation, embankment/sub-grade construction, bridges and other structures across water courses, pavement courses and shoulders. He shall also submit for approval his proposed method of erosion/sedimentation control on service road and borrow pits and his plan for disposal of waste materials. Work shall not be started until the erosion/sedimentation control schedules and methods of operations for the applicable construction have been approved by the Engineer.

The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations shall be limited to the extent practicable. The Contractor shall provide immediate permanent or temporary erosion, slope protection and sedimentation control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage adjacent properties, or cause contamination of nearby streams or other water courses, lakes, reservoirs etc. Such work may involve the construction of temporary berms, dikes, sediment basins, slope drains and use of temporary mulches, fabrics, mats seeding, or other control devices or methods as necessary to control erosion and sedimentation. Cut and fill slopes shall be seeded and turfed as shown on the drawings.

The Contractor shall be required to incorporate all permanent erosion and sedimentation control features into the project at the earliest practicable time as outlined in his accepted schedule to minimize the need for temporary erosion and sedimentation control measures.

Temporary erosion/sedimentation and pollution control measures shall be used to control the phenomenon of erosion, sedimentation and pollution that may develop during normal construction practices, but may neither be foreseen during design stage nor associated with permanent control features on the Project.

Where erosion or sedimentation is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion or sedimentation control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion or sedimentation control measures may be required

between successive construction stages. Under no conditions shall a large surface area of erodible earth material be exposed at one time by clearing and grubbing or excavation without prior approval of the Engineer.

The Engineer may limit the area of excavation, borrow and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such permanent erosion, sedimentation and pollution control measures, in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion/sedimentation control measures shall be taken immediately to the extent feasible and justified.

In the event temporary erosion, sedimentation and pollution control measures become necessary due to the Contractor's negligence, carelessness or failure to install permanent controls as a part of the work as scheduled or ordered by the Engineer, these shall be carried out at the Contractor's own cost. Temporary erosion, sedimentation and pollution control work required, which is not attributed to the Contractor's negligence, carelessness or failure to install permanent controls, will be performed as ordered by the Engineer.

Temporary erosion, sedimentation and pollution control may include construction work outside the right-of-way where such work is necessary as a result of road construction such as borrow pit operations, service roads and equipment storage sites.

The temporary erosion, sedimentation and pollution control features installed by the Contractor shall be acceptably maintained by him till these are needed, unless otherwise agreed by the Engineer.

306.4 Measurement for Payment

The soil erosion, sedimentation and pollution control works shall be measured in terms of units specified in the Bill of Quantities for the respective items.

306.5 Rates

The Contract unit rate for different items of soil erosion, sedimentation and pollution control works shall be payment in full for carrying out all required operations including full compensation for all labour, materials, tools, equipment and incidentals to complete the works to the Specifications.

307 TURFING WITH SODS

307.1 Scope

This work shall consist of furnishing and laying of the live sod of perennial turf forming grass on

embankment slopes, verges (earthen shoulders) or other locations shown on the drawings or as directed by the Engineer. Unless otherwise specified, the work shall be taken up as soon as possible following construction of the embankment, provided the season is favourable for establishment of the sod.

307.2 Materials

The sod shall consist of dense, well-rooted growth of permanent and desirable grasses, indigenous to the locality where it is to be used, and shall be practically free from weeds or other undesirable matter. At the time the sod is cut, the grass on the sod shall have a length of approximately 50 mm and the sod shall have been freed of debris.

Thickness of the sod shall be as uniform as possible, with some 50-80 mm or so of soil covering the grass roots depending on the nature of the sod, so that practically all the dense root system of the grasses is retained in the sod strip. The sods shall be cut in rectangular strips of uniform width, not less than about 250 mm x 300 mm in size but not so large that it is inconvenient to handle and transport these without damage. During wet weather, the sod shall be allowed to dry sufficiently to prevent tearing during handling and during dry weather shall be watered before lifting to ensure its vitality and prevent the dropping of the soil in handling.

307.3 Construction Operations

307.3.1 Preparation of the Earth Bed

The area to be sodded shall have been previously constructed to the required slope and cross-section. Soil on the area shall be loosened, freed of all stones larger than 50 mm size, sticks, stumps and any undesirable foreign matter, and brought to a reasonably fine granular texture to a depth of not less than 25 mm for receiving the sod.

Where required, topsoil shall be spread over the slopes. Prior to placing the topsoil, the slopes shall be scarified to a depth which, after settlement, will provide the required nominal depth shown on the drawings. Spreading shall not be done when the ground is excessively wet.

Following soil preparation and top soiling, where required, fertilizer and ground limestone when specified shall be spread uniformly at the rate indicated on the drawings. After spreading, the materials shall be incorporated in the soil by using disc harrow or other means to the depths shown on the drawings.

307.3.2 Placing the Sods

The prepared sod bed shall be moistened to the loosened depth, if not already sufficiently moist, and the sod shall be placed thereon within approximately 24 hours after the same

had been cut. Each sod strip shall be laid edge to edge and such that the joints caused by abutting ends are staggered. Every strip, after it is snugly placed against the strips already in position, shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil.

On side slopes steeper than 2 (horizontal) to 1 (vertical), the laying of sods shall be started from bottom upwards. At points where water may flow over a sodded area, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth placed over this followed by its thorough compaction.

307.3.3 Staking the Sods

Where the side slope is 2 (horizontal) to 1 (vertical) or steeper and the distance along the slope is more than 2 m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000 mm along the longitudinal axis of the sods strips. Stakes shall be driven approximately plumb through the sods to be almost flush with them.

307.3.4 Top Dressing

After the sods have been laid in position, the surface shall be cleaned of loose sod, excess soil and other foreign material. Thereafter, a thin layer of topsoil shall be scattered over the surface of top dressing and the area thoroughly moistened by sprinkling with water.

307.3.5 Watering and Maintenance

The sods shall be watered by the Contractor for a period of at least four weeks after laying. Watering shall be so done as to avoid erosion and prevent damage to sodded areas by wheels of water tanks.

The Contractor shall erect necessary warning signs and barriers, repair or replace sodded areas failing to show uniform growth of grass or damaged by his operations and shall otherwise maintain the sod at his cost until final acceptance.

307.4 Measurements for Payment

Turfing with sods shall be measured as finished work in square metres.

307.5 Rate

The Contract unit rate for turfing with sods shall mean paying in full for carrying out all the required operations explained above including compensation for

- i) furnishing all the materials to be incorporated in the Works with all leads and lifts; and

- ii) all labour, tools, equipment and incidentals to complete the work in accordance with these Specifications.

The Contract unit rate for application of topsoil shall be as per Clause 301.9.5.

308 SEEDING AND MULCHING

308.1 Scope

This shall consist of preparing slopes, placing topsoil, furnishing all seeds, commercial or organic fertilizers and mulching materials, providing jute netting, coir netting, or polymer netting and placing and incorporating the same on embankment slopes or other locations designated by the Engineer or shown in the Contract documents.

308.2 Materials

308.2.1 Seeds

The seeds shall be of approved quality and type suitable for the soil on which these are to be applied, and shall give acceptable purity and germination to requirements set down by the Engineer.

Fertilizers shall consist of standard commercial materials and conform to the grade specified. Organic manure shall be fully putrified organic matter such as cow dung.

Mulching materials shall consist of straw, hay, wood shavings, or sawdust and shall be delivered in dry condition suitable for placing with a mulch blower. They shall be reasonably free of weed seed and such foreign materials as may detract from their effectiveness as a mulch or be injurious to the plant growth.

308.2.2 Topsoil

Topsoil shall not be obtained from an area known to have noxious weeds growing in it. If treated with herbicide or sterilents, it shall be got tested by appropriate agricultural authority to determine the residual in the soil. Topsoil shall not contain less than 2 percent and more than 12 percent organic matter.

308.2.3 Bituminous Emulsion

A suitable grade of bituminous emulsion used as a tie down for mulch shall be as described in the Contract document or as desired by the Engineer. Emulsified bitumen shall not contain any solvent or diluting agent toxic to plant life.

308.2.4 Netting

Jute netting shall be undyed jute yarn woven into a uniform open weave with approximate 25 mm square openings.

Geonetting shall be made of uniformly extruded rectangular mesh having mesh opening of 20 mm x 20 mm. The colour may be black or green. It shall weigh not less than 3.8 kg per 1000 sqm.

308.2.5 A layer of biodegradable mulching material sandwiched between two layers of polymer netting or non-woven coconut fibre coir netting can also be used.

308.3 Seeding Operations**308.3.1 Seed-Bed Preparation**

The area to be seeded shall be brought to the required slope and cross-section by filling, reshaping eroded areas and refinishing slopes, medians etc. Topsoil shall be evenly spread over the specified areas to the depth shown on the drawings, unless otherwise approved by the Engineer. The seed-bed preparation shall consist of eliminating all live plants by suitable means using agricultural implements. All stones 150 mm and larger shall be removed. The soil shall be excavated on the contour to a depth of 100 mm. All clods larger than 25 mm in diameter shall be crushed and packed. Where necessary, water shall then be applied. All topsoil shall be compacted unless otherwise specified or approved by the Engineer. Compaction shall be by slope compactor, cleated tractor or similar equipment approved by the Engineer. Equipment shall be so designed and constructed as to produce a uniform rough textured surface ready for seeding and mulching and which will bond the topsoil to the underlying material. The entire area shall be covered by a minimum of 4 passes of the roller or approved equipment.

308.3.2 Fertilizer Application

Fertilizer to the required quantities shall be spread and thoroughly incorporated into the soil surface as a part of the seed-bed preparation.

308.3.3 Planting of Seeds

All seeds shall be planted uniformly at the approved rate. Immediately after sowing, the area shall be raked, dragged or otherwise treated so as to cover the seeds to a depth of 6 mm.

The operation of seed sowing shall not be performed when the ground is muddy or when the soil or weather conditions would otherwise prevent proper soil preparation and subsequent operations.

308.3.4 Soil Moisture and Watering Requirements

Soil moisture shall exist throughout the zone from 25 mm to at least 125 mm below the surface at the time of planting.

Watering of the seeded areas shall be carried out as determined by the Engineer.

308.4 Mulching, Applying Bituminous Emulsion and Jute Netting/Geonetting/Netting of Coir

Within 24 hours of seeding, mulching material mixed with organic manure shall be placed so as to form a continuous, unbroken cover of approximate uniform thickness of 25 mm using an acceptable mechanical blower. Mulching material shall be held in place and made resistant to being blown away by suitable means approved by the Engineer. When called for in the Contract documents, mulch material shall be anchored in place with bituminous emulsion applied at the rate of 2300 litres per hectare. Any mulch disturbed or displaced following application shall be removed, reseeded and remulched as specified. Jute netting/geonetting or netting of coir shall be unrolled and placed parallel to the flow of water immediately following the bringing, to finished grade, the area specified on the drawings or the placing of seed and fertilizer. Where more than one strip is required to cover the given areas, they shall overlap a minimum of 100 mm. Jute netting/Geonetting /coir netting shall be held in place by approved wire staples, pins, spikes or wooden stakes driven vertically into the soil.

308.5 Maintenance

The Contractor shall maintain all seeded and mulched areas until final acceptance. Maintenance shall include protection of traffic by approved warning signs or barricades and repairing any areas damaged following the seeding and mulching operations. If mulched areas become damaged, the area shall be reshaped and then seeded and mulched again as originally specified.

308.6 Measurements of Payment

Seeding and mulching shall be measured as finished work in square metres.

308.7 Rate

The Contract unit rate for seeding and mulching shall be payment in full for carrying out all the required operations including full compensation for all materials, labour, tools and incidentals.

309 SURFACE/SUB-SURFACE DRAINS**309.1 Scope**

The work shall consist of constructing surface and/or sub-surface drains in accordance with the requirements of these Specifications and to the lines, grades, dimensions and other particulars shown on the drawings or as directed by the Engineer. Schedule of work shall be so arranged that the drains are completed in proper sequence with road works to ensure that no excavation of the completed road works is necessary subsequently or any damage is caused to these works due to lack of drainage.

309.2 Surface Drains

Surface drains shall be excavated to the specified lines, grades, levels and dimensions to the requirements of Clause 301. The excavated material shall be removed from the area adjoining the drains and if found suitable, utilized in embankment/sub-grade construction. All unsuitable material shall be disposed of as directed.

The excavated bed and sides of the drains shall be dressed to bring these in close conformity with the specified dimensions, levels and slopes.

Where so indicated, drains shall be lined or turfed with suitable materials in accordance with details shown on the drawings.

All works on drain construction shall be planned and executed in proper sequence with other works as approved by the Engineer, with a view to ensuring adequate drainage for the area and minimizing erosion/sedimentation.

309.3 Sub-Surface Drains**309.3.1 Scope**

Sub-surface drains shall be of close-jointed perforated pipes, open-jointed unperforated pipes, surrounded by granular material laid in a trench or aggregate drains to drain the pavement courses. Sub-surface drains designed using Geosynthetics and approved by the Engineer can also be used.

309.3.2 Materials**309.3.2.1 Pipe**

Perforated pipes for the drains may be metal/asbestos cement/cement concrete/Poly Vinyl

Chloride (PVC)/Poly Propylene (PP)/Poly Ethylene (PE) and unperforated pipes of metal vitrified clay/cement concrete/asbestos cement PVC/PP/PE. The type, size and grade of the pipe to be used shall be as specified in the Contract. In no case, however, shall the internal diameter of the pipe be less than 100 mm. Holes for perforated pipes shall be on one half of the circumference only and conform to the spacing indicated on the drawings. Size of the holes shall not ordinarily be greater than half of D_{85} size of the material surrounding the pipe, subject to being minimum 3 mm and maximum 6 mm. D_{85} stands for the size of the sieve that allows 85 percent of the material to pass through it.

309.3.2.2 Backfill Material

Backfill material shall consist of sound, tough, hard, durable particles of free draining sand-gravel material or crushed stone and shall be free of organic material, clay balls or other deleterious matter. Unless the Contract specifies any particular gradings for the backfill material or requires these to be designed on inverted filter criteria for filtration and permeability to the approval of the Engineer, the backfill material shall be provided on the following lines:

- i) Where the soil met with in the trench is of fine grained type (e.g., silt, clay or a mixture thereof), the backfill material shall conform to Class I grading set out in-Table 300-3;
- ii) Where the soil met with in the trench is of coarse silt to medium sand or sandy type, the backfill material shall correspond to Class II grading of Table 300-3; and
- iii) Where soil met with in the trench is gravelly sand, the backfill material shall correspond to Class III grading of Table 300-3.

Geosynthetics for use with subsurface drain shall conform to the requirements as per Section 700.

309.3.3 Trench Excavation

Trench for sub-surface drain shall be excavated to the specified lines, grades and dimensions shown in the drawings provided that width of trench at pipe level shall not be less than 450 mm. The excavation shall begin at the outlet end of the drain and proceed towards the upper end. Where unsuitable material is met with at the trench bed, the same shall be removed to such depth as directed by the Engineer and backfilled with approved material which shall be thoroughly compacted to the specified degree.

309.3.4 Laying of Pipe and Backfilling

Laying of pipe in the trench shall be started at the outlet end and proceed towards the upper end, true to the lines and grades specified.

Table 300-3 : Grading Requirements for Filter Material Percent Passing by Weight

Sieve Designation	Class I	Class II	Class III
53 mm	-	-	100
45 mm	-	-	97-100
26.5 mm	-	100	-
22.4 mm	-	95-100	58-100
11.2 mm	100	48-100	20-60
5.6 mm	92-100	28-54	4-32
2.8 mm	83-100	20-35	0-10
1.4 mm	59-96	-	0-5
710 micron	35-80	6-18	-
355 micron	14-40	2-9	-
180 micron	3-15	-	-
90 micron	0-5	0-4	0-3

Before placing the pipe, backfill material of the required grading(s) shall be laid for full width of the trench bed and compacted to a minimum thickness of 150 mm or as shown on the drawings. The thickness of the backfill material on the sides of the pipe shall be as shown on the drawings subject to a minimum of 150 mm. The pipe shall then be embedded firmly on the bed.

Perforated pipes, unless otherwise specified, shall be placed with their perforations down to minimize clogging. The pipe sections shall be joined securely with appropriate coupling fittings or bands.

Non-perforated pipes shall be laid with joints as close as possible with the open joints wrapped with suitable pervious material (like suitable Geosynthetics of not less than 150 mm width) to permit entry of water but prevent fines entering the pipes. In the case of non-perforated pipes with bell end, the bell shall face upgrade.

Upgrade end sections of the pipe installation shall be tightly closed by means of concrete plugs or plugs fabricated from the same material as the pipe and securely held in place to prevent entry of soil materials.

After the pipe installation has been completed and approved, backfill material of the required grading (s) (see Clause 309.3.2.2) shall be placed over the pipe to the required level in horizontal layers not exceeding 150 mm in thickness and thoroughly compacted. The minimum thickness of material above the top of the pipe shall be 300 mm.

Unless otherwise provided, sub-surface drains not located below the road pavement shall be sealed at the top by means of 150 mm thick layer of compacted clay so as to prevent percolation of surface water.

309.3.5 Use of Geosynthetics in Laying of Pipe and Backfilling

After excavating the trench for subsurface drain, the filter fabric shall be placed, the pipe installed and the trench backfilled with permeable material according to dimensions and details shown on the drawings. Surfaces to receive filter fabric prior to placing shall be free of loose or extraneous material and sharp objects that may damage the filter fabric during installation. Adjacent rolls of the fabric shall be overlapped a minimum of 450 mm. The preceding roll shall overlap the following roll in the direction the material is being spread.

Damage to the fabric resulting from Contractor's vehicles, equipment or operations shall be replaced or repaired by the Contractor at his Cost.

309.3.6 Drain Outlet

The outlet for a sub-surface drain shall not be under water or plugged with debris but should be a free outlet discharging into a stream, culvert or open ditch. The bottom of the pipe shall be kept above high water level in the ditch and the end protected with a grate or screen. For a length of 500 mm from the outlet end, the trench for pipe shall not be provided with granular material but backfilled with excavated soil and thoroughly compacted so as to stop water directly percolating from the backfill material around the pipe. The pipe in this section shall not have any perforations.

309.3.7 Aggregate Drains

Aggregate drains shall be placed within the verge/shoulders after completion of the pavement. Depth, thickness and spacing of the aggregate drains shall be as shown on the drawings.

Trenches for aggregate drains shall be excavated to a minimum width of 300 mm and to the depth shown on the drawings or ordered by the Engineer. The bottom of the trench shall be sloped to drain and shall be free from loose particles of soil. The trench shall be excavated so as to expose clearly the granular pavement courses to be drained.

Aggregate for the drains shall be durable gravel, stone or slag and shall be free from vegetable matter and other deleterious substances. The grading requirements are given in Table 300-4. Grading to be adopted shall be indicated in the drawings.

Table 300-4 : Grading Requirements for Aggregate Drains

Sieve Designation	Percent Passing by Weight	
	Type A	Type B
63 mm	-	100
37.5 mm	100	85– 100
19 mm	-	0 – 20
9.5 mm	45 – 100	0 – 5
3.35 mm	25 – 80	-
600 micron	8 – 45	-
150 micron	0 – 10	-
75 micron	0 – 5	-

309.4 Measurements for Payment

Measurement for surface and sub-surface drains shall be per running metre length of the drain.

309.5 Rates

The Contract unit rates for surface and sub-surface drains shall be payment in full for all items such as excavation, dressing the sides and bottom; providing lining, turfing, pitching, masonry, concrete and plastering; providing, laying and jointing pipes including wrapping with geosynthetic fabric; providing, laying and compacting backfill around the pipe, granular bedding; providing, fixing and painting of cover etc. including full compensation for all materials, labour, tools, equipment and other incidentals to complete the work as shown on drawings with all leads and lifts including removal of unsuitable material. Provision of inlets, gratings, sumps, outlet pipes, bedding, disburers etc. wherever required shall be incidental to construction of drain.

310 PREPARATION AND SURFACE TREATMENT OF FORMATION

Preparation and surface treatment of the formation, shall be carried out only after completion of any specified sub-grade drainage and unless otherwise agreed by the Engineer, immediately prior to laying the sub-base or the road base where no sub-base is required. The sequence of operations shall be as follows:

- a) Full formation, after reinstatement of any soft areas to the required Specifications shall be well cleaned and freed of all mud and slurry.
- b) The surface shall be compacted to the required density by a smooth wheeled roller of 80 to 100 kN weight after spraying requisite amount of water, if required.
- c) the formation shall be finished to the requirements of Clause 305.3.9.

The entire work of surface treatment of formation shall be deemed as incidental to the work of sub-base/base course to be provided for the same.

311 WORKS TO BE KEPT FREE OF WATER

311.1 The Contractor shall arrange for the rapid dispersal of water collected/accumulated on the earthwork or completed formation during construction or on the existing roadway or which enters the earthwork or any other item of work from any source, and where practicable, the water shall be discharged into the permanent outfall of the drainage system. The arrangements shall be made in respect of all earthwork including excavation for pipe trenches, foundations or cuttings.

311.2 The Contractor shall provide, where necessary, temporary water courses, ditches, drains, pumping or other means for maintaining the earthwork free from water. Such provisions shall include carrying out the work of forming the cut sections and embankments in such manner that their surfaces have at all times a prescribed crossfall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

The works involved in keeping the earthwork or any other item of works free of water shall be deemed as incidental to the respective item of work and as such no separate payment shall be made for the same.

312 WATER COURSES AT CULVERTS

312.1 Excavation carried out in the diversion, enlargement, deepening or straightening water courses at culverts, where necessary, shall include the operations such as clearing, grubbing, removal of vegetation, trimming of slopes, grading of beds, disposal of excavated materials, pumping, timbering etc. necessary for dealing with the flow of water.

312.2 The beds and sloping sides of water courses shall, where shown on the drawings, be protected against the action of water by rubble paving to form a flat or curved surface as indicated. The protection shall consist of large smooth faced stones or of blocks of precast concrete. Stones for rubble paving shall be roughly dressed square. No stone shall be less than 225 mm in depth nor less than 0.02 cu.m in volume and no rounded boulders shall be used. After completion of construction of culverts, temporary diversion of water course, if any, shall be closed and water course restored for flow through the culvert as per the direction of the Engineer.

312.3 Measurements for Payment

The work for water courses at culverts as stated above shall be measured in terms of units specified in the Bill of Quantities for respective items. The temporary diversion of channel to facilitate construction of culverts, its closure and restoration to original water course shall be

considered incidental to the work of construction of culverts and no extra payment shall be made for the same.

312.4 Rates

The Contract unit rates for different items of water courses at culverts shall be payment in full for carrying out all required operations including full compensation for all cost of materials, labour, tools, equipment and other incidentals to complete the work to the Specifications.

313 ROCKFILL EMBANKMENT

313.1 Scope

The work covers embankment constructed with pieces of rock and shall be in accordance with the lines, grades and cross-sections as shown in drawings or as directed by the Engineer.

There shall be a minimum of 500 mm thick earthen cushion over the rockfill. The construction of earth fill/ subgrade does not form part of scope of this work.

313.2 Materials

The size of rock pieces used in rockfill embankments shall be such that they can be deposited in layers so as to suit the conditions evaluated in the field compaction trials or as directed by the Engineer. The rockfill shall consist of hard, durable and inert material, preferably maximum size not exceeding 300 mm and percent finer than 125 mm not exceeding 10 percent.

Argillaceous rocks (clay, shales etc.), unburnt colliery stock and chalk shall not be used in rockfill.

The rock fragments and blinding material required for filling the voids shall also satisfy the above requirements.

313.3 Spreading and Compaction

The material shall be tipped, spread and levelled in layers extending to the full width of embankment by a suitable dozer. Fragments of rock shall then be spread on the top of layer to the required extent and layer compacted by minimum of 5 passes of vibratory roller having static weight 8-10 tonnes. The compacted thickness of each layer shall not exceed 500 mm. After compaction of each layer, the surface voids shall be filled with broken fragments. Next layer, where required, shall be placed in the same manner, above the earlier compacted layer.

The top layer of rockfill, on which normal earth fill will rest shall be thoroughly blinded with suitable granular material to seal its surface.

313.4 Measurements for Payment

Measurement shall be made by taking cross-sections at intervals in the original position before the work starts and after its completion and computing the volume in cu.m by the method of average end areas.

313.5 Rate

The Contract unit rate shall be paid in full for carrying out all the above operations including cost of rockfill, broken fragments and blinding material and shall provide full compensation for all items as per clause 305.8.

314 GROUND IMPROVEMENT FOR WEAK EMBANKMENT FOUNDATION USING GEOSYNTHETIC DRAINS AND STONE COLUMNS

314.1 Scope

The scope for improving the ground of problematic sub-soil conditions comprises of several alternatives and combination of more than one of the following alternatives. The improvement may be chosen based on the sub-soil conditions :

- i) Using geosynthetic drains [Prefabricated Vertical Drain (PVD)] with surcharge involving design and installation of PVD to achieve 90% consolidation of sub-soil within a prescribed time.
- ii) Rammed stone columns.
- iii) Stone columns formed by vibroflot technique.

Where specified in the Contract the scope of the work shall also cover the design of the ground improvement works by the Contractor.

314.2 Prefabricated Vertical Drain (PVD) with Surcharge

The design and construction of this drain shall generally comply with the requirements of IS:15284 (Part 2) and the requirements given below. In the case of conflict between the requirements of IS:15284 and this Specification, the requirements of this Specification shall prevail.

314.2.1 Materials

- i) **Geosynthetic Drain:** Geosynthetic strip or band drain shall be manufactured by an ISO 9001 certified manufacturer. It shall consist of a corrugated or studded or 3-d mesh consisting of an inner core of thick polyester fused at intersection, wrapped in a non-woven geotextile. Band drain shall be of width and thickness as specified in the design and shall be a minimum of 100 mm width and 5 mm thickness. The core shall serve as the drainage medium conveying the core water from the soft subsoil to the drainage layer at the top. The core shall be of three-dimensional mesh, made of polyester or equivalent. The filter should be non-woven needle punched adhesive-bonded fabric. The filter and the core shall be ultrasonically welded together at edges to produce a fully integrated product. The drain shall meet the properties specified in Table 700-3.

The drains shall be installed to depths and at spacing as per the design and drawings. The Contractor shall submit to the Engineer the complete scheme for installation of vertical band drains alongwith the particulars and test results from the manufacturer showing conformance to the specifications. Unless specified otherwise, the design of the ground improvement measures shall be to achieve 90 percent consolidation in the time prescribed by the employer. The equipment and the methodology for installation of the drains shall satisfy the specified requirement of prescribed degree of consolidation and the time for achieving the same.

- ii) **Granular Sand Blanket :** After installation of the vertical band drains in the sub-soil, a blanket of well draining granular material/coarse sand (natural or crushed) conforming to Class I grading given in Table 300-4 of specified thickness compacted to a density of 75 to 80 percent of maximum dry density obtained by heavy compaction (IS:2720-Part 8) shall be provided. The granular sand blanket shall be exposed to atmosphere at its periphery for dissipation of pore water pressure
- iii) **Geotextile Fabric for Separation and Drainage :** The requirements of synthetic geotextile shall be as given in Table 700-1.

314.2.2 Construction and Installation Requirements

- i) **Shipment and Storage :** The Geosynthetic Band Drain shall be dry and wrapped such that it is protected from the exposure to ultraviolet light during shipping and storage. At no time shall the band drain be exposed to ultraviolet light for a period exceeding fourteen days. If stored outdoor, they shall be elevated and protected with a waterproof

cover. The Geo-synthetic Band Drain shall be labeled as per ASTM D 4873, "Guide for identification, storage, and handling of geotextile.

- ii) **Drain Installation** : Band Drains in roll shall be installed using an installation rig/sticher mounted on a base machine (Hydraulic or Mechanical). The end of the drain shall be attached to a hollow rectangular mandrel or shoe, which will be driven into the soft clay by appropriate mechanism, such as lance. On reaching the refusal strata (stiff soil), the mandrel with the drain shall be left behind and the lance withdrawn. The top of the drain above the ground level shall be cut off at design level (150 mm into the drainage blanket). The rig/ sticher moves on to the next location.
- iii) After installation of vertical band drains, a blanket of granular coarse sand as mentioned above shall be spread over the entire area and covered with geotextile layer on top and bottom as directed by the Engineer.
- iv) **Installation of geotextile fabric for separation and drainage** :
 - a) **Shipment and Storage** : The geotextile shall be kept dry and wrapped such that it is protected from the exposure to ultraviolet light during shipping and storage. At no time shall the paving fabric be exposed to ultraviolet light for a period exceeding fourteen days. Geotextile rolls shall be stored in a manner, which protects them from elements. If stored outdoor, they shall be elevated and protected with a waterproof cover. The geotextile shall be labeled as per ASTM D 4873, "Guide for identification, storage and handling of geotextiles".
 - b) **Fabric Placement** : The geotextile shall be laid smooth without wrinkles or folds on the sand blanket in the direction of construction traffic. Adjacent geotextile rolls shall be overlapped, sewn or jointed, (Preferably sewn or joined). On curves the geotextile may be folded or cut & overlap to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock. Prior to covering, the geotextile shall be inspected by the Engineer to ensure that the geotextile has not been damaged (i.e. holes, tears, rips) during installation. Damaged geotextiles, as identified by the Engineer, shall not be allowed. The surcharge shall be placed such that atleast the minimum specified lift thickness shall be between the geotextile and the equipment tyres or tracks at all times. Turning of vehicles shall not be permitted on the first lift above the geotextile.

- c) **Seaming** : A sewn seam is to be used for the seaming of the geotextile. The thread used shall consist of high strength polypropylene or polyester. Nylon thread shall not be used. The thread shall also be resistant to ultraviolet radiation. The thread shall be of contrasting color to that of the geotextile itself. For seams which are sewn in the field, the Contractor shall provide at least a 2 m length sewn seam for sampling by the Engineer before the geo-textile is installed. For seams which are sewn in the factory, the Engineer shall obtain samples of the factory seams at random from any roll of geotextile which is used on the project. For seams that are field sewn, the seams sewn for sampling shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, samples of seams from both directions shall be provided. The seam assembly description shall be submitted by the Contractor along with the sample of the seam. The description shall include the seam type, stitch type, sewing thread and stitch density.
- v) **Addition of Surcharge** : Addition of surcharge load by approved embankment material shall be placed over the geotextile layer up to a height as per the design requirement. The addition of surcharge shall be placed with adequate side slope to avoid any slope failure. The addition of surcharge shall be kept in place for a period as per the design to achieve desired degree of consolidation. After ascertaining that the desired degree of consolidation is achieved, the addition of surcharge which is not forming part of permanent work/ embankment shall be removed to the required level as per drawings. Removal of additional surcharge material shall be done without damaging the road embankment. After removal of additional surcharge, the damaged embankment top, if any, shall be made good as instructed by the Engineer. The addition and removal of surcharge shall be incidental to the work except for payment of additional surcharge quantity forming part of permanent embankment. The quantity for payment will be determined based on the settlements readings observed through instrumentation.
- vi) **Instrumentation and Monitoring the Behaviour of Sub-Soil/ Embankment** : Monitoring the behavior of the sub-soil/ embankment construction shall form part of the work. The design shall be based on the gain in the shear strength of the subsoil due to consolidation process. The following critical parameters shall be monitored :
- a) **Monitoring the Build up and Dissipation of Pore Pressure:**
Casagrande open standpipe type piezometers shall be used for

the measurement of changes in pore pressure. The specifications for the Casagrande piezometer shall be as follows.

The piezometer shall be 38 mm in dia and 300 mm in length;

The air entry value shall be of the order of 0.3 kg/cm².

The standpipe shall be more than 16 mm in diameter;

The piezometer shall be installed in 150 mm borehole, at specified depths. Sand cover around the piezometer tip and bentonite seal above shall be provided; and

Suitable electronic sensor shall be used to record the water level

Piezometers including dummy piezometers shall be installed at locations specified by the Engineer.

- b) **Rate and Magnitude of Vertical Settlements of the Subsoil under the Surcharge Load** : Settlements shall be measured by installing platform type settlement gauges, which consist of the following :

Wooden base plate 1000 mm square and 50 mm thick;

GI pipe of 25 mm dia fitted to the base plate with a suitable sleeve arrangement and nuts and bolts;

Outer loose fitting sleeve, to prevent soil from coming into contact with the inner pipe;

The pipe and the sleeve consist of 1.5 m long sections, which can be screwed on at the top, so that as the surcharge is built up, the top of the pipe is well clear of the fill;

Settlement gauges shall be installed at the ground level, before the starting of the fill construction. These shall be installed locations specified by the Engineer. The readings of settlement gauges also form the basis to estimate the quantity of surcharge forming part of permanent work. The number of settlement gauges shall be decided by the Engineer keeping in view this aspect.

- c) **Measurement of Shear Strength** : The shear strength parameters of the subsoil [unconfined compressive strength (UCS)] shall be measured at locations specified by the Engineer at the end of each stage of surcharge loading in order to compare the actual details with the design assumptions. For the recovery of undisturbed samples from the subsoil for determining UCS, before start of construction of surcharge, 100 mm dia casing pipe shall be installed into the ground to 3 m depth, preferably by driving; the top of the casing pipe shall have provision for adding extensions

at top by screw coupling; and as the surcharge construction proceeds the casing pipe shall be extended. This procedure ensures avoiding drilling through the surcharge already placed as well as any damage to the installed band drains. Undisturbed samples (UDS) are recovered and UCS is determined in the site laboratory (sending UDS sample to distant laboratories would result in loss of water content and disturbance of the samples leading to erroneous values of UCS). Undisturbed samples shall be recovered at every 1.5 m depth at the specified locations, so that complete strength profile of subsoil is obtained.

- vii) During the placing of the surcharge and compaction, the Contractor shall take utmost care so that the monitoring instruments are not damaged. Compaction by small vibratory rollers shall be done for 1.5 m around the monitoring instruments and bigger rollers shall not be used near the monitoring instruments. Similarly care shall be taken that movement of dumpers does not damage the monitoring instruments.
- viii) **Frequency of Observations** : The readings of the piezometers and the settlement gauges shall be recorded at the following frequency.
 - a) Daily reading shall be taken in stretches where filling/ surcharge operations are in progress. Weekly readings shall be taken in stretches, where no filling/ surcharge is being done.
 - b) Weekly readings shall be taken after the desired fill/ surcharge height is achieved, till the next stage filling commences. All data shall be recorded in a register and maintained properly.
 - c) The Data from the monitoring instruments provides the background for regulating the rate of placing the fill/ surcharge as well as the waiting period between stages.
- ix) **Precautions against Pilferage**: The observation data shall be recorded during construction and for three months thereafter. It is therefore essential that the instruments are not tampered and stolen. Suitable precautions shall be taken in this regard by the Contractor.
- x) **Drainage of Ground Water** : The water which will come out from the subsoil through vertical drains will be accumulated at temporary ditches to be dug at nearby areas and the accumulated water will be dewatered regularly from the ditches to the outfalls as directed by the Engineer.
- xi) **Certification from the Manufacturer of Band Drain and Geotextile Fabric for Separation and Drainage** :
 - a) The Contractor shall provide to the Engineer, a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filament or yarns and other pertinent

information to fully describe the material. Each roll shall be labelled or tagged to protect product identification as well as inventory and quality control.

- b) The manufacturer shall be responsible for establishing and maintaining a quality control programme to assure compliance with the requirement of the specification. Documentation describing the quality control programme shall be made available upon request.
- c) The manufacturer's certificate shall state that the furnished material meets minimum averages roll values (MARV) requirements of the specifications as evaluated under the Manufacturer's quality control programme. The certificate shall be attested by a person having legal authority to bind the Manufacturer.

314.2.3 Measurements for Payment

- i) The Geosynthetic Band Drains (or geodrain) shall be measured in linear metre of its length.
- ii) The granular sand blanket shall be measured in cubic metre.
- iii) The geo-synthetic fabric shall be measured in square metre of plan area of final finished work.
- iv) Instrumentation and monitoring the behaviour of sub-soil/ embankment shall be measured in number of locations.
- v) The additional surcharge quantity forming part of permanent embankment shall be measured in cum.

The overlaps, patches, sewn seams and securing pins shall not to be measured.

314.2.4 Rate

Rate shall include cost of design, materials, installation, operations involved in pre-loading/ additional surcharge, dewatering, labour, plant hire, material storage and handling expenses for completing the work including submission of construction drawings and provision of specialist attendance & supervision at site for (i) geodrain; (ii) sand blanket; (iii) geofabric; (iv) instrumentation and monitoring; and (v) permanent embankment part of surcharge as described above.

314.3 Rammed Stone Columns using Non-Displacement Method of Construction

314.3.1 The design and construction of this column shall generally comply with the requirements of IS:15284 (Part 2), including the requirements given below. In the case of

conflict between the requirements of IS:15284 and these Specifications the requirements of these Specifications shall prevail.

314.3.2 Stone columns shall be formed from well-graded crushed stone and gravel compacted to a dense state. The size of the well graded crushed aggregate shall vary from 2 mm to 75 mm conforming to the gradation given below.

Size of the Crushed Aggregate	% Passing
75 mm	90-100
50 mm	80-90
38 mm	55-75
20 mm	10-20
12 mm	5-13
2 mm	5

The crushed aggregate shall be chemically inert, hard and resistant to breakage. The diameter of the stone columns shall be as shown in the drawings.

314.3.3 Granular Blanket

A compacted and well draining layer of gravel or coarse sand, of specified thickness, compacted in layers to a relative density of 75 to 80 percent shall be provided above the existing ground. This blanket shall be exposed to atmosphere at its periphery for pore water pressure dissipation.

314.3.4 Construction and Installation Requirements

The "Rammed Stone Columns" shall be constructed by non-displacement technique namely "Bailer and Casing Method" as given in IS:15284 (Part 1). After ensuring complete removal of slush deposited during boring operations, a minimum depth of 0.5 m, preferably 0.75 below the granular blanket shall be compacted by other suitable means such as rolling/ tamping to the specified densification criteria.

314.3.5 Field Controls

In the above method, the following minimum field controls shall essentially be observed.

The set criteria and the consumption of granular fill form the main quality control measures for the columns constructed by the non-displacement technique. The set criteria shall be established as given in IS:15284 (Part 1). For ascertaining the consumption of fill, the diameter of the column as formed during field trials shall be measured in its uppermost part along the four diameters and average of these observations taken as the column diameter.

314.3.6 Field Loading Tests

Initial and routine tests shall be carried out as given in IS:15284 (Part 1).

314.3.7 Recording of Data shall be done as given in IS:15284 (Part 1).

314.3.8 Load Test Results

The ultimate load capacity of single column shall be determined from load tests. The settlement of a stone column obtained at safe/ working load from load test results on a single column shall not be directly used in forecasting the settlement of the structure unless experience from similar foundations in similar soil conditions on its settlement behaviour is available. The average settlement may be assessed on the basis of sub-soil data and loading details of the structures as a whole using the principles of soil mechanics.

314.3.9 Certification

The Contractor shall be responsible for establishing and maintaining a quality control programme to assure compliance with the requirements of the specifications.

314.3.10 Measurement for Payment

- i) The rammed stone column of the specified diameter shall be measured in linear metre of its compacted length.
- ii) The sand blanket shall be measured in cu.m.
- iii) The initial and routine load tests, unless otherwise specified in the contract, shall be measured in numbers and paid.

314.3.11 Rate

The rate shall include the cost of providing all materials, tools, equipment, labour, supervision and incidentals necessary to complete the work as per these specifications.

314.4 Stone Columns using Vibro-replacement (Vibroflot) Method of Construction**314.4.1 Scope**

The scope of the work shall consist of:

- i) construction of stone columns, complete in-place including layout;
- ii) supplying crushed stone, equipment, electrical power, water and any other necessary items for stone column and its installation;

- iii) Control and disposal of surface water resulting from stone column construction operations;
- iv) Construction and removal of silt settling ponds or similar facilities as required, and the regrading of the site as required;
- v) Stockpiling and disposal of silt from the site if necessary; and
- vi) Load testing of stone columns as specified

314.4.2 The design and construction of stone columns shall comply with IS:15284 (Part I) subject to certain modifications incorporated in these Specifications or any other modification suggested by the Engineer. The construction of sand (or stone) working platform and necessary access to site shall not form part of the scope of this work. Stone Column with maximum compacted density shall extend to the full depth of the compressible stratum and reach the Dense Sand Layer/Stiff Clay Layer.

314.4.3 The Contractor shall (i) meet all applicable laws and regulations concerning surface runoff, siltation, pollution and general disposal of the effluent from the construction of the stone columns and general site work, (ii) construct and relocate temporary ditches, swales, banks, dams, and similar facilities as necessary to control the flow of surface water during the work, remove them when no longer required, and regrade the affected areas for acceptable drainage as specified for site grading, (iii) construct silt settling ponds as required in locations indicated or approved. ensure that earth banks and water control devices are safely designed and prevent inadvertent discharge into watercourses off the site, stockpile and dispose of all silt as approved by the Engineer, (iv) remove settling ponds and other structures when no longer required and regrade the areas for acceptable drainage as specified for site grading.

314.4.4 Materials

- a) **Stone Aggregate for Compacted Column** : The crushed stone and gravel for column backfill shall be clean, hard, angular, chemically inert, resistant to breakage and free from organic, trash, or other deleterious materials. It shall be well-graded stones of 75 mm down to 2 mm size. The uniformity co-efficient shall be greater than 3. The Aggregate Impact Value shall not be more than 30 percent.
- b) **Drainage Blanket** : Sand/crushed stone, which is hard, inert, resistant to chemical change and free from organic, trash, or other deleterious materials shall only be used in drainage blanket. The blanket shall be well graded and free draining granular material of thickness 500 mm or more, compacted in layers to a relative density of 75 to 80 percent. This blanket shall be exposed to atmosphere at its periphery for pore water pressure dissipation.

314.4.5 Construction and Installation

The stone columns shall be installed by Vibroflot method given in IS:15284 (Part 1). Stones shall be fed by mechanical means i.e. use of loader/ hopper/ chute etc. The slush, muck and other loose materials at work site shall be removed/ disposed off suitably by the Contractor as instructed by the Engineer. The Contractor shall take adequate measures to ensure stability of bore holes made for installation of stone column.

314.4.5.1 A detailed installation procedure/method statement shall be submitted by the Contractor including:

- i) Type and number of Vibroflots and general method of operation including construction schedule.
- ii) Mechanical arrangement for placing stones (s) around the probe point
- iii) Quality control, Quality Assurance Procedure covering details on automatic recording devices to monitor and record stone consumption
- iv) Type of equipment to be deployed
- v) Manpower to be engaged
- vi) The proposed sequence and timing for constructing stone columns along with a bar chart for the entire ground improvement work.

314.4.5.2 Stone column installation procedure shall be as approved by the Engineer. The construction technique and probe shall be capable of producing and/or complying with the following:

- i) The holes shall be close to circular.
- ii) The probe and follower tubes shall be of sufficient length to reach the elevations shown on the plans. The probe, used in combination with the flow rate and available pressure to the tip jet, shall be capable of penetrating to the required tip elevation. Preboring of stiff lenses, layers or strata is permitted.
- iii) The probe shall have visible external markings at suitable increments to enable measurement of penetration and re-penetration depths
- iv) Sufficient quantity of wash water shall be provided to the tip of the probe to widen the probe hole to a diameter to allow adequate space for stone backfill placement around the probe. The flow of water from the bottom jet shall be maintained at all times during backfilling to prevent caving or collapse of the hole and to form a clean stone column. The flow rate will generally be greater as the hole is jetted in, and decrease as the stone column comes up

- v) After forming the hole, the vibrator shall be lifted up a minimum 3 m, dropped at least twice to flush the hole out. The probe shall not, however, be completely removed from the hole
- vi) The column shall be formed by adding stone in lifts having each lift height between 600 cm and 1000 cm. The stone aggregate in each lift shall be compacted by re-penetrating it at least twice with the horizontally vibrating probe so as to densify and force the stone radially into the surrounding in-situ soil. The stone in each increment shall be re-penetrated a sufficient number of times to develop a minimum ammeter reading on the motor of at least 40 amps more than the free-standing (unloaded) ampere draw on the motor, but no less than 80 amps total
- vii) Stone columns shall be installed so that each completed column will be continuous throughout its length

314.4.5.3 Data captured shall be continuously displayed on a LCD unit and graphical output (plots of depth versus time and power consumption) generated by automated computerized recording device throughout the process of stone column installation for each point shall be submitted to the Engineer.

The equipment to be used shall be instrumented with sensors and the data processed by a micro-processing unit to enable continuous monitoring and data capture of the following during construction of each stone column:

- a) depth of vibrator and vibrator movements (depth of penetration)
- b) power consumption (compaction effort)

314.4.5.4 If erosion of upper granular working platform material occurs, the depressions shall be backfilled with sand/ granular material which meets the specification for the working platform. Such backfilling shall be at the Contractor's expense. The working surface shall be cleaned at the completion of the stone column construction of all unsuitable materials washed up from the stone column holes. Such unsuitable materials include clay or silt lumps, wood fragments or other organic matter. If, in the opinion of the Engineer, these materials create "soft spots" or zones of compressibility or weakness in connection with the placement of overlying embankment materials, such unsuitable materials shall be disposed of in a manner approved by the Engineer

314.4.5.5 In the event of obstructions preventing the penetration of the Vibrofloat, the Contractor shall stop work, move to another compaction point and immediately notify the Engineer. The Engineer may at his option authorize one or several of the following: (i) position the compaction point a short distance away from the original position, (ii) additional compaction points to bridge the obstruction, (iii) remove the obstruction, replace removed soils, and again jet the column hole in the indicated location, (iv) perform other removal or relocation operations or (v) any other method.

314.4.6 Field Controls

In the above method, the following minimum field controls shall be observed.

- a) Vibrofloat penetration depth including the depth of embedment in firm strata.
- b) Monitoring of volume of backfill added to obtain an indication of the densities achieved, and
- c) Monitoring of ammeter or hydraulic pressure gauge readings to verify that the maximum possible density has been achieved in case of Vibrofloated columns.

314.4.7 Recording of Data shall be done as given in IS:15284 (Part 1).

314.4.8 Field Loading Tests

314.4.8.1 The Initial load tests shall be performed at a trial test site approved by the Engineer to evaluate the load-settlement behaviour of the soil-stone column system. The tests shall be conducted on a single and also on a group of minimum three columns in accordance with IS:15284 (Part-1). The number of initial tests shall be as follows:

Single column tests – 1 test per 500 or part thereof stone columns.

Three column group tests – 1 test per 1000 or part thereof stone columns.

314.4.8.2 The Routine load tests shall be carried out on a single job column in accordance with IS:15284 (Part-1). The job columns shall be loaded for a test load of 1.1 times the design load intensity with kentledge minimum 1.3 times the design load pattern. The number of routine tests shall be as follows:

Single column tests – 1 test per 500 or part thereof stone columns.

314.4.8.3 The test load shall be applied at increments of one-tenth to one-fifth of the design load upto a maximum of 1.5 times the design load. Each load stage shall be maintained till the settlement rate is less than 0.1 mm/30 min.

314.4.8.4 The test load shall be maintained for a minimum period of 24 hours. The ultimate load on the stone column shall be determined by double tangent diagram. The test load shall be removed in five to six stages. Each unloading stage shall be maintained till the rebound attains a rate of 2.0 mm/30 min.

314.4.8.5 Safe and efficient working of the loading arrangements is entirely the Contractor's responsibility and any impediment resulting in the failure of the test arrangement may debar the Contractor from payment for the test. Alternatively, it may make the Contractor liable to repeat the test on separate column/columns without any extra cost.

314.4.8.6 The construction of stone columns shall be carried out using the same procedure as adopted for the test column to the satisfaction of the Engineer. The stone columns under the test shall be a part of a larger stone column group. The interpretation of the results shall be free from ambiguity and shall be subject to the Engineer's approval. No works shall proceed unless the Contractor shall satisfy the Engineer beyond reasonable doubt that the performance of the stabilized soil material will be compliant with the Specification.

314.4.9 Tolerances

314.4.9.1 Setting Out

Setting out shall be carried out from reference lines and points shown in the drawings. Immediately before installation of the stone columns, the stone column positions shall be marked with suitable identifiable markers.

314.4.9.2 Position

No vibration center or stone column shall be more than 150 mm off its correct center location in any direction at the working platform level as shown on the approved plans.

314.4.9.3 Verticality

Stone Columns shall be constructed as vertical as possible. The axis of the stone column shall not be inclined from the vertical by more than 1h: 20v as indicated by the tilt of vibrator and follower tubes.

314.4.10 Personnel

The Contractor shall employ suitable personnel having experience in the construction of stone columns.

314.4.11 Quality Control

The Contractor shall establish and maintain a quality control programme to assure compliance with the requirements of the specifications.

314.4.12 Measurements for Payment

- i) The stone column by Vibrofloat method shall be measured in linear metre of its compacted length.
- ii) The sand blanket shall be measured in cu.m.

- iii) The initial and routine load tests, unless otherwise specified in the Contract, shall be measured in numbers and paid.

314.4.13 Rate

The rate shall include the cost of providing all materials, tools, equipment, labour, supervision and incidentals necessary to complete the work as per these Specifications.

400

**SUB-BASES, BASES
(NON-BITUMINOUS) AND
SHOULDERS**

401 GRANULAR SUB-BASE**401.1 Scope**

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

401.2 Materials

401.2.1 The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the gradings given in Table 400-1 and physical requirements given in Table 400-2. Gradings III and IV shall preferably be used in lower sub-base. Gradings V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

401.2.2 If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

Table 400-1 : Grading for Granular Sub-base Materials

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55 -90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25 - 55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20- 40	30-50	-	-	10-20	10-25
0.85 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10- 15	-	-	0-5	0-8
0.075 mm	<5	< 5	< 5	< 5	-	0-3

Table 400-2 : Physical Requirements for Materials for Granular Sub-base

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

401.3 Construction Operations

401.3.1 Preparation of Sub-grade

Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80–100 kN smooth wheeled roller.

401.3.2 Spreading and Compacting

The sub-base material of the grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super-elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

401.4 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

401.5 Arrangements for Traffic

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

401.6 Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

401.7 Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- i) making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- ii) supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;
- iv) carrying out the work in part widths of road where directed; and
- v) carrying out the required tests for quality control.

402 LIME TREATED SOIL FOR IMPROVED SUB-GRADE/SUB-BASE**402.1 Scope**

This work shall consist of laying and compacting an improved sub-grade/lower sub-base of soil treated with lime on prepared sub-grade in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. Lime treatment is generally effective for soils which contain a relatively high percentage of clay and silty clay.

402.2 Materials**402.2.1 Soil**

Except when otherwise specified, the soil used for stabilization shall be the local clayey soil having a plasticity index greater than 8.

402.2.2 Lime

Lime for lime-soil stabilization work shall be commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing. Unless otherwise permitted by the Engineer, the lime shall have purity of not less than 70 percent by weight of Quick-lime (CaO) when tested in accordance with IS:1514. Lime shall be properly stored to avoid prolonged exposure to the atmosphere and consequent carbonation which would reduce its binding properties.

402.2.3 Quantity of Lime in Stabilized Mix

Quantity of lime to be added as percentage by weight of the dry soil shall be as specified in the Contract. The quantity of lime used shall be related to its calcium oxide content which shall be specified. Where the lime of different calcium oxide content is to be used, its quantity shall be suitably adjusted with the approval of the Engineer so that equivalent calcium oxide is incorporated in the work. The mix design shall be done to arrive at the appropriate quantity of lime to be added, having due regard to the purity of lime, the type of soil, the moisture-density relationship, and the design CBR/Unconfined Compressive Strength (UCS) value specified in the Contract. The laboratory CBR/UCS value shall be at least 1.5 times the minimum field value of CBR/UCS stipulated in the Contract.

402.2.4 Water

The water to be used for lime stabilisation shall be clean and free from injurious substances. Potable water shall be used.

402.3 Construction Operations**402.3.1 Weather Limitations**

Lime-soil stabilisation shall not be done when the air temperature in the shade is less than 10°C.

402.3.2 Degree of Pulverisation

For lime-soil stabilisation, the soil before addition of stabilizer, shall be pulverized using agricultural implements like disc harrows (only for low volume roads) and rotavators to the extent that it passes the requirements set out in Table 400-3 when tested in accordance with the method described in Appendix-3.

Table 400-3 : Soil Pulverisation Requirements for Lime Stabilisation

IS Sieve designation	Minimum percent by weight passing the IS Sieve
26.5 mm	100
5.6 mm	80

402.3.3 Equipment for Construction

Stabilised soil sub-bases shall be constructed by mix-in-place method of construction or as otherwise approved by the Engineer. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs.

The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of pulverizing and mixing the soil with additive and water to specified degree to the full thickness of the layer being processed, and of achieving the desired degree of mixing and uniformity of the stabilized material. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for work.

The thickness of any layer to be stabilized shall be not less than 100 mm when compacted. The maximum thickness can be 200 mm, provided the plant used is accepted by the Engineer.

402.3.4 Mix-in-place Method of Construction

Before deploying the equipment, the soil after it is made free of undesirable vegetation or other deleterious matter shall be spread uniformly on the prepared subgrade in a quantity sufficient to achieve the desired compacted thickness of the stabilised layer. Where single-pass equipment is to be employed, the soil shall be lightly rolled as directed by the Engineer.

The equipment used shall either be of single-pass or multiple pass type. The mixers shall be equipped with an appropriate device for controlling the depth of processing and the mixing blades shall be maintained or reset periodically so that the correct depth of mixing is obtained at all times.

With single-pass equipment the forward speed of the machine shall be so selected in relation to the rotor speed that the required degree of mixing, pulverisation and depth of processing is obtained. In multiple-pass processing, the prepared sub-grade shall be pulverised to the required depth with successive passes of the equipment and the moisture content adjusted to be within prescribed limits mentioned hereinafter. The lime shall then be spread uniformly and mixing continued with successive passes until the required depth and uniformity of processing have been obtained.

The mixing equipment shall be so set that it cuts slightly into the edge of the adjoining lane processed previously so as to ensure that all the material forming a layer has been properly processed for the full width.

402.3.5 Construction with Manual Means

Where manual mixing is permitted, the soil from borrow areas shall first be freed of all vegetation and other deleterious mater and placed on the prepared subgrade. The soil shall then be pulverized by means of crow-bars, pick axes or other means approved by the Engineer.

Water in requisite quantities may be sprinkled on the soil for aiding pulverisation. On the pulverized soil, the lime in requisite quantities shall be spread uniformly and mixed thoroughly by working with spades or other similar implements till the whole mass is uniform. After adjusting the moisture content to be within the limits mentioned later, the mixed material shall be leveled up to the required thickness so that it is ready to be rolled.

402.3.6 Addition of Lime

Lime may be mixed with the prepared material either in slurry form or dry state at the option of the Contractor with the approval of the Engineer.

Dry lime shall be prevented from blowing by adding water to the lime or other suitable means selected by the Contractor, with the approval of the Engineer.

The tops of windrowed material may be flattened or slightly trenched to receive the lime.

The distance to which lime may be spread upon the prepared material ahead of the mixing operation shall be determined by the Engineer.

No traffic other than the mixing equipment shall be allowed to pass over the spread lime until after completion of mixing.

Mixing or remixing operations, regardless of equipment used, shall continue until the material is free of any white streaks or pockets of lime and the mixture is uniform.

Non-uniformity of colour reaction, when the treated material is tested with the standard phenolphthalein alcohol indicator, will be considered evidence of inadequate mixing.

402.3.7 Moisture Content for Compaction

The moisture content at compaction checked vide IS:2720 (Part 2) shall neither be less than the optimum moisture content corresponding to IS:2720 (Part 8) nor more than 2 percent above it.

402.3.8 Rolling

Immediately after spreading, grading and levelling of the mixed material, compaction shall be carried out with approved equipment preceded by a few passes of lighter rollers if necessary. Rolling shall commence at edges and progress towards the centre, except at super elevated portions or for carriageway with unidirectional cross-fall where it shall commence at the inner edge and progress towards the outer edge. During rolling, the surface shall be frequently checked for grade and crossfall (camber) and any irregularities corrected by loosening the material and removing/adding fresh material. Compaction shall continue until the density achieved is at least 98 percent of the maximum dry density for the material determined in accordance with IS:2720 (Part 8).

Care shall be taken to see that the compaction of lime stabilised material is completed within three hours of its mixing or such shorter period as may be found necessary in dry weather.

During rolling it shall be ensured that roller does not bear directly on hardened or partially hardened treated material previously laid other than what may be necessary for achieving the specified compaction at the joint. The final surface shall be well closed, free from movement under compaction planes, ridges, cracks or loose material. All loose or segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompact.

402.3.9 Curing

The sub-base course shall be suitably cured for a minimum period of 7 days after which subsequent pavement courses shall be laid to prevent the surface from drying out and becoming friable. No traffic of any kind shall ply over the completed sub-base unless permitted by the Engineer.

402.4 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

402.5 Strength

When lime is used for improving the subgrade, the soil-lime mix shall be tested for its CBR value. When lime stabilized soil is used in a sub-base, it shall be tested for unconfined compressive strength (UCS) at 7 days. In case of variation from the design CBR/UCS, in situ value being lower, the pavement design shall be reviewed based on the actual CBR/UCS values. The extra pavement thickness needed on account of lower CBR/UCS value shall be constructed by the Contractor at his own cost.

402.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be provided and maintained in accordance with Clause 112.

402.7 Measurements for Payment

Stabilised soil sub-graded sub-base shall be measured as finished work in position in cubic metres.

402.8 Rate

The Contract unit rate for lime stabilised soil sub-graded/ sub-base shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v).

403 CEMENT TREATED SOIL AND CEMENT-FLYASH TREATED SUB-BASE/BASE**403.1 Scope**

This work shall consist of laying and compacting a sub-base/base course of soil treated with cement or cement-flyash on prepared subgrade/sub-base, in accordance with the requirements of these

Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

403.2 Materials**403.2.1 Material to be Treated**

The material used for cement or cement-flyash treatment shall be soil including sand and gravel, laterite, kankar, brick aggregate, crushed rock or slag or any combination of these. For use in a sub-base course, the material shall have a grading shown in Table 400-4. It shall have a uniformity coefficient not less than 5, capable of producing a well-closed surface finish. For use in a base course, the material shall be sufficiently well graded to ensure a well-closed surface finish and have a grading within the range given in Table 400-4. If the material passing 425 micron sieve is plastic, it shall have a liquid limit not greater than 45 percent and a plasticity index not greater than 20 percent determined in accordance with IS:2720 (Part 5). The physical requirements for the material to be treated with cement for use in a base course shall be same as for Grading I Granular Sub-base, Clause 401.2.2.

403.2.2 Cement

Cement for stabilization shall either be ordinary Portland Cement, Portland Slag Cement or Portland Puzzolana Cement and shall comply with the requirements of IS:269, 455 or 1489 respectively.

Table 400-4 : Grading Limits of Material for Stabilisation with Cement

IS sieve size	Percentage by mass passing Sub-Base/Base within the range
53.00 mm	100
37.5 mm	95 – 100
19.0 mm	45 – 100
9.5 mm	35 – 100
4.75 mm	25 – 100
600 micron	8 – 65
300 micron	5 – 40
75 micron	0 – 10

403.2.3 Lime

If needed for pre-treatment of highly clayey soils, Clause 402.2.2 shall apply.

403.2.4 Flyash

Flyash may be from anthracitic coal or lignitic coal. Flyash to be used for cement-flyash treatment shall conform to the requirement given in Tables 400-5 and 400-6.

Table 400-5 : Chemical Requirements for Fly Ash as Pozzolana

Sl. No.	Characteristics	Requirements for Fly Ash		Method of Test
		Anthracitic Flyash	Lignitic Flyash	
1)	SiO ₂ +Al ₂ O ₃ +Fe ₂ O ₃ in percent by mass, Min	70	50	IS:1727
2)	SiO ₂ in percent by mass, Min	35	25	IS:1727
3)	MgO in percent by mass, Max	25	5.0	IS:1727
4)	SO ₃ in percent by mass, Max	2.75	3.5	IS:1727
5)	Available alkalis as Na ₂ O/K ₂ O in percent by mass, Max,	1.5	1.5	IS:4032
6)	Total chlorides in percent by mass, Max	0.05	0.05	IS:1727
7)	Loss on ignition in percent by mass, Max	5.0	5.0	IS:1727

Table 400-6 : Physical Requirement for Fly Ash as a Pozzolona

Sl. No.	Characteristics	Requirement
1)	Fineness-specific surface in m ² /Kg by Blaine's permeability test, Min	250
2)	Particles retained on 45 micron IS sieve, Max	40
3)	Lime reactivity in N/mm ² , Min	3.5
4)	Soundness by autoclave test expansion of specimen in percent, Max	0.8
5)	Soundness by Lechatelier method-expansion in mm, Max	10

Pond ash or bottom ash, which do not meet the requirements of Tables 400-5 and 400-6 can also be used for cement-flyash treatment. However, in all cases of cement stabilised fly-ash/ bottom ash/ pond ash, mix should develop adequate strength.

403.2.5 Quantity of Cement in Cement-Soil Stabilised Mix

The quantity of cement to be added as percent by weight of the dry soil shall be specified in the Contract. Also if lime is used as pretreatment for highly clayey soils, the quantity as percent by weight of dry soil shall be specified in the Contract. The mix design shall be done on the basis of 7 day unconfined compressive strength (UCS) and/or durability test under 12 cycles of wet-dry conditions. The laboratory strength values shall be at least 1.5 times the minimum field UCS value stipulated in the Contract.

403.2.6 Quantity of Cement in Cement/Fly Ash Treated Sub-base/Base

The quantity of cement shall be more than 2 percent by weight of cement/ fly-ash mix. The mix design shall be done to achieve a strength of 1.75 MPa when tested on cylindrical specimens compacted to the density at optimum moisture content, tested in accordance with IS:2720 (Part 8 as specified in the contract) after 7 days moist curing. The design mix shall indicate the proportions of cement and fly ash and the quantity of water to be mixed.

403.2.7 Water

The water to be used for cement stabilization shall be clean and free from injurious substances. Potable water shall be used.

403.3 Construction Operations**403.3.1 Weather Limitations**

Stabilisation shall not be done when the air temperature in the shade is less than 10°C.

403.3.2 Degree of Pulverisation

For stabilisation, the soil before addition of cement shall be pulverised, where necessary, to the extent that it passes the requirements as set out in Table 400-7 when tested in accordance with the method described in Appendix-3.

Table 400-7 : Soil Pulverisation Requirements for Cement Stabilisation

IS sieve Designation	Minimum percent by weight passing the IS sieve
26.5 mm	100
5.6 mm	80

403.3.3 Clauses 402.3.3 to 402.3.5 shall apply as regards spreading and mixing the stabilizer except that cement or lime plus cement as the case may be, shall be used as the stabilizing material in place of lime.

403.3.4 Moisture Content for Compaction

The moisture content at compaction checked vide IS:2720 (Part 2) shall not be less than the optimum moisture content corresponding to IS:2720 (Part 8) nor more than 2 percent above it.

403.3.5 Rolling

Clause 402.3.8 shall apply except that care shall be taken to see that the compaction of cement stabilised material is completed within two hours of its mixing or such shorter period as may be found necessary in dry weather.

403.3.6 Curing

The sub-base/base course shall be suitably cured for 7 days. Subsequent pavement course shall be laid soon after to prevent the surface from drying out and becoming friable. No traffic of any kind shall ply over the completed sub-base unless permitted by the Engineer.

403.4 Surface Finish

The surface finish of construction shall conform to the requirements of Clause 902.

403.5 Strength and Quality Control

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Cement treated soil sub-base/base and cement/fly ash treated sub-base/base shall be tested for the unconfined compressive strength (UCS) value at 7 days, actually obtained in-situ. In case of variation from the design UCS, in-situ value being on lower side, prior to proceeding with laying of base/surface course on it, the pavement design shall be reviewed for actual UCS value. The extra pavement thickness needed on account of lower UCS shall be constructed by the Contractor at his own cost.

403.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be provided and maintained in accordance with Clause 112.

403.7 Measurements for Payment

Stabilised soil sub-base/base shall be measured as finished work in position in cubic metres.

403.8 Rate

The Contract unit rate for cement treated soil sub-base/base with pretreatment with lime if required and cement/fly ash treated sub-base/base shall be payment in full for carrying out

required operations including full compensation for all components listed in Clause 401.7 (i) to (v).

404 WATER BOUND MACADAM SUB-BASE/BASE

404.1 Scope

This work shall consist of clean crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly prepared subgrade/sub-base/base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

404.2 Materials

404.2.1 Coarse Aggregates

Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel /shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in **Table 400-8**. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part 5).

Table 400-8 : Physical Requirements of Coarse Aggregates for Water Bound Macadam for Sub-base/Base Courses

S.No.	Test	Test Method	Requirements
1) ***	Los Angeles Abrasion value or Aggregate Impact value	IS: 2386(Part 4) IS: 2386 (Part-4) or IS:5640*	40 percent (Max) 30 percent (Max)
2)	Combined Flakiness and Elongation Indices (Total) **	IS:2386 (Part-1)	35 percent (Max)

* Aggregates which get softened in presence of water shall be tested for Impact value under wet conditions in accordance with IS:5640.

** The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag.

*** In case water bound macadam is used for sub-base, the requirements in respect of Los Angeles Value and Aggregate Impact Value shall be relaxed to 50 percent and 40 percent maximum respectively.

404.2.2 Crushed or Broken Stone

The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

404.2.3 Crushed Slag

Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per m³ and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

- i) Chemical stability : To comply with requirements of appendix of ES:1047
- ii) Sulphur content : Maximum 2 percent
- iii) Water absorption : Maximum 10 percent

404.2.4 Overburnt (Jhama) Brick Aggregates

Jhama brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials. This shall be used only for road stretch when traffic is low.

404.2.5 Grading Requirement of Coarse Aggregates

The coarse aggregates shall conform to one of the Gradings given in Table 400-9 as specified.

404.2.6 Screenings

Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

Table 400-9 : Grading Requirements of Coarse Aggregates

Grading No.	Size Range	IS Sieve Designation	Percent by weight Passing
1)	63 mm to 45 mm	75 mm	100
		63 mm	90 – 100
		53 mm	25 – 75
		45 mm	0 – 15
		22.4 mm	0 – 5
2)	53 mm to 22.4 mm	63 mm	100
		53 mm	95 – 100
		45 mm	65 – 90
		22.4 mm	0 – 10
		11.2 mm	0 – 5

Note : The compacted thickness for a layer shall be 75 mm.

Screenings shall conform to the grading set forth in Table 400-10. The quantity of screenings required for various grades of stone aggregates are given in Table 400-11. The Table also gives the quantities of materials (loose) required for 10 m² for sub-base/base compacted thickness of 75 mm.

The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites, etc. as they are likely to get crushed to a certain extent under rollers.

404.2.7 Binding Material

Binding material to be used for water bound macadam as a filler material meant for preventing ravelling shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS:2720 (Part-5).

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06–0.09 m³ per 10 m².

Table 400-10 : Grading For Screenings

Grading Classification	Size of Screenings	IS Sieve Designation	Percent by Weight Passing the Sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95 – 100
		5.6 mm	15 - 35
		180 micron	0 – 10
B	11.2 mm	11.2 mm	100
		9.5 mm	80 – 100
		5.6 mm	50 – 70
		180 micron	5 – 25

Table 400-11 : Approximate Quantities of Coarse Aggregates and Screenings Required for 75 mm Compacted Thickness of Water Bound Macadam (WBM) Sub-Base/Base Course for 10 m² Area

Classification	Size Range	Compacted Thickness	Loose Qty.	Screenings			
				Stone Screening		Crushable Type Such as Moorum or Gravel	
				Grading Classification & Size	For WBM Sub-base/ Base Course (Loose Quantity)	Grading Classification & Size	Loose Qty.
Grading 1	63 mm to 45 mm	75 mm	0.91 to 1.07 m ³	Type A 13.2 mm	0.12 to 0.15 m ³	Not uniform	0.22 to 0.24 m ³
-do-	-do-	-do-	-do-	Type B 11.2 mm	0.20 to 0.22 m ³	-do-	-do-
Grading 2	53 mm to 22.4 mm	75 mm	-do-	-do-	0.18 to 0.21 m ³	-do-	-do-

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel.

404.3 Construction Operations

404.3.1 Preparation of Base

The surface of the sub-grade/sub-base/base to receive the water bound macadam course shall be prepared to the specified grade and camber and cleaned of dust, dirt and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained.

Where the WBM is to be laid on an existing metalled road, damaged area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for WBM.

As far as possible, laying water bound macadam course over existing bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it.

404.3.2 Inverted Choke/Sub-surface Drainage Layer

If water bound macadam is to be laid directly over the sub-grade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared sub-grade before application of the aggregates is taken up. In case of a fine sand or silty or clayey sub-grade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared sub-grade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

404.3.3 Lateral Confinement of Aggregates

For construction of WBM, arrangement shall be made for the lateral confinement of aggregates. This shall be done by building adjoining shoulders along with WBM layers. The practice of constructing WBM in a trench section excavated in the finished formation must be completely avoided.

Where the WBM course is to be constructed in narrow widths for widening of an existing pavement, the existing shoulders should be excavated to their full depth and width up to the sub-grade level except where widening specifications envisages laying of a stabilised sub-base using in-situ operations in which case the same should be removed only up to the sub-base level.

404.3.4 Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly and evenly upon the prepared sub-grade/sub-base in the required quantities from the stockpiles to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not more than 75 mm. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed base be permitted. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimize the need for manual rectification afterwards.

No segregation of coarse aggregates shall be allowed and the coarse aggregates, as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

404.3.5 Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on superelevated portions and carriageway with unidirectional cross-fall, where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the center. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the center line of the road, in successive passes uniformly overlapping preceding tracks by at least one-half width.

Rolling shall be carried out on courses where coarse aggregates of crushed/ broken stone are used, till the road metal is partially compacted. This will be followed by application of screenings and binding material where required in Clauses 404.3.6 and 404.3.7.

However, where screenings are not to be applied as in the case of aggregates like brick metal, laterite and Kankar for sub-base construction, the compaction shall be continued until the aggregates are thoroughly keyed. Rolling shall be continued and light sprinkling of water shall be done till the surface is well compacted.. Rolling shall not be done when the sub-

grade is soft or yielding or when it causes a wave-like motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely with templates and longitudinally with 3 m straight edge. Any irregularities, exceeding 12 mm, shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to the desired camber and grade. In no case shall the use of screenings be permitted to make up depressions.

Material, which gets crushed excessively during compaction or becomes segregated, shall be removed and replaced with suitable aggregates.

404.3.6 Application of Screenings

After the coarse aggregates have been rolled to Clause 404.3.5, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be equipped with pneumatic tyres and operated so as not to disturb the coarse aggregates.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregates. These operations shall continue until no more screenings can be forced into voids of the coarse aggregates. The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

404.3.7 Sprinkling of Water and Grouting

After application of screenings, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregates have been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the sub-base or sub-grade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it shall be taken up after curing as per Clause 402.3.9 and as directed by the Engineer.

Application of binding material : After the application of screenings in accordance with Clauses 404.3.6 and 404.3.7, the binding material where it is required to be used (Clause 404.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

404.3.8 Setting and Drying

After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course shall be allowed to completely dry and set before the next pavement course is laid over it.

404.4 Surface Finish and Quality Control of Work

404.4.1 The surface finish of construction shall conform to the requirements of Clause 902.

404.4.2 Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

404.4.3 The water bound macadam work shall not be carried out when the atmospheric temperature is less than 10°C in the shade.

404.4.4 Reconstruction of Defective Macadam

The finished surface of water bound macadam shall conform to the tolerances of surface regularity as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to sub-grade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and re-compacted. The area treated shall not be less than 10 sq.m. In no case shall depressions be filled up with screenings or binding material.

404.5 Arrangements for Traffic

During the period of construction, the arrangements for traffic shall be done as per Clause 112.

404.6 Measurements for Payment

Water bound macadam shall be measured as finished work in position in cubic metres.

404.7 Rate

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v), including arrangement of water used in the work as approved by the Engineer.

405 CRUSHED CEMENT CONCRETE SUB-BASE**405.1 Scope**

This work shall consist of breaking and crushing the damaged cement concrete slabs and re-compacting the same as sub-base/base course in one or more layers. The work shall be performed on such widths and lengths as may be specified, in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as otherwise directed by the Engineer.

405.2 Materials**405.2.1 Coarse Aggregates**

Coarse aggregates for this work shall be broken cement concrete slabs crushed to a size not exceeding 75 mm and as far as possible, conforming to one of the gradings given in **Table 400-9**.

405.3 Construction Operations**405.3.1 General**

Crushed cement concrete sub-base course may be constructed in one or two layers, depending upon the thickness of the concrete slabs dismantled and crushed. The thickness of each layer shall not exceed 75 mm compacted thickness.

405.3.2 Preparation of Surface

The surface of the subgrade shall be prepared in accordance with Clause 404.3.1.

405.3.3 Spreading of Aggregates

The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

405.3.4 Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on superelevated portions and carriageway with unidirectional cross-fall where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the center. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the center line of the road, in successive passes uniformly overlapping preceding tracks by at least one-half width.

Rolling shall be continued and light sprinkling of water shall be done till the surface is well compacted.

The rolled surface shall be checked transversely with templates and longitudinally with 3 m straight edge. Any irregularities, exceeding 12 mm, shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to the desired camber and grade.

405.4 Surface Finish and Quality Control of Work

The surface finish and control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

405.5 Arrangements for Traffic

During the period of construction, arrangement for traffic shall be done as per Clause 112.

405.6 Measurements for Payment

Breaking the existing cement concrete pavement slabs, crushing and recompacting the slab material as sub-base course shall be measured as a single item in terms of the volume of sub-base laid in position in cubic metres.

405.7 Rate

The Contract unit rate for crushed cement concrete sub-base course shall be payment in full for carrying out the required operations including full compensation for:

- i) making arrangements for traffic to Clause 112 except for initial treatment to verges/shoulders and construction of diversions;
- ii) breaking the cement concrete slabs, crushing, sieving and recompacting the slab material as sub-base course;
- iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;
- iv) carrying out the work in part widths of road where directed; and
- v) carrying out the required tests for quality control.

406 WET MIX MACADAM SUB-BASE/BASE**406.1 Scope**

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub-base/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be upto 200 mm with the approval of the Engineer.

406.2 Materials**406.2.1 Aggregates****406.2.1.1 Physical Requirements**

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than

90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-12.

If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

Table 400-12 : Physical Requirements of Coarse Aggregates for Wet Mix Macadam for Sub-base/Base Courses

S. No.	Test	Test Method	Requirements
1)	Los Angeles Abrasion value	IS:2386 (Part-4)	40 percent (Max.)
	or Aggregate Impact value	IS:2386 (Part-4) or IS:5640	30 percent (Max.)
2)	Combined Flakiness and Elongation indices (Total)	IS:2386 (Part-1)	35 percent (Max.)*

* To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

406.2.1.2 Grading Requirements

The aggregates shall conform to the grading given in Table 400-13.

Table 400-13 : Grading Requirements of Aggregates for Wet Mix Macadam

IS Sieve Designation	Percent by weight passing the IS Sieve
53.00 mm	100
45.00 mm	95–100
26.50 mm	–
22.40 mm	60–80
11.20 mm	40–60
4.75 mm	25–40
2.36 mm	15–30
600.00 micron	8–22
75.00 micron	0–5

Material finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

406.3 Construction Operations

406.3.1 Preparation of Base

Clause 404.3.1 shall apply.

406.3.2 Provision of Lateral Confinement of Aggregates

While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 404.3.3.

406.3.3 Preparation of Mix

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/ positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. The plant shall have following features:

- i) For feeding aggregates– three/ four bin feeders with variable speed motor
- ii) Vibrating screen for removal of oversize aggregates
- iii) Conveyor Belt
- iv) Controlled system for addition of water
- v) Forced/positive mixing arrangement like pug-mill or pan type mixer
- vi) Centralized control panel for sequential operation of various devices and precise process control
- vii) Safety devices

Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

406.3.4 Spreading of Mix

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-grade/sub-base/base in required quantities. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread by a paver finisher. The paver finisher shall be self-propelled of adequate capacity with following features:

- i) Loading hoppers and suitable distribution system, so as to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.
- ii) Hydraulically operated telescopic screed for paving width upto to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.
- iii) Automatic levelling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used with the prior approval of the Engineer. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual mixing and /or laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual mixing/laying in inaccessible/ remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual mixing/laying is intended to be used, the same shall be done with the approval of the Engineer.

406.3.5 Compaction

After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with an arrangement

for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/superelevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or sub-grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case shall the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material as determined by the method outlined in IS:2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompact.

406.3.6 Setting and Drying

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

406.4 Opening to Traffic

No vehicular traffic shall be allowed on the finished wet mix macadam surface. Construction equipment may be allowed with the approval of the Engineer.

406.5 Surface Finish and Quality Control of Work**406.5.1 Surface Evenness**

The surface finish of construction shall conform to the requirements of Clause 902.

406.5.2 Quality Control

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

406.6 Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub-grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompacted in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

406.7 Arrangement for Traffic

During the period of construction, arrangements for traffic shall be done as per Clause 112.

406.8 Measurements for Payment

Wet mix macadam shall be measured as finished work in position in cubic metres.

406.9 Rate

The Contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7.

407 CRUSHER-RUN MACADAM BASE**407.1 Scope**

This work shall consist of furnishing, placing and compacting crushed stone aggregate

sub-base and base courses constructed in accordance with the requirements set forth in these Specifications and in conformity with the lines, grades, thickness and cross-sections shown on the drawings or as directed by the Engineer.

407.2 Materials

The material to be used for the work shall be crushed rock. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. It shall be free from any organic matter and other deleterious substances and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base. The aggregates shall conform to the grading and quality requirements given in Tables 400-14 and 400-15.

The grading to be adopted shall be as indicated in the Contract.

407.3 Construction Operations

407.3.1 Preparation of Sub-grade

The surface of the sub-grade shall be prepared in accordance with Clause 404.3.1. Any ruts, deformations or soft yielding places which occur in the sub-base or sub-grade shall be corrected and compacted to the required density before the aggregate base course is placed thereon.

407.3.2 Spreading, Watering, Mixing and Compaction

The aggregate shall be uniformly deposited on the approved subgrade by means of hauling vehicle with or without spreading devices. Aggregate will be distributed over the surface to the depth specified on the drawings or as directed by the Engineer.

Table 400-14 : Aggregate Grading Requirements

Sieve Size	Percent passing by weight	
	53 mm max. size	37.5 mm max. size
63 mm	100	
45 mm	87 – 100	100
22.4 mm	50 – 85	90 – 100
5.6 mm	25 – 45	35 – 55
710 mm	10 – 25	10 – 30
90 mm	2 – 5	2 – 5

Table 400-15 : Physical Requirements of Coarse Aggregates for Crusher-Run Macadam Base

	Test	Test Method	Requirements
1)	Los Angeles Abrasion value or Aggregate Impact value	IS:2386 (Part 4) IS:2386 (Part 4) or IS:5640	40 maximum 30 maximum
2)	Combined Flakiness and Elongation Indices (Total)	IS:2386 (Part 1)	35 maximum**
3)	*Water absorption	IS:2386 (Part 3)	2 percent maximum
4)	Liquid Limit of material passing 425 micron	IS:2720 (Part 5)	25 maximum
5)	Plasticity Index of material passing 425 micron	IS:2720 (Part 5)	6 maximum

* If the water absorption is more than 2 percent, soundness test shall be carried out as per IS:2386 (Part-5)

** To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

After the base course material has been deposited, it shall be thoroughly blade-mixed to full depth of the layer by alternately blading the entire layer to the center and back to the edges of the road. It shall then be spread and finished to the required cross-section by means of a motor grader.

Water shall be applied prior to and during all blading and processing operations to moisten the material sufficiently to prevent segregation of the fine and coarse particles. Water shall be applied in sufficient amounts during construction to assist in compaction.

Compaction shall commence immediately after the spreading operation. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm, compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity. The speed of the roller shall not exceed 5 km/h. Each layer of material shall be compacted to not less than 98 percent of the maximum density as determined by IS:2720 (Part-8).

407.4 Opening to Traffic

No vehicular traffic shall be allowed on the finished crusher-run macadam surface. Construction equipment may be allowed with the approval of the Engineer.

407.5 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and work shall be exercised by the Engineer in accordance with Section 900.

407.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be done in accordance with Clause 112.

407.7 Measurements for Payment

Crusher-run macadam base shall be measured as finished work in position in cubic metres.

407.8 Rate

The Contract unit rate for crusher run macadam base shall be payment in full for carrying out the required operations including full compensation for all components as in Clause 401.7 (i) to (v).

408 SHOULDERS, ISLANDS AND MEDIANS**408.1 Scope**

The work shall consist of constructing shoulder (hard/paved/earthen with brick or stone block edging) on either side of the pavement, median in the road dividing the carriageway into separate lanes and islands for channelising the traffic at junctions in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

408.2 Materials

Shoulder on either side of the road may be of selected earth/granular material/paved conforming to the requirements of Clause 305/401 and the median may be of selected earth conforming to the requirements of Clause 305.

Median/Traffic islands shall be raised and kerbed at the perimeter and the enclosed area filled with earth and suitably covered with grass turf/shrubs as per Clause 307 and/or paved as per Clauses 410.3.4 or 410.3.5.

Paved shoulders shall consist of sub-base, base and surfacing courses, as shown in the drawings and materials for the same shall conform to relevant Specifications of the corresponding items. Where paved or hard shoulders are not provided, the pavement shall be provided with brick/stone block edgings as shown in the drawings. The brick shall conform to Clause 1003 of these Specifications. Stone blocks shall conform to Clause 1004 of these Specifications and shall be of size 225 mm x 110 mm x 75 mm.

408.3 Size of Shoulders/Medians/Islands

Shoulder (earthen/hard/paved)/median/traffic island dimensions shall be as shown on the drawings or as directed by the Engineer.

408.4 Construction Operations

408.4.1 Shoulders

The sequence of operations shall be such that the construction of paved shoulder is done in layers each matching the thickness of adjoining pavement layer. Only after a layer of pavement and corresponding layers in paved and earth shoulder portion have been laid and compacted, the construction of next layer of pavement and shoulder shall be taken up.

Where the materials in adjacent layers are different, these shall be laid together and the pavement layer shall be compacted first. The corresponding layer in paved shoulder portion shall be compacted thereafter, which shall be followed by compaction of each shoulder layer. The adjacent layers having same material shall be laid and compacted together.

In all cases where paved shoulders have to be provided along side of existing carriageway, the existing shoulders shall be excavated in full width and to the required depth as per Clause 301.3.7. Under no circumstances, box cutting shall be done for construction of shoulders.

Compaction requirement of earthen shoulder shall be as per Table 300-3. In the case of bituminous courses and concrete pavement, work on shoulder shall start only after the pavement course has been laid and compacted.

During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water.

Regardless of the method of laying, all shoulder construction material shall be placed directly

on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement, and the area so affected thoroughly cleaned.

408.4.2 Median and Islands

Median and islands shall be constructed in a manner similar to shoulder up to the road level. Thereafter, the median and islands, if raised, shall be raised at least 300 mm by using kerb stones of approved material and dimensions and suitably finished and painted as directed by the Engineer. If not raised, the median and islands shall be differentiated from the shoulder/pavement as the case may be, as directed by the Engineer. The confined area of the median and islands shall be filled with local earth or granular material or any other approved material and compacted by plate compactor/power rammer. The confined area after filling with earth shall be turfed with grass or planted with shrubs, or finished with tiles/slabs as provided in the drawings.

408.4.3 Brick/Stone Block Edging

The brick/stone blocks shall be laid on edge, with the length parallel to the transverse direction of the road. They shall be laid on a bed of 25 mm sand, set carefully rolled into position by a light roller and made flush with the finished level of the pavement.

408.5 Surface Finish and Quality Control of Works

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with **Section 900**.

408.6 Measurements for Payment

Shoulder (earthen/hard/paved), island and median construction shall be measured as finished work in position as below:

- i) For excavation in cu.m.
- ii) For earthwork/granular fill in cu.m.
- iii) For sub-base, base, surfacing courses in units as for respective items
- iv) For kerb in running metre; length of kerb for median shall be measured for each side separately.
- v) For turfing, shrubs and tile/slab finish in sq.m.
- vi) For brick/stone block edging in running metre, the length for brick/stone block edging for median edging shall be measured for each side separately.

408.7 Rate

The Contract unit rate for shoulder (hard/paved/earthen with brick or stone block edging), island and median construction shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v) as applicable. The rate for brick/stone block edging shall include the cost of sand cushion.

409 CEMENT CONCRETE KERB AND KERB WITH CHANNEL**409.1 Scope**

This work shall consist of constructing cement concrete kerbs and kerbs with channel in the central median and/or along the footpaths or separators in conformity with the lines, levels and dimensions as specified in the drawings or as directed by the Engineer.

409.2 Materials

Kerbs and kerb with channel shall be provided in cement concrete of Grade M 20 in accordance with Section 1700 of these Specifications.

409.3 Type of Construction

These shall be cast-in-situ construction with suitable kerb casting machine in all situations except at locations where continuous casting with equipment is not practicable. In those locations precast concrete blocks shall be used.

409.4 Equipment

A continuous kerb casting equipment of adequate capacity and controls, capable of laying the kerbs in required cross-sections and producing a well-compacted mass of concrete free of voids and honeycombs, shall be used.

409.5 Construction Operations

409.5.1 Kerb shall be laid on firm foundation of minimum 150 mm thickness of cement concrete of M 15 grade cast in-situ or on extended width of pavement. The foundation shall have a projection of 50 mm beyond the kerb stone. Before laying the foundation of lean concrete, the base shall be leveled and slightly watered to make it damp.

409.5.2 In the median portions in the straight reaches, the kerb shall be cast in continuous lengths. In the portions where footpath is provided and/or the slope of the carriageway is towards median (as in case of superelevated portion), there shall be sufficient gap/recess left in the kerb to facilitate drainage openings.

409.5.3 After laying the kerbs and just prior to hardening of the concrete, saw cut grooves shall be provided at 5 m intervals up to finished road level or as specified by the Engineer.

409.5.4 Kerbs on the drainage ends such as along the footpath or the median in superelevated portions, shall be cast with monolithic concrete channels as indicated in drawings. The slope of the channel towards drainage pipes shall be ensured for efficient drainage of the road surface.

409.5.5 Vertical and horizontal tolerances with respect to true line and level shall be ± 6 mm.

409.6 Measurements for Payment

Cement concrete kerb/kerb with channel including foundation shall be measured in linear metre for the complete item of work.

409.7 Rate

The Contract unit rates for cement concrete kerb/kerb with channel including foundation for kerb shall be payment in full compensation for furnishing all materials, labour, tools, equipment for construction and other incidental cost necessary to complete the work.

410 FOOTPATHS AND SEPARATORS

410.1 Scope

The work shall consist of constructing footpaths and/or separators at locations as specified in the drawings or as directed by the Engineer.

The lines, levels and dimensions shall be as per the drawings. The scope of the work shall include provision of all drainage arrangements as shown in the drawings or as directed by the Engineer.

410.2 Materials

The footpaths and separators shall be constructed with any of the following types:

- a) Cast-in-situ cement concrete of Grade M 20 as per Section 1700 of the Specifications. The minimum size of the panels shall be as specified in the drawings.

- b) Precast cement concrete blocks and interlocking blocks/tiles of grade not less than M 30 as per Section 1700 of the Specifications. The thickness and size of the cement concrete blocks or interlocking blocks/tiles shall be as specified in the drawings.
- c) Natural stone slab cut and dressed from stone of good and sound quality, uniform in texture, free from defects and at least equal to a sample submitted by the Contractor and approved by the Engineer. The thickness and size of the natural stone slab shall be as specified in the drawings.

410.3 Construction Operations

410.3.1 Drainage pipes below the footpath originating from the kerbs shall be first laid in the required slope and connected to the drains/sumps/storm water drain/drainage chutes as per provisions of the drawings, or as specified.

410.3.2 Portion on back side of kerbs shall be filled and compacted with granular sub-base material as per Clause 401 of the Specifications in specified thickness.

410.3.3 The base for cast-in-situ cement concrete panels/ tiles/ nature stone slab shall be prepared and finished to the required lines, levels and dimensions as indicated in the drawings.

Over the prepared base, precast concrete interlocking blocks/tiles/natural stone slabs and/or cast-in- situ slab shall be set/laid as described in Clauses 410.3.4 and 410.3.5.

410.3.4 Tiles/Natural Stone Slabs

The blocks/tiles/slabs shall be set on a layer of average 12 mm thick cement-sand mortar (1:3) laid on prepared base in such a way that there is no rocking. The gaps between the blocks/tiles/slabs shall not be more than 12 mm and shall be filled with cement-sand mortar (1:3).

410.3.5 Cast-in-Situ Cement Concrete

The panels of specified size shall be cast on the prepared base in panels of specified size in a staggered manner. Construction joints shall be provided as per Section 1700 of the Specifications.

410.3.6 Precast Concrete Blocks and Interlocking Concrete Block Pavements

The precast concrete blocks and interlocking concrete block pavement shall be laid on a

bedding of sand of thickness specified in the drawing. The grading of the sand layer shall be as in Table 400-16.

Table 400-16

IS Sieve Size	Percent Passing
9.52 mm	100
4.75 mm	95–100
2.36 mm	80–100
1.18 mm	50–95
600 micron	25–60
300 micron	10–30
150 micron	0–15
75 micron	0–10

The joints shall be filled with sand passing a 2.35 mm size with the grading as in Table 400-17.

Table 400-17

IS Sieve Size	Percent Passing
2.36 mm	100
1.18 mm	90–100
600 micron	60–90
300 micron	30–60
150 micron	15–30
75 micron	0–10

The bedding sand slightly moist, the moisture content being about 4 percent. The bedding sand shall be compacted by vibratory plate compactor.

The blocks shall be laid to the levels indicated on the drawings and to the pattern directed by the Engineer. The surface tolerance shall be ± 10 mm with respect to the design level. The blocks shall be embedded using a hammer.

410.4 Measurements for Payment

Footpaths and separators shall be measured in Sq.m between inside of kerbs. The edge restraint block and kerb shall be measured separately in linear meter. The items pertaining to drainage shall be measured separately.

410.5 Rate

Contract unit rates shall be inclusive of full compensation for all labour, materials, tools, equipment for footpaths including the base. Cost of providing pipes and arrangement for their discharge into appropriate drainage channels shall be incidental to the construction of footpaths.

500

**BASES AND SURFACE
COURSES (BITUMINOUS)**

501 GENERAL REQUIREMENTS FOR BITUMINOUS PAVEMENT LAYERS**501.1 General**

Bituminous pavement courses shall be made using the materials described in the Specifications.

The use of machinery and equipment mentioned in various Clauses of these Specifications is mandatory. Details of the machinery and equipment are available in the Manual for Construction and Supervision of Bituminous Works. The equipment mandatory for any particular project shall be in accordance with the Contract Specifications for that project.

501.2 Materials**501.2.1 Binder**

The binder shall be an appropriate type of bituminous material complying with the relevant Indian Standard, as defined in the appropriate Clauses of these Specifications, or as otherwise specified herein. The choice of binder shall be stipulated in the Contract or by the Engineer. Where viscosity grades of bitumen are specified, they are referred to by a designation in accordance with IS:73. Where modified bitumen is specified, it shall conform to the requirements of IRC:SP:53 and IS:15462; and the following provision of this Specification shall apply.

- i) Modified bitumen from refinery sources or blended at approved central plant or at site using appropriate industrial process and plant with high shear mill, and testing facilities to achieve stable and homogenous mix shall be used. The use of high shear mixer or any other device capable of producing a homogeneous blend is essential when the modifier is in powder form.
- ii) Transportation tanks and storage tanks shall be insulated and equipped with effective heating system and circulation/ agitating device to maintain the specified temperature, homogeneity and viscosity of the bitumen during transit and storage.
- iii) Separation, difference in softening point (R&B), shall not be more than 3°C for any type of specified modified bitumen when tested as per Annex B of IS:15462.

Selection criteria for viscosity grade bitumen, based on highest and lowest daily mean temperatures at a particular site, are given in Table 500-1.

Selection criteria for modified bitumen shall be in accordance with IRC:SP:53.

**Table 500-1 : Selection Criteria for Viscosity-Graded (VG) Paving Bitumens
Based on Climatic Conditions**

Lowest Daily Mean Air Temperature, °C	Highest Daily Mean Air Temperature, °C		
	Less than 20°C	20 to 30°C	More than 30°C
More than -10°C	VG-10	VG-20	VG-30
-10°C or lower	VG-10	VG-10	VG-20

Both the highest daily mean air temperature and the lowest daily mean air temperatures mentioned in Tables 500-5 and 500-6 can be obtained for the weather station nearest to the project site from the Indian Meteorological Organization (IMO). This daily mean high temperature on a specific day is the same as daily "normal" high temperature for that day as usually reported in some newspapers. The highest of the 365 daily mean high air temperatures (which usually occurs on some day in May or June) is used in Tables 500-5 and 500-6. Likewise, the lowest daily mean air temperature (which usually occurs on some day in January) can also be obtained from the IMO. Since these are mean temperatures based on the average of 30-40 years data, these temperatures are significantly lower than the absolute maximum temperatures, which may have occurred in a specific year.

501.2.2 Coarse Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. Where the Contractor's selected source of aggregates has poor affinity for bitumen, the Contractor shall demonstrate through test results that with the use of anti-stripping agents, the stripping value is improved to satisfy the specification requirements. The Engineer may approve such a source and, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, at the cost of the Contractor.

Where crushed gravel is proposed for use as aggregate not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces, except that in the case of bituminous concrete the requirement in this regard shall be 95 percent.

The aggregates shall satisfy the physical requirements set forth in the individual relevant clause for the material.

501.2.3 Fine Aggregates

Fine aggregates shall consist of crushed or naturally occurring material, or a combination of the two, passing 2.36 mm sieve and retained on the 75 micron sieve. They shall be clean,

hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter. Natural sand shall not be allowed in binder and wearing courses. However, natural sand upto 50 percent of the fine aggregates may be allowed in base courses. Fine aggregates shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part 37). The plasticity index of the fraction passing 0.425 mm shall not exceed 4 when tested in accordance with IS:2720 (Part 5). The fine aggregates shall satisfy the physical requirements set forth in the individual relevant-clause for the material in question.

501.2.4 Sources of Material

The sources of materials proposed to be used by the Contractor shall be tested to the satisfaction of the Engineer who shall give the necessary approval. The Engineer may from time to time withdraw approval of a specific source, or attach conditions to the existing approval. Any change in aggregate source for bituminous mixes shall require a new mix design, and laying trials, where the mix is based on a job mix design. Stockpiles from different sources, approved or otherwise, shall be kept separate, such that there is no contamination between one material and another. Each source submitted for approval shall contain material sufficient for at least 5 days' work.

501.3 Mixing

Pre-mixed bituminous materials shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperatures are given in Table 500-2 of these Specifications. the difference in temperature between the binder and aggregate shall at no time exceed 14°C. In order to ensure uniform quality of the mix and better coating of aggregates, the hot mix plant shall be calibrated from time to time. The essential features of the hot mix plants are given in Annex A of IRC:27.

Table 500-2 : Mixing, Laying and Rolling Temperatures for Bituminous Mixes (Degree Celcius)

Bitumen Viscosity Grade	Bitumen Temperature	Aggregate Temperature	Mixed Material Temperature	Laying Temperature	*Rolling Temperature
VG-40	160-170	160-175	160-170	150 Min	100 Min
VG-30	150-165	150-170	150-165	140 Min	90 Min
VG-20	145-165	145-170	145-165	135 Min	85 Min
VG-10	140-160	140-165	140-160	130 Min	80 Min

* Rolling must be completed before the mat cools to these minimum temperatures.

If a continuous type mixing plant is used, the Contractor must demonstrate by laboratory analysis that the cold feed combined grading is within the grading limits specified for that bituminous bound material. In the case of a designed job mix, the bitumen and filler content shall be derived using this combined grading.

501.4 Transporting

Bituminous materials shall be transported in clean insulated and covered vehicles. An asphalt release agent, such as soap or lime water, may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

501.5 Laying

501.5.1 Weather and Seasonal Limitations

Laying shall be suspended:

- i) In presence of standing water on the surface;
- ii) When rain is imminent, and during rains, fog or dust storm;
- iii) When the base/binder course is damp;
- iv) When the air temperature on the surface on which it is to be laid is less than 10°C for mixes with conventional bitumen and is less than 15°C for mixes with modified bitumen;
- v) When the wind speed at any temperature exceeds the 40 km per hour at 2 m height.

501.5.2 Cleaning of Surface

The surface on which the bituminous work is to be laid shall be cleaned of all loose and extraneous matter by means of a mechanical broom and air jet. The equipment for applying a high pressure air jet from a compressor to remove dust or loose matter shall be available full time at the site.

501.5.3 Spreading

Prior to spreading the mix, the base shall be prepared by carrying out the required operations as per Clause 501.8 depending upon the site conditions. Except in areas where paver cannot get access, bituminous materials shall be spread, levelled and tamped by an approved self-propelled paving machine equipped with an electronic sensing device. The essential features of the paver finisher shall conform to Annex A of IRC:27. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay. The

rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of the paver, and its method of operations, shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space (such as confined space, foot ways, of irregular shape and varying thickness, approaches to expansion joints, etc.) where paver cannot be used, the material shall be spread, raked and levelled with suitable hand tools by trained staff.

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these Specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300 mm short of the joint. The remainder of the pavement up to the joint, and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material, with a temperature greater than 145°C, shall not be laid or deposited on bridge deck water-proofing systems, unless precautions against heat damage have been approved by the Engineer.

501.5.4 Cleanliness and Overlaying

Bituminous material shall be kept clean and uncontaminated. The only traffic permitted to run on bituminous material to be overlaid shall be that engaged in laying and compacting the next course or, where a binder course is to be sealed or surface dressed, that engaged on such surface treatment. Should any bituminous material become contaminated, the Contractor shall make it good to the satisfaction of the Engineer, in compliance with Clause 501.8.

Binder course material shall be covered by either the wearing course or surface treatment, whichever is specified in the Contract.

501.6 Compaction

Bituminous materials shall be laid and compacted in layers, which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

Compaction of bituminous materials shall commence as soon as possible after laying. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in the relevant part of these Specifications. Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this, rolling shall commence at the edges and progress towards the center longitudinally except that on super-elevated and unidirectionally cambered portions, it shall progress from the lower to the upper edge parallel to the center line of the pavement. Rolling shall continue until all roller marks have been removed from the surface. All deficiencies in the surface after laying shall

be made good by the attendants behind the paver, before initial rolling is commenced. The initial or breakdown rolling shall be done with 8–10 tonne static weight smooth-wheel rollers. The intermediate rolling shall be done with 8–10 tonne static weight or vibratory roller or with a pneumatic tyre roller of 12 to 15 tonne weight, with a tyre pressure of at least 0.56 MPa. The Contractor shall demonstrate the efficiency of the equipment proposed to be used by carrying compaction trials. The procedure for site trials shall be submitted to the Engineer for approval. The finish rolling shall be done with 6 to 8 tonne smooth wheel tandem rollers. Rolling shall continue until the specified compaction is achieved.

Where compaction is to be determined by density of cores, the requirements to prove the performance of rollers shall apply in order to demonstrate that the specified density can be achieved. In such cases the Contractor shall specify the plant, and the method by which he intends to achieve the specified level of compaction and finish at temperatures above the minimum specified rolling temperature. Laying trials shall then demonstrate the acceptability of the plant and method used.

Bituminous materials shall be rolled in a longitudinal direction, with the driven rolls nearest the paver. The roller shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least one-third of the width of the rear roll or, in the case of a pneumatic-tyred roller, at least the nominal width of 300 mm.

In portions with super-elevated and unidirectional camber, after the edge has been rolled, the roller shall progress from the lower to the upper edge.

Rollers should move at a speed of not more than 5 km per hour. The roller shall not be permitted to stand on pavement which has not been fully compacted, and necessary precautions shall be taken to prevent dropping of oil, grease, petrol/ diesel or other foreign matter on the pavement either when the rollers are operating or standing. The wheels of roller machine shall be in good working order, to prevent the mix from adhering to the wheels. Only sufficient moisture to prevent adhesion between the wheels of rollers and the mix should be used. Surplus water shall not be allowed to stand on the partially compacted pavement.

501.7 Joints

501.7.1 Where joints are made, the material shall be fully compacted and the joint made flush in one of the following ways:

- a) All joints shall be cut vertical to the full thickness of the previously laid mix. All loosened material shall be discarded and the vertical face coated with a suitable viscosity grade hot bitumen, or cold applied emulsified bitumen. While spreading the material along the joint the material spread shall overlap 25 mm to 50 mm on the previously laid mix beyond the vertical face of the joint. The thickness of the loose

overlap material should be approximately a quarter more than the final compacted thickness. The overlapped mix shall be dragged back to the hot lane so that the roller can press the small excess into the hot side of the joint to obtain a high joint density.

- b) By using two or more pavers operating in echelon, where this is practicable and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling.

501.7.2 All longitudinal joints shall be offset at least 300 mm from parallel joints in the layer beneath or as directed, and in a layout approved by the Engineer. Joints in the wearing course shall coincide with either the lane edge or the lane marking, whichever is appropriate. Longitudinal joints shall not be situated in wheel track zones.

501.7.3 For transverse joints method a) above shall apply. Transverse joints in the successive and adjoining layers shall have a minimum offset of 2 m.

501.8 Preparation of Surface

501.8.1 Scope

This work shall consist of preparing an existing granular or black-topped surface for laying bituminous course. The work shall be performed on such widths and lengths as shown on the drawings or as instructed by the Engineer. The existing surface shall be firm and clean, and treated with Prime or Tack coat where specified in the Contract.

501.8.2 Materials

501.8.2.1 For Scarifying and Re-laying the Granular Surface

The material used shall be coarse aggregates salvaged from the scarification of the existing granular base course supplemented by fresh coarse aggregates and screenings so that aggregates and screenings thus supplemented correspond to Clauses 404 or 406.

501.8.2.2 For Patching Potholes and Sealing Cracks

Where the existing surface to be overlaid is bituminous, material required for patching and sealing cracks shall be in accordance with Clauses 3004.2 and 3004.3, or as directed by the Engineer.

501.8.2.3 For Profile Corrective Course

The type of material for use as profile corrective course shall be as shown on the drawings

or as directed by the Engineer. Where it is to be laid as part of the overlay/ strengthening course, the profile corrective course material shall be of the same specification as that of the overlay/ strengthening course. However, if provided as a separate layer, it shall be of the specification and details given in the Contract.

501.8.3 Construction Operations

501.8.3.1 Preparing Existing Granular Surface

Where the existing surface is granular, all loose materials shall be removed, and the surface lightly watered where the profile corrective course to be provided as a separate layer is also granular. Where the profile corrective course of bituminous material is to be laid over the existing granular surface, the latter shall, after removal of all loose material, be primed in accordance with Clause 502 and a tack coat applied in accordance with Clause 503.

The surface of all granular layers on which bituminous works are to be placed, shall be free from dust. All such layers must be capable of being swept, after the removal of any non-integral loose material, by means of a mechanical broom, without shedding significant quantities of material and dust removed by air jet, washing, or other means approved by the Engineer.

After cleaning, the surface shall be correct to line and level within the tolerances specified for base course.

501.8.3.2 Scarifying Existing Bituminous Surface

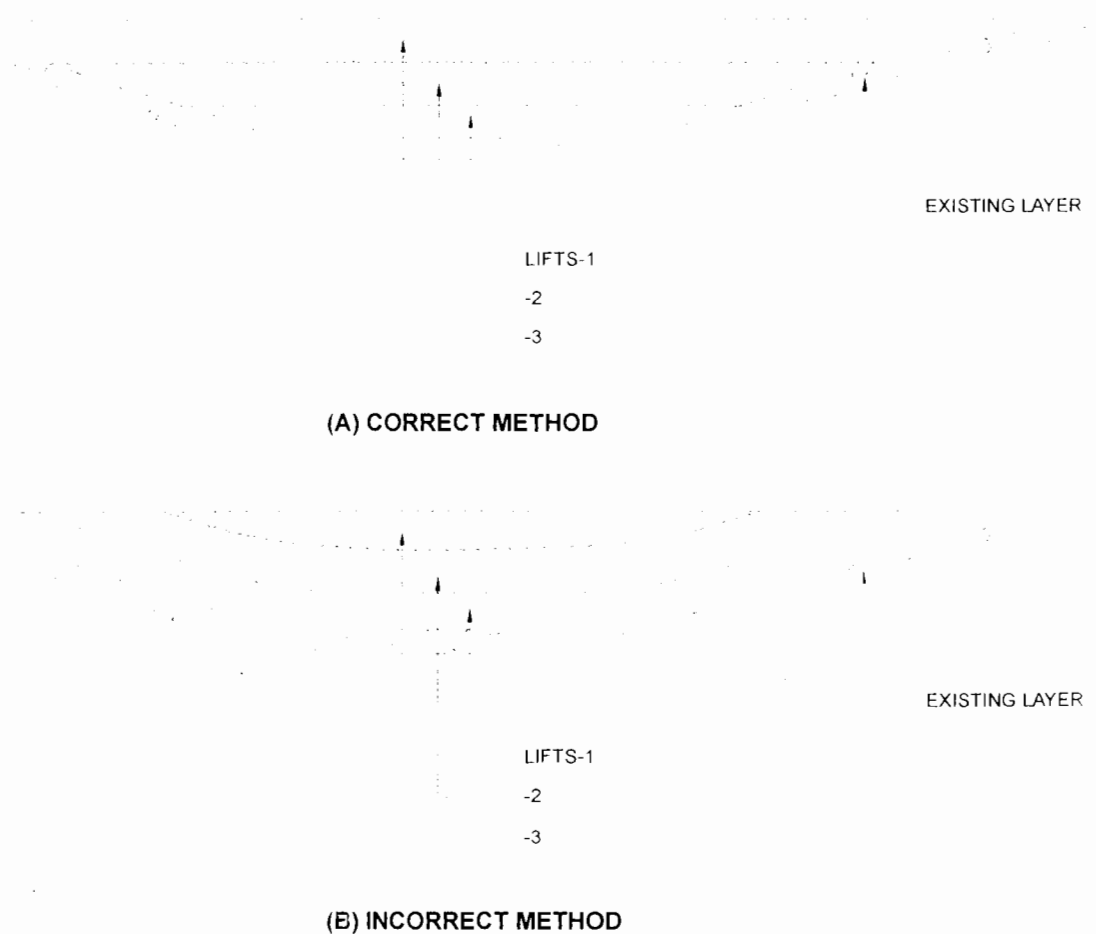
Where specified or shown on the drawings, the existing bituminous layer in the specified width shall be removed with care and without causing undue disturbance to the underlying layer, by a suitable method approved by the Engineer. After removal of all loose and disintegrated material, the underlying layers which might have been disturbed shall be suitably reworked supplementing the base material as necessary with suitable fresh stone aggregates and compacted to line and level. The compacted finished surface shall be primed in accordance with **Clause 502**. Reusable materials shall be stacked as directed by the Engineer with all leads and lifts.

501.8.3.3 Patching of Potholes and Sealing of Cracks

Where the existing surface to be overlaid is bituminous, any existing potholes and cracks shall be repaired and sealed in accordance with Clauses 3004.2 and 3004.3, or as directed by the Engineer.

501.8.3.4 Profile Corrective Course**a) Application of Profile Corrective Course**

- i) A profile corrective course for correcting the existing pavement profile shall be laid to varying thickness as shown on the Drawings.
 - ii) Any high spots in the existing black-topped surface shall be removed by a milling machine or other approved method, and all loose material shall be removed to the satisfaction of the Engineer.
 - iii) Where the maximum thickness of profile corrective course will be not more than 40 mm, the profile corrective course shall be constructed as an integral part of the overlay course. In other cases, the profile corrective course shall be constructed as a separate layer, adopting such construction procedures and using such equipment as approved by the Engineer, to lay the specified type of material, to thickness and tolerance as specified for the course to be provided.
 - iv) The profile corrective course shall be laid to tolerances and densities as specified for wearing course if it is laid integral with the wearing course. The profile corrective course shall be laid to tolerances and densities as specified for base course, if it is to be covered with a wearing course layer.
- b) **Laying on Granular Base** : After preparing the granular surface in accordance with Clauses 501.8.3.1 and 501.8.3.2, the profile corrective course shall be laid using material as described in Clauses 501.8.2.3 and 501.8.3.4 (a), or as otherwise described in the Contract, and compacted to the requirements of the particular Specification.
- c) **Laying on Existing Bituminous Surface** : The existing bituminous surface shall be prepared in accordance with Clause 501.8.3.3, and after applying a tack coat conforming to Clause 503, the bituminous profile corrective course shall be laid using material as described in Clauses 501.8.2.3 and 501.8.3.4(a) and compacted to the requirements of the Specification.
- d) **Correction of Local Depressions, Camber and Super-Elevation** : Where local sags or depressions occur in the existing pavement, a specific filling operation shall be instructed by the Engineer, which should be laid in accordance with Fig. 500-1. Normally, the maximum layer thickness at any point should not exceed 100 mm. In placing multiple lifts, they should be arranged according to the correct method as illustrated.



Note: Profile corrective course material to be in accordance with the lift thickness

Fig. 500-1 : Methods for Providing Corrective Course for Short Sags and Depressions

For correction of camber or super-elevation of the existing carriageway, the method shown in Fig. 500-2 shall be adopted, depending on the profile of the existing carriageway.

501.8.3.5 Covering the Profile Corrective Courses

Profile corrective course shall be so planned that the layer shall be covered by the designed base/wearing course at the earliest opportunity, before opening to regular traffic.

501.8.4 Surface Finish and Quality Control of Work

The relevant provisions of Section 900 shall apply.

501.8.5 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

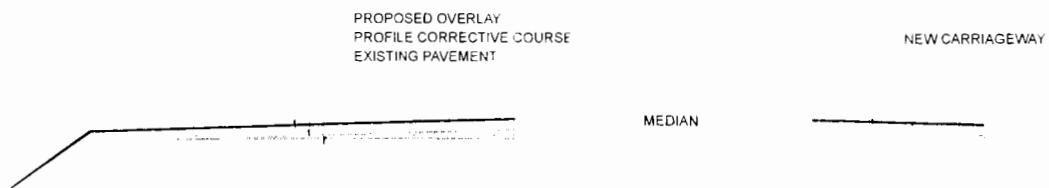
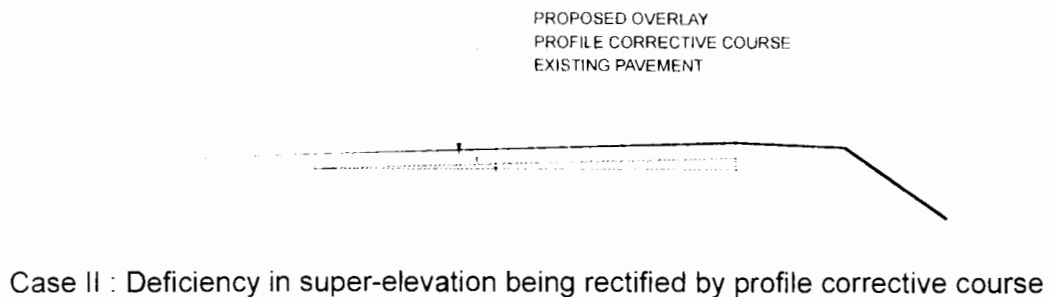
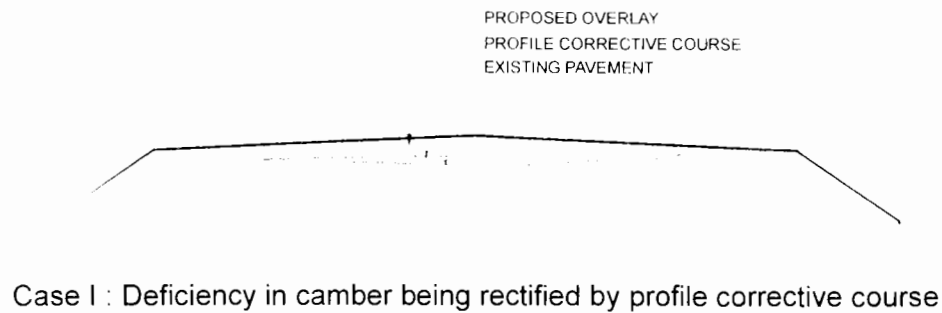


Fig. 500-2 : Correction of Camber or Super-Elevation

501.8.6 Environmental Protection

The provisions of Clause 111 and the provision of Annex A to Clause 501 shall apply.

501.8.7 Measurement for Payment

501.8.7.1 Cleaning of the Surface

The work of cleaning of the surface using mechanical broom and air-jet shall be incidental to the work of preparation of surface.

501.8.7.2 Scarifying

Scarifying the existing bituminous surface shall be measured and paid for on a square metre basis.

501.8.7.3 Prime Coat

Prime coat shall be measured and paid for on a square metre basis.

501.8.7.4 Tack Coat

Tack coat shall be measured and paid for on a square metre basis.

501.8.7.5 Potholes and Crack Sealing

The work of filling potholes shall be measured separately and be paid for in square metres or on weight basis in tonnes as specified in the Contract.

The work of sealing cracks by applying fog spray or emulsion slurry seal shall be measured in square metres, for the area covered by the spray.

The work of sealing cracks of size 3 mm to 6 mm in width shall be measured in square metres or in linear meters as specified in the Contract.

The work of sealing cracks of size greater than 6 mm width shall be measured in linear metres.

501.8.7.6 Profile Corrective Course

Profile corrective course shall be measured as the volume laid in position in cubic metres, or in tonnage, as stipulated in the Contract. The volume shall be calculated by plotting the exact profile of corrective course as required, and laid, superimposed on the existing pavement profile. Cross-sectional areas of the profile corrective course shall be measured at intervals of 10 m centre to centre on straight sections and at 5 m center to centre on curves longitudinally and at seven locations transversely, for two lane carriageway, and at three locations transversely for single lane and the volume shall be calculated using the method of end areas.

501.8.7.7 Filling of Local Depressions

The work of filling depressions where instructed to be carried out separately shall be measured by the weight of the bituminous material placed in position.

501.8.8 Rates**501.8.8.1 Rate for Scarifying**

The contract unit rate for scarifying existing bituminous surfaces, including repairing/reworking

disturbed underlying layers and removing and stacking reusable and unusable materials, shall include but not necessarily be limited to, the cost of all labour, supply of materials needed for repair/reworking, hire charges of tools and plant, and transportation of scarified materials with all leads and lifts.

501.8.8.2 Rate for Premixed Bituminous Material

The contract unit rate for premixed bituminous material shall be payment in full for carrying out the required operations including full compensation for, but not necessarily limited to:

- i) Making arrangements for traffic to Clause 112 except for initial treatment to verge, shoulders and construction of diversions;
- ii) Cleaning of the surface;
- iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lifts;
- iv) Mixing, transporting, laying and compacting the mix, as specified including all wastage in cutting joints;
- v) All labour, tools, equipment, plant including installation of hot mix plant, power supply units and all machinery, incidental to complete the work to these Specifications;
- vi) Carrying out the work in part widths of the road where directed;
- vii) Carrying out all tests for control of quality;
- viii) The rate shall cover the provision of bitumen at the application rate specified in the contract, with the provision that the variation in actual percentage of bitumen used shall be assessed and the payment adjusted accordingly as per Contract;
- ix) The rates include for all testing, mix design, transporting and testing of samples, and cores and tests as directed by the Engineer; and
- x) The cost of all plant and laying trials as specified to prove the mixing and laying methods shall be deemed to be included in the Contractor's rates.

501.8.8.3 Rate for Potholes and Crack Sealing

The rate for patching potholes shall be as per Clause 3004.2.6.

The rate for sealing cracks by applying fog spray shall be as per Clause 513.9.

The rate for sealing of cracks of width 3 mm or more shall be as per Clause 3004.3.3.5.

The contract unit rate for cracks between 6 mm and 15 mm shall be measured on a linear metre basis, and the rate is to include for all materials, tools, plant, labour, and transport.

501.8.8.4 Rate for Prime Coat

The Contract unit rate for prime coat shall be as per Clause 502.8.

501.8.8.5 Rate for Tack Coat

The Contract unit rate for tack coat shall be as per Clause 503.8.

501.8.8.6 Rate for Filling of Local Depressions

The Contract unit rate for filing of local depressions shall be payment in full for (i) furnishing all materials, (ii) all works involved including trimming, cleaning, backfilling, priming, application of tack coat, filling with bituminous material in layers and compacting each layer (iii) all labour, tools, equipment and incidentals to complete the works in accordance with the Specifications.

501.8.8.7 Rate for Profile Corrective Course

The Contract unit rate for profile corrective course when laid separately shall be payment in full for carrying out the required operations as specified, and shall include all components listed in Clause 501.8.8.2.

Annex 'A' to Clause 501**Annex 'A'**
PROTECTION OF THE ENVIRONMENT**1 GENERAL**

- 1.1 This Appendix sets out limitations on the Contractor's activities specifically intended to protect the environment.
- 1.2 The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the works and all associated operations on or off site are carried out in conformity with statutory and regulatory environmental requirements including those prescribed elsewhere in these specifications.
- 1.3 The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising from the execution of the Works. This shall wherever possible be achieved by suppression of the nuisance at source rather than abatement of the nuisance once generated.
- 1.4 In the event of any spoil, debris, waste or any deleterious substance from the site being deposited on any adjacent land, the Contractor shall immediately remove all such material and restore the affected area to its original state to the satisfaction of the Engineer.

2 WATER QUALITY

- 2.1 The Contractor shall prevent any interference with the supply to or abstraction from, and prevent any pollution of, water resources (including underground percolating water) as a result of the execution of the Works.
- 2.2 Areas where water is regularly or repetitively used for dust suppression purposes shall be laid to fall to specially-constructed settlement tanks to permit sedimentation of particulate matter. After settlement, the water may be reused for dust suppression and rinsing.
- 2.3 All water and other liquid waste products arising on the site shall be collected and disposed of at a location on or off the site and in a manner that shall not cause nuisance or pollution.
- 2.4 The Contractor shall not discharge or deposit any matter arising from the execution of the Works into any waters except with the permission of the Engineer and the regulatory authorities concerned.
- 2.5 The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to, the site are kept safe and free from any debris and any materials arising from the Works.

- 2.6 The Contractor shall protect all watercourses, waterways, ditches, canals, drains, lakes and the like from pollution as a result of the execution of the Works.

3**AIR QUALITY**

- 3.1 The Contractor shall devise and arrange methods of working to minimize dust, gaseous or other air-borne emissions and carry out the Works in such a manner as to minimize adverse impacts on air quality.
- 3.2 The Contractor shall utilize effective water sprays during delivery, manufacture, processing and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather. Stockpiles of friable materials shall be covered with clean tarpaulins, with application of sprayed water during dry and windy weather. Stockpiles of material or debris shall be dampened prior to their movement, except where this is contrary to the Specifications.
- 3.3 Any vehicle with an open load-carrying area used for transporting potentially dust producing material shall have properly fitting side and tail boards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards, and shall be covered with a clean tarpaulin in good condition. The tarpaulin shall be properly secured and extended at least 300 mm over the edges of the side and tail boards.
- 3.4 In the event that the Contractor is permitted to use gravel or earth roads for haulage, he shall provide suitable measures for dust palliation, if these are, in the opinion of the Engineer, necessary. Such measures may include sprinkling water on the road surface at regular intervals.

4**NOISE**

- 4.1 The Contractor shall consider noise abatement measures in his planning and execution of the Works.
- 4.2 The Contractor shall take all necessary measures so that the operation of all mechanical equipment and construction processes on and off the site shall not cause any unnecessary or excessive noise, taking into account applicable environmental requirements. The Contractor shall use all necessary measures and shall maintain all plant and silencing equipment in good condition so as to minimize the noise emission during construction works.

5 CONTROL OF WASTES

5.1 The Contractor shall control the disposal of all forms of waste generated by the construction operations and in all associated activities. No uncontrolled deposition or dumping shall be permitted. Wastes to be so controlled shall include, but shall not be limited to, all forms of fuel and engine oils, all types of bitumen, cement, surplus aggregates, gravels, bituminous mixes etc. The Contractor shall make specific provision for the proper disposal of these and any other waste products, conforming to local regulations and acceptable to the Engineer.

6 EMERGENCY RESPONSE

6.1 The Contractor shall plan and provide for remedial measures to be implemented in the event of occurrence of emergencies such as spillages of oil or bitumen or chemicals.

6.2 The Contractor shall provide the Engineer with a statement of the measures he intends to implement in the event of such an emergency, which shall include a statement of how he intends to provide personnel adequately trained to implement such measures.

7. MEASUREMENT

7.1 No separate measurement shall be made in respect of compliance by the Contractor with these provisions. The Contractor shall be deemed to have made allowance for such compliance with these provisions in the preparation of his prices for items of work included in the Bill of Quantities and full compensation for such compliance will be deemed to be covered by them.

502 PRIME COAT OVER GRANULAR BASE**502.1 Scope**

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix. The work shall be carried out on a previously prepared granular/ stabilized surface to Clause 501.8.

502.2 Materials

502.2.1 The primer shall be cationic bitumen emulsion SS1 grade conforming to IS:8887 or medium curing cutback bitumen conforming to IS:217 or as specified in the Contract.

502.2.2 Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as given in Table 500-3.

Table 500-3 : Quantity of Bitumen Emulsion for Various Types of Granular Surfaces

Type of Surface	Rate of Spray (kg/sq.m)
WMM/WBM	0.7–1.0
Stabilized soil bases/Crusher Run Macadam	0.9–1.2

502.2.3 Cutback for primer shall not be prepared at the site. Type and quantity of cutback bitumen for various types of granular surface shall be as given in Table 500-4.

Table 500-4 : Type and Quantity of Cutback Bitumen for Various Types of Granular Surface

Type of Surface	Type of Cutback	Rate of Spray (kg/sq.m)
WMM/WBM	MC 30	0.6–0.9
Stabilized soil bases/ Crusher Run Macadam	MC 70	0.9–1.2

502.2.4 The correct quantity of primer shall be decided by the Engineer and shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm.

502.3 Weather and Seasonal Limitations

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Cutback bitumen as primer shall not

be applied to a wet surface. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

502.4 Construction

502.4.1 Equipment

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

502.4.2 Preparation of Road Surface

The granular surface to be primed shall be swept clean by power brooms or mechanical sweepers and made free from dust. All loose material and other foreign material shall be removed completely. If soil/ moorum binder has been used in the WBM surface, part of this should be brushed and removed to a depth of about 2 mm so as to achieve good penetration.

502.4.3 Application of Bituminous Primer

After preparation of the road surface as per Clause 502.4.2, the primer shall be sprayed uniformly at the specified rate. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

No heating or dilution of SS1 bitumen emulsion and shall be permitted at site. Temperature of cutback bitumen shall be high enough to permit the primer to be sprayed effectively through the jets of the spray and to cover the surface uniformly.

502.4.4 Curing of Primer and Opening to Traffic

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course.

502.5 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

502.6 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

502.7 Measurement for Payment

Prime coat shall be measured in terms of surface area of application in square metres.

502.8 Rate

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v) and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of quantity at 0.6 kg per square metre or at the rate specified in the Contract, with adjustment, plus or minus, for the variation between this quantity and the actual quantity approved by the Engineer after the preliminary trials referred to in Clause 502.4.3.

503 TACK COAT**503.1 Scope**

The work shall consist of the application of a single coat of low viscosity liquid bituminous material to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or as instructed by the Engineer. The work shall be carried out on a previously prepared surface in accordance with Clause 501.8.

503.2 Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS 1) complying with IS:8887 or suitable low viscosity paving bitumen of VG 10 grade conforming to IS:73. The use of cutback bitumen RC:70 as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer. The type and grade of binder for tack coat shall be as specified in the Contract or as directed by the Engineer.

503.3 Weather and Seasonal Limitations

Bituminous material shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Where the tack coat

consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cutback bitumen, the surface shall be dry.

503.4 Construction

503.4.1 Equipment

The tack coat shall be applied by a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying shall not be permitted except in small areas, inaccessible to the distributor, or narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

503.4.2 Preparation of Base

The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clauses 501.8. The granular or stabilized surfaces shall be primed as per Clause 502. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

503.4.3 Application of Tack Coat

The application of tack coat shall be at the rate specified in Table 500-5, and it shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract, then it shall be the rate specified in Table 500-5. No dilution or heating at site of RS1 bitumen emulsion shall be permitted. Paving bitumen if used for tack coat shall be heated to appropriate temperature in bitumen boilers to achieve viscosity less than 2 poise. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C and for cutback, 50°C to 80°C. The method of application of tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed or forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Table 500-5 : Rate of Application of Tack Coat

Type of Surface	Rate of Spray of Binder in Kg per sq. m
Bituminous surfaces	0.20 – 0.30
Granular surfaces treated with primer	0.25 – 0.30
Cement concrete pavement	0.30 – 0.35

503.4.4 Curing of Tack Coat

The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

503.5 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

503.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

503.7 Measurement for Payment

Tack coat shall be measured in terms of surface area of application in square metres.

503.8 Rate

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for all components listed in Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications. The rate shall cover the provision of tack coat, at 0.2 kg per square metre or at the rate specified in the Contract, with the provision that the variation between this quantity and actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

504 BITUMINOUS MACADAM**504.1 Scope**

This work shall consist of construction in a single course having 50 mm to 100 mm thickness or in multiple courses of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Since the bituminous macadam is an open-graded mix, there is a potential that it may trap water or moisture vapour within the pavement system. Therefore, adjacent layer (shoulders) should have proper drainage quality to prevent moisture-induced damage to the BM.

504.2 Materials**504.2.1 Bitumen**

The bitumen shall be viscosity graded paving bitumen complying with Indian Standard Specification for paving bitumen, IS:73 or as specified in the Contract. The type and grade of

bitumen to be used would depend upon the climatic conditions and the traffic. Guidelines for selection of bitumen are given in Table 500-1.

504.2.2 Coarse Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. It shall be clean, hard, durable and cubical shape, free from dust and soft organic and other deleterious substances. The aggregate shall satisfy the physical requirements specified in Table 500-6. Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on 4.75 mm sieve shall have at least two fractured faces resulting from crushing operation. Before approval of the source, the aggregates shall be tested for stripping. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment.

504.2.3 Fine Aggregates

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of two, passing 2.36 mm sieve and retained on 75 micron sieve. It shall be clean, hard, durable, free from dust and soft organic and other deleterious substances. Natural sand shall not be used in the binder course.

Table 500-6 : Physical Properties of Coarse Aggregate

Property	Test	Requirement	Test method
Cleanliness	Grain size analysis	Max. 5% passing 0.075 micron	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max. 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or	Max. 40%	IS:2386 Part IV
	Aggregate Impact Value	Max. 30%	IS:2386 Part IV
Durability	Soundness (Sodium or Magnesium)	5 cycles	
	Sodium Sulphate	Max. 12%	IS:2386 Part V
	Magnesium Sulphate	Max. 18%	IS:2386 Part V
Water absorption	Water absorption	Max. 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate	Min. Retained Coating 95%	IS:6241
Water sensitivity	Retained Tensile strength*	Min. 80%	AASHTO 283

* If the minimum retained tensile strength falls below 80 percent, use of anti stripping agent is recommended to meet the minimum requirements.

504.2.4 Aggregate Grading and Binder Content

The combined grading of the coarse aggregates and fine aggregates, when tested in accordance with IS:2386 Part 1, wet sieving method, shall conform to limits given in Table 500-8. The type and quantity of bitumen and appropriate thickness is also given in Table 500-7.

504.2.5 Proportioning of Material

The combined aggregate grading shall not vary from the lower limit on one sieve to the higher limit on the adjacent sieve to avoid gap grading. The aggregate may be proportioned and blended to produce a uniform mix complying with the requirements in Table 500-7. The binder content shall be within a tolerance of ± 0.3 percent by weight of total mix when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

504.3 Construction Operation**504.3.1 Weather and Seasonal Limitations**

The provisions of Clause 501.5.1 shall apply.

Table 500-7 : Aggregate Grading and Bitumen Content

Grading	1	2
Nominal maximum aggregate size*	40 mm	19 mm
Layer thickness	80 -100 mm	50 -75 mm
IS Sieve size (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	90-100	
26.5	75-100	100
19	–	90 – 100
13.2	35-61	56 – 88
4.75	13 – 22	16 – 36
2.36	4 – 19	4 – 19
0.3	2 – 10	2 – 10
0.075	0 – 8	0 – 8
Bitumen content ** percent by mass of total mix	3.3**	3.4**

* Nominal maximum aggregate size is the largest specified sieve size upon which any of the aggregate material is retained.

** Corresponds to specific gravity of the Aggregate being 2.7. In case aggregates have specific gravity more than 2.7, bitumen content can be reduced proportionately. Further, for regions where highest daily mean air temperature is 30°C or lower and lowest daily mean air temperature is -10°C or lower, the bitumen content may be increased by 0.5 percent.

504.3.2 Preparation of the Base

The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clauses 501.8 and 902.3 as appropriate, and a prime coat, shall be applied in accordance with Clause 502 where specified, or as directed by the Engineer. The surface shall be thoroughly swept clean by a mechanical broom, and the dust removed by compressed air. In locations where mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer.

504.3.3 Tack Coat

A tack coat in accordance with Clause 503 shall be applied as required under the Contract or as directed by the Engineer.

504.3.4 Preparation and Transportation of the Mix

The provisions of Clauses 501.3 and 501.4 shall apply.

504.3.5 Spreading

The provisions of Clause 501.5.3 shall apply.

504.3.6 Rolling

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7.

Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause 903.

504.4 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902. For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

504.5 Protection of the Layer

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, by the Contractor the course shall be covered by a seal coat to the requirement of Clause 512 before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

504.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

504.7 Measurement for Payment

Bituminous macadam shall be measured as finished work in cubic metres, or by weight in metric tonnes, where used as regulating course, or square metres at the specified thickness as indicated in the Contract or shown on the drawings, or as otherwise directed by the Engineer.

504.8 Rate

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include cost for all components listed in Clause 501.8.8.2.

505 DENSE BITUMINOUS MACADAM**505.1 Scope**

The specification describes the design and construction procedure for Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. The work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 100 mm.

505.2 Materials**505.2.1 Bitumen**

The bitumen shall be viscosity grade paving bitumen complying with the Indian Standard Specification IS:73, modified bitumen complying with Clause 501.2.1 or as otherwise specified in the Contract.

The type and grade of bitumen to be used shall be specified in the Contract.

505.2.2 Coarse Aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates has poor affinity for bitumen, the Contractor shall produce test results that with the use of anti-stripping agents, the stripping value is improved to satisfy the specification requirements. The Engineer may approve such a source and as a condition for the approval of that source, the bitumen shall be treated with an approved anti-stripping agent, as per the manufacturer's recommendations, at the cost of the Contractor. The aggregates shall satisfy the requirements specified in Table 500-8.

Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

505.2.3 Fine Aggregates

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36 mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However, natural sand upto 50 percent of the fine aggregate may be allowed in base courses. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part 37). The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS:2720 (Part 5).

505.2.4 Filler

Filter shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The filler shall be graded within the limits indicated in Table 500-9.

The filler shall be free from organic impurities and have a plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-8, then 2 percent by total weight of aggregate, of hydrated lime shall be used and percentage of fine aggregate reduced accordingly.

505.2.5 Aggregate Grading and Binder Content

505.2.5.1 When tested in accordance with IS:2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and filler for the particular mixture shall fall within the limits given in Table 500-10 for grading 1 or 2 as specified in the Contract. To avoid gap grading, the combined aggregate gradation shall not vary from the lower limit on one sieve to higher limit on the adjacent sieve.

Table 500-8 : Physical Requirements for Coarse Aggregate for Dense Bituminous Macadam

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices*	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness either :Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386 Part V
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength**	Min. 80%	AASHTO 283

* To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

** If the minimum retained tensile test strength falls below 80 percent, use of anti stripping agent is recommended to meet the requirement.

Table 500-9 : Grading Requirements for Mineral Filler

IS sieve (mm)	Cumulative Percent Passing by Weight of Total Aggregate
0.6	100
0.3	95 – 100
0.075	85 – 100

Table 500-10 : Composition of Dense Graded Bituminous Macadam

Grading	1	2
Nominal aggregate size*	37.5 mm	26.5 mm
Layer thickness	75 – 100 mm	50 – 75 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95 – 100	100
26.5	63-93	90-100
19	–	71-95
13.2	55-75	56-80
9.5	–	–
4.75	38-54	38-54
2.36	28-42	28-42
1.18	–	–
0.6	–	–
0.3	7 – 21	7 – 21
0.15	–	–
0.075	2 – 8	2-8
Bitumen content % by mass of total mix	Min 4.0**	Min 4.5**

* The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained.

** Corresponds to specific gravity of aggregates being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is – 10°C or lower, the bitumen content may be increased by 0.5 percent.

505.2.5.2 Bitumen content indicated in Table 500-10 is the minimum quantity. The quantity shall be determined in accordance with Clause 505.3.

505.3 Mix Design

The bitumen content required shall be determined following the Marshall mix design procedure contained in Asphalt Institute Manual MS-2.

The Fines to Bitumen (F/B) ratio by weight of total mix shall range from 0.6 to 1.2.

505.3.1 Requirements for the Mix

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-11.

Table 500-11 : Requirements for Dense Graded Bituminous Macadam

Properties	Viscosity Grade Paving Bitumen	Modified bitumen		Test Method
		Hot climate	Cold climate	
Compaction level	75 blows on each face of the specimen			
Minimum stability (kN at 600C)	9.0	12.0	10.0	AASHTO T245
Marshall flow (mm)	2 – 4	2.5 – 4	3.5 – 5	AASHTO T245
Marshall Quotient $\left(\frac{\text{Stability}}{\text{Flow}}\right)$	2 – 5	2.5 – 5		MS-2 and ASTM D2041
% air voids	3 – 5			
% Voids Filled with Bitumen (VFB)	65 – 75			
Coating of aggregate particle	95% minimum			IS:6241
Tensile Strength ratio	80% Minimum			AASHTO T 283
% Voids in Mineral Aggregate (VMA)	Minimum percent voids in mineral aggregate (VMA) are set out in Table 500-13			

505.3.2 Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in Table 500-11. The binder content shall be selected to obtain 4 percent air voids in the mix design. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2.

Where maximum size of the aggregate is more than 26.5 mm, the modified Marshall method using 150 mm diameter specimen described in MS-2 and ASTM D 5581 shall be used. This method requires modified equipment and procedures. When the modified Marshall test is used, the specified minimum stability values in Table 500-12 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

Table 500-12 : Minimum Percent Voids In Mineral Aggregate (VMA)

Nominal Maximum Particle Size ¹ (mm)	Minimum VMA Percent Related to Design Percentage Air voids		
	3.0	4.0	5.0
26.5	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Note : Interpolate minimum voids in the mineral aggregate (VMA) for designed percentage air voids values between those listed.

505.3.3 Job Mix Formula

The Contractor shall submit to the Engineer for approval at least 21 days before the start the work, the job mix formula proposed for use in the works, together with the following details:

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows:
 - a) Binder type, and percentage by weight of total mix;
 - b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The individual gradings of the individual aggregate fraction, and the proportion of each in the combined grading;
- v) The results of mix design such as maximum specific gravity of loose mix (Gmm), compacted specimen densities, Marshall stability, flow, air voids, VMA, VFB and related graphs and test results of AASHTO T 283 Moisture susceptibility test;
- vi) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch;
- vii) Test results of physical characteristics of aggregates to be used;
- viii) Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded by the Contractor to the Engineer for approval before the placing of the material.

505.3.4 Plant Trials – Permissible Variation in Job Mix Formula

Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials to establish that the plant can produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 500-13 and shall remain within the gradation band. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

Table 500-13 : Permissible Variations in the Actual Mix from the Job Mix Formula

Description	Base/binder Course
Aggregate passing 19 mm sieve or larger	± 8%
Aggregate passing 13.2 mm, 9.5 mm	± 7%
Aggregate passing 4.75 mm	± 6%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 5%
Aggregate passing 0.3 mm, 0.15 mm	± 4%
Aggregate passing 0.075 mm	± 2%
Binder content	± 0.3%
Mixing temperature	± 10°C

505.3.5 Laying Trials

Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid and compacted all in accordance with Clause 501. The laying trial shall be carried out on a

suitable area which is not to form part of the works. The area of the laying trials shall be a minimum of 100 sq.m of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method. The compacted layers of Dense Graded Bituminous Macadam (DBM) shall have a minimum field density equal to or more than 92% of the density based on theoretical maximum specific gravity (G_{mm}) obtained on the day of compaction in accordance with ASTM D 2041.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

505.4 Construction Operations

505.4.1 Weather and Seasonal Limitations

The provisions of Clause 501.5.1 shall apply.

505.4.2 Preparation of Base

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer.

505.4.3 Geosynthetics

Where Geosynthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

505.4.4 Stress Absorbing Layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

505.4.5 Prime Coat

Where the material on which the dense bituminous macadam is to be laid is other than a

bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of Clause 502, or as directed by the Engineer.

505.4.6 Tack Coat

Where the material on which the dense bituminous macadam is to be laid is either bitumen bound layer or primed granular layer, tack coat shall be applied, as specified, in accordance with the provisions of Clause 503, or as directed by the Engineer.

505.4.7 Mixing and Transportation of the Mix

The provisions as specified in Clauses 501.3 and 501.4 shall apply. Table 500-2 gives the mixing, laying and rolling temperature for dense mixes using viscosity grade bitumen. In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends upon the type and amount of modifier used and shall be adopted as per the recommendations of the manufacturer. In order to have uniform quality, the plant shall be calibrated from time to time.

505.4.8 Spreading

The provisions of Clauses 501.5.3 and 501.5.4 shall apply.

505.4.9 Rolling

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

505.5 Opening to Traffic

It shall be ensured that the traffic is not allowed without the approval of the Engineer in writing, on the surface until the dense bituminous layer has cooled to the ambient temperature.

505.6 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

505.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

505.8 Measurement for Payment

Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tonnes or by the square metre at a specified thickness as indicated in the Contract drawings, or documents, or as otherwise directed by the Engineer.

505.9 Rate

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out all the required operations as specified and shall include, to all components listed in Clause 501.8.8.2. The rate shall include the provision of bitumen, at 4 percent and 4.5 percent by weight of the total mixture for grading 1 and grading 2 respectively.

The variation in actual percentage of bitumen used shall be assessed and the payment adjusted plus or minus accordingly.

506 SAND ASPHALT BASE COURSE**506.1 Scope**

This work shall consist of a base course composed of a mixture of sand, mineral filler where required and bituminous binder, placed and compacted upon a prepared and accepted sub-base in accordance with these Specifications and the lines, levels, grades, dimensions and cross sections shown on the Drawings or as directed by the Engineer.

Note: Sand Asphalt Base course is used in special situations like quality coarse aggregates not being available within economical leads and/or water needed for conventional base course not being readily available, as in desert areas.

506.2 Materials**506.2.1 Bitumen**

The bitumen shall be paving bitumen of viscosity grade VG 30 or VG 20, as specified in the Contract, conforming to IS:73.

506.2.2 Sand

The sand shall be clean, naturally occurring or blended material free from any deleterious substances, dry and well graded within the limits given in Table 500-14 and with other physical properties conforming to the requirements of this Table.

Table 500-14 : Sand Grading and Physical Requirements

Sieve Size (mm)	Cumulative Percentage by Weight of Total Aggregate Passing
9.5	100
4.75	85 – 100
2.36	80 – 100
1.18	70 – 98
0.60	55 – 95
0.30	30 – 75
0.15	10 – 40
0.075	4 – 10
Plasticity Index (%)	6 max.
Sand equivalent (IS:2720 Part 37)	30 min.
Los Angeles Abrasion Value (IS:2386, Part 4)	40 max.

Note : Maximum thickness for sand asphalt is 80 mm.

506.2.3 Filler

When required, filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement as approved by the Engineer. The filler shall conform to Clause 505.2.4.

506.3 Mix Design

506.3.1 Requirements for the Mix

Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-15.

506.3.2 Binder Content

The binder content shall be optimized to achieve the requirements of the mix set out in Table 500-15. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2.

Table 500-15 : Requirements for Sand Asphalt Base Course

Parameter	Requirement
Minimum stability (kN at 60°C)	2.0
Minimum flow (mm)	2
Compaction level (Number of blows)	2 x 75
Percent air voids	3-5
Percent voids in mineral aggregate (VMA)	16 min.
Percent voids filled with bitumen (VFB)	65-75

506.3.3 Job Mix Formula

The Contractor shall develop the job mix formula proposed for use in the works and submit it to the Engineer for approval together with the following details :

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows where each is applicable:
 - a) Binder, as percentage by weight of total mixture;
 - b) Sand/Mineral filler as percentage by weight of total aggregate including mineral filler;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The results of tests enumerated in Table 500-15 as obtained by the Contractor;
- v) Test results of physical characteristics of aggregates to be used;
- vi) Mixing temperature and compacting temperature.

While working out the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mixture and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which joint samples of all ingredients of the mix shall be furnished by the Contractor as required by the former.

The approved job mix formula shall remain effective unless and until modified by the Engineer. Should a change in the source of materials be proposed, a new job mix formula shall be established by the Contractor and approved by the Engineer before actually using the materials.

506.3.4 Permissible Variation from Job Mix Formula

The Contractor shall produce a uniform mix conforming to the approved job mix formula, subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used, within the limits as specified in Table 500-12, with the condition that the gradation after the variation remains within the gradation envelop. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

506.4 Construction Operations**506.4.1 Weather and Seasonal Limitations**

Clause 501.5.1 shall apply.

506.4.2 Preparation of Base

The surface on which Sand Asphalt Base course Material is to be laid shall be prepared, shaped and graded in the profile required for the particular layer in accordance with Clauses 501 and 902 as appropriate or as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using a mechanical brush, and the dust blown off by compressed air. In confined locations where mechanical plant cannot get access, other methods shall be used as approved by the Engineer. A prime coat, where specified, shall be applied in accordance with Clause 502 or as directed by the Engineer.

506.4.3 Tack Coat

A tack coat over the base shall be applied in accordance with Clause 503, or otherwise as directed by the Engineer.

506.4.4 Preparation and Transportation of the Mixture

The provisions of Clauses 501.3 and 501.4 shall apply.

506.4.5 Spreading

The provisions of Clauses 501.5.2 to 501.5.4 shall apply. Laying must be accomplished at a suitable temperature to ensure proper compaction. Guidance for mixing and compaction temperature for the particular bitumen may be taken from Table 500-3 and shall correspond to a viscosity of 2 Poise (0.2 Pa.s) and 3 poise (0.3 Pa.s) respectively, based on the original (unaged) bitumen properties.

506.4.6 Rolling

Clause 501.6 shall apply. Generally the initial or breakdown rolling shall be done with 8-10 tonne static weight smooth-wheeled rollers. The intermediate rolling shall be done with 8–10 tonne static weight or vibratory rollers or with a pneumatic tyred roller of 12-15 tonne weight having a tyre pressure of at least 0.56 MPa. The finish rolling shall be done with 8–10 tonne deadweight smooth wheeled tandem rollers. The exact pattern of rolling shall be established at the laying trials.

506.5 Opening to Traffic

It shall be ensured that the traffic is not allowed without the express approval of the Engineer in writing, on the surface until the paved mat has cooled below 60°C in its entire depth.

506.6 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902.

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

506.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

506.8 Measurement for Payment

Sand Asphalt Base course materials shall be measured as finished work, for the area covered, in cubic metres, metric tonnes, or in square metres, at a specified thickness, as stated in the Contract.

506.9 Rate

The Contract unit rate for Sand Asphalt Base course materials shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2 (i) to (x). The rate shall cover provision of 5 percent of bitumen by weight of the total mixture.

The variation in the actual percentage of bitumen used will be assessed and the rate, adjusted plus or minus, as applicable.

507 BITUMINOUS CONCRETE**507.1 Scope**

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 30 mm/40 mm/50 mm thick.

507.2 Materials**507.2.1 Bitumen**

The bitumen shall conform to Clause 504.2.1.

507.2.2 Coarse Aggregates

The coarse aggregates shall be generally as specified in Clause 504.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-16 and where crushed gravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

Table 500-16 : Physical Requirements for Coarse Aggregate for Bituminous Concrete

Property	Test	Specification	Method of Test
Cleanliness (dust)	Grain size analysis	Max 5% passing 0.075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35%	IS:2386 Part I
Strength	Los Angeles Abrasion Value or Aggregate Impact Value	Max 30% Max 24%	IS:2386 Part IV
Durability	Soundness either: Sodium Sulphate or Magnesium Sulphate	Max 12% Max 18%	IS:2386 Part V
Polishing	Polished Stone Value	Min 55	BS:812-114
Water Absorption	Water Absorption	Max 2%	IS:2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95%	IS:6241
Water Sensitivity	Retained Tensile Strength*	Min 80%	AASHTO 283

* If the minimum retained tensile test strength falls below 80 percent, use of anti stripping agent is recommended to meet the requirement.

507.2.3 Fine Aggregates

The fine aggregates shall be all as specified in Clause 505.2.3.

507.2.4 Filler

Filler shall be as specified in Clause 505.2.4.

507.2.5 Aggregate Grading and Binder Content

When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and filler shall fall within the limits shown in Table 500-17. The grading shall be as specified in the Contract.

Table 500-17 : Composition of Bituminous Concrete Pavement Layers

Grading	1	2
Nominal aggregate size*	19 mm	13.2 mm
Layer thickness	50 mm	30–40 mm
IS Sieve¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	90-100	100
13.2	59-79	90-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix	Min 5.2*	Min 5.4**

Notes :

- * The nominal maximum particle size is the largest specified sieve size up on which any of the aggregate is retained.
- ** Corresponds to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7, the minimum bitumen content can be reduced proportionately. Further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is – 10°C or lower, the bitumen content may be increased by 0.5 percent

507.3 Mix Design**507.3.1 Requirements for the Mix**

Clause 505.3.1 shall apply.

507.3.2 Binder Content

Clause 505.3.2 shall apply.

507.3.3 Job Mix Formula

Clause 505.3.3 shall apply.

507.3.4 Plant Trials – Permissible Variation in Job Mix Formula

The requirements for plant trials shall be as specified in Clause 505.3.4, and permissible limits for variation as given in Table 500-18.

Table 500-18 : Permissible Variations in Plant Mix from the Job Mix Formula

Description	Permissible Variation
Aggregate passing 19 mm sieve or larger	± 7%
Aggregate passing 13.2 mm, 9.5 mm	± 6%
Aggregate passing 4.75 mm	± 5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 4%
Aggregate passing 0.3 mm, 0.15 mm	± 3%
Aggregate passing 0.075 mm	± 1.5%
Binder content	± 0.3%
Mixing temperature	± 10°C

507.3.5 Laying Trials

The requirements for laying trials shall be as specified in Clause 505.3.5. The compacted layers of bituminous concrete (BC) shall have a minimum field density equal to or more than 92 percent of the average theoretical maximum specific gravity (G_{mm}) obtained on the day of compaction in accordance with ASTM D2041.

507.4 Construction Operations**507.4.1 Weather and Seasonal Limitations**

The provisions of Clause 501.5.1 shall apply.

507.4.2 Preparation of Base

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer.

507.4.3 Geosynthetics

Where Geosynthetics are specified in the Contract, this shall be in accordance with the requirements stated in Clause 703.

507.4.4 Stress Absorbing Layer

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 517.

507.4.5 Tack Coat

The provisions as specified in Clause 504.4.6 shall apply.

507.4.6 Mixing and Transportation of the Mix

The provisions as specified in Clauses 501.3, 501.4 and 504.4.7 shall apply.

507.4.7 Spreading

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

507.4.8 Rolling

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

507.5 Opening to Traffic

Provisions in Clause 504.5 shall apply.

507.6 Surface Finish and Quality Control

The surface finish of the completed construction shall conform to the requirements of

Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of these Specifications.

507.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

507.8 Measurement for Payment

The measurement shall be as specified in **Clause 505.8**.

507.9 Rate

The contract unit rate shall be all as specified in Clause 504.9, except that the rate shall include the provision of bitumen at 5.2 percent & 5.4 percent for grading 1 and grading 2 by weight of total mix respectively. The variation in actual percentage of bitumen used will be assessed and the payment adjusted plus and minus accordingly.

508 CLOSE-GRADED PREMIX SURFACING/MIXED SEAL SURFACING

508.1 Scope

508.1.1 The work shall consist of the preparation, laying and compaction of a close-graded premix surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

508.1.2 Close graded premix surfacing shall be of Type A or Type B as specified in the Contract documents. Type A grading is recommended for use in areas having rainfall more than 150 cm per year. In other areas Type B grading may be used.

508.2 Materials

508.2.1 Binder

The provisions of Clause 510.1.2.1 shall apply.

508.2.2 Coarse Aggregates

The provisions of Clause 511.1.2.2 shall apply.

508.2.3 Fine Aggregates

The fine aggregates shall consist of crushed rock, or natural sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particles, dry; and free from injurious, soft or flaky particles and organic or deleterious substances.

508.2.4 Aggregate Gradation

The coarse and fine aggregates shall be so graded or combined as to conform to one or the other gradings given in Table 500-19, as specified in the contract.

Table 500-19 : Aggregate Gradation

IS Sieve Designation (mm)	Cumulative Percent by Weight of Total Aggregate Passing	
	Type A	Type B
13.2 mm	–	100
11.2 mm	100	88 – 100
5.6 mm	52 – 88	31 – 52
2.8 mm	14 – 38	5 – 25
0.090 mm	0 – 5	0 -5

508.2.5 Proportioning of Materials

The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic metre per square metre area. The quantity of binder used for premixing shall be 22.0 kg and 19.0 kg per 10 square metre area for Type A and Type B surfacing respectively.

508.3 Construction Operations

The provisions of Clause 510.1.3.1 through Clause 510.1.3.5 shall apply.

508.4 Opening to Traffic

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Speed restrictions may be imposed at initial stages.

508.5 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. For control on the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

508.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be in accordance with the provisions of Clause 112.

508.7 Measurement for Payment

Close-graded premix surfacing, Type A or B shall be measured as finished work, for the area specified to be covered, in square metres at a specified thickness. The area will be the net area covered.

508.8 Rate

The contract unit rate for close-graded premix surfacing, Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

509 SURFACE DRESSING**509.1 Scope**

This work shall consist of the application of one coat or two coats of surface dressing, each coat consisting of a layer of bituminous binder sprayed on a previously prepared, base, followed by a cover of stone chips rolled in to form a wearing course to the requirements of these Specifications.

509.2 Materials**509.2.1 Binder**

The binder shall either be bitumen conforming to IS:73 or rapid setting cationic bitumen emulsion (RS-2) conforming to IS:8887. Grade of bitumen shall depend upon the climatic condition. For selection of grade of bitumen guidance may be taken from Table 500-1. The type of binder to be used shall be stated in the Contract, or as directed by the Engineer.

509.2.2 Aggregates

The stone chips (cover aggregate) shall conform to the requirements of Clause 505.2.2., except that their water absorption shall be restricted to a maximum of 1 percent and they shall have a Polished Stone Value of minimum 60. [in BS:812 (Part-114)], of not less than 60. The size of the aggregate shall depend upon the type of surface on which it is laid and the traffic intensity. The chips shall be single sized, clean, hard, durable, of cubical shape; and free from dust and soft or friable matter, organic or other deleterious matter and conform to one of the gradings given in Table 500-21. The size of the aggregate shall depend upon the type of surface on which it is laid and the traffic intensity. Table 500-20 may be used as guidance.

Pre-coated Chips : As an alternative to the use of an adhesion agent or wherever specified in the Contract, the chips may be pre-coated before they are spread except when the sprayed binder film is a bitumen emulsion. Pre-coating the chips may be carried out by mixing aggregates with 0.75 to 1.0 percent of bitumen by weight of chips in a suitable mixer. The chips shall be heated to 160°C and mixed with the binder heated to its application temperature. The pre-coated chips shall be allowed to cure for at least one week or until they become non sticky and can be spread easily.

Table 500-20 : Recommended Nominal Size of Aggregates (mm)

Type of Surface	Traffic Intensity in Terms of Number of Vehicles Per Day in the Lane Under Consideration		
	1000-2000	200-1000	20-200
Very hard	10	6	6
Hard	13	10	6
Normal	13	10	6
Soft	19	13	13
Very soft		19	13

Table 500-21 : Grading requirements for Aggregates used for Surface Dressing

IS Sieve Designation (mm)	Cumulative Percent by Weight of Total Aggregates Passing for the Following Nominal Sizes (mm)			
	19	13	10	6
26.5	100			
19	85-100	100		
13	0-40	85-100	100	
9.5	0-7	0-40	85-100	100
6.3		0-7	0-35	85-100
4.75			0-10	
3.35				0-35
2.36	0-2	0-2	0-2	0-10
0.60				0-2
0.075	0-1.5	0-1.5	0-1.5	0-1.5
Minimum 65% by weight of aggregate	Passing 19 and retained on 13.2	Passing 13.2 and retained on 9.5	Passing 9.5 and retained on 6.3	Passing 6.3 and retained on 3.35

509.2.3 Rates of Spread of Binder and Chips

The rate of spread of binder and chips will depend upon the nominal size of the aggregate and the extent of its embedment into the surface. The rate shall be determined as per the procedure given in Manual for Construction and Supervision of Bituminous Construction. Approximate rate of application of aggregates, and binder under average conditions are given in Table 500-22.

Table 500-22 : Approximate Rate of Application of Binder and Aggregates

Nominal Aggregate Size mm	Binder (Kg/m ²)			Aggregates Cu.m/m ²
	Uncoated Aggregates		Coated Aggregates	
	Bitumen	Emulsion	Bitumen	
19	1.2	1.8	1.0	0.014-0.015
13	1.0	1.5	0.8	0.009-0.011
10	0.9	1.3	0.7	0.007-0.009
6	0.75	1.1	0.6	0.003-0.005

Note : Bitumen for coated aggregates excludes quantity of bitumen required for coating.

509.2.4 Anti-Stripping Agent

Where the proposed aggregate fails to pass the stripping test then an approved anti-stripping agent (Appendix 4 for details) may be added to the binder in accordance with the manufacturer's instructions. The effectiveness of the proposed anti-stripping agent must be demonstrated by the Contractor, before approval by the Engineer.

509.3 Construction Operations**509.3.1 Weather and Seasonal Limitations**

Clause 501.5.1 shall apply.

509.3.2 Preparation of Base

The base on which the surface dressing is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with Clause 501 or as directed by the Engineer. Prime coat, where needed, shall be provided as per Clause 502 or as directed by the Engineer. Where the existing surface shows signs of fattening up, the excess bitumen shall be removed as directed by the Engineer. The bituminous surface to be dressed shall be thoroughly cleaned either by using a mechanical broom and/or compressed air, or any other approved equipment/method as specified in the Contract or directed by the Engineer. The

prepared surface shall be dust free, clean and dry, (except in the case of cationic emulsion where the surface shall be slightly damp).

509.3.3 Application of Binder

After preparation of base, paving grade binder heated to an appropriate temperature or bitumen emulsion shall be sprayed uniformly using mechanical sprayers. During the operation the ratio between truck speed and pump revolution shall be maintained constant with the help of automatic control. When work resumes, the binder shall not be sprayed on the earlier completed surface. This can be done by covering the completed work with bitumen impregnated paper. Excessive deposit of bituminous material shall be immediately removed. The equipment described in IRC:SP:34 with synchronized spraying and compaction shall be preferred for better control and uniformity in construction.

The spraying temperatures for binder are given below:

Binder Grade	Whirling Spray Jets		Slot Jets	
	Min°C	Max°C	Min°C	Max°C
VG 10	180	200	165	175

509.3.4 Application of Stone Chips

Immediately after application of the binder, clean, dry chips (in the case of emulsion the chippings may be slightly damp) shall be spread uniformly by means of a mechanical chip spreader on the surface so as to cover the surface completely with a single layer of chips.

509.3.5 Rolling

Rolling of the chips should preferably be carried out by a pneumatic tyre roller in accordance with Clauses 501.6 and 501.7. Rolling shall commence at the edges and progress towards the centre except in super-elevated and uni-directional cambered portions where it shall proceed from the lower edge to the higher edge. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. While rolling is in progress, additional chips shall be spread by hand in necessary quantities required to make up irregularities. Rolling shall continue until all aggregate particles are firmly embedded in the binder and present a uniform closed surface.

509.3.6 Application of Second Coat of Surface Dressing

Where surface dressing in two coats is specified, the second coat should not be applied until the first coat has been open to traffic for two weeks. The surface on which the second coat is

laid must be clean and free of dust. The construction operations for the second coat shall be the same as described in Clauses 510.3.3 to 510.3.5.

509.4 Opening to Traffic

Traffic shall not be permitted to run on any newly surface dressed area until the following day. In special circumstances, however, the Engineer may allow the road to be opened to traffic immediately after rolling, but in such cases traffic speed shall be limited to 20 km per hour until the following day.

509.5 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902.

For control on the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

509.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

509.7 Measurement for Payment

Each coat of surface dressing shall be measured as finished work for the area instructed to be covered, in square metres.

509.8 Rate

The Contract unit rate for surface dressing, based on the approximate rates of application for binder given in Table 500-22 and each size of chippings given in Clause 509.2.3, shall be adjusted, plus or minus, for the difference between the approximate rate of spread and the rate of spread determined based on design and approved by the Engineer. The adjusted rate shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

510 OPEN-GRADED PREMIX SURFACING

510.1 Open-Graded Premix Surfacing using Viscosity Grade Paving Bitumen

510.1.1 Scope

This work shall consist of preparation, laying and compaction of an open-graded premix surfacing material of 20 mm thickness composed of small-sized aggregate premixed with

bituminous binder on a previously prepared base, in accordance with the requirements of these Specifications to serve as a wearing course.

510.1.2 Materials

510.1.2.1 Binder

The binder shall be viscosity grade bitumen of a suitable grade as specified in the Contract, or as directed by the Engineer, and satisfying the requirements of IS:73. For selection of grade of bitumen guidance may be taken from Table 500-1.

510.1.2.2 Aggregates

The aggregates shall conform to Clause 504.2.2 except that the water absorption shall be limited to a maximum of 1 percent. The Polished Stone Value, shall not be less than 55, when tested as per BS:812-114.

510.1.2.3 Proportioning of Material

The materials shall be proportioned in accordance with Table 500-23.

Table 500-23 : Quantities of Materials Required for 10 m² of Road Surface for 20 mm Thick Open-graded Premix Surfacing

	Materials	Quantity
Aggregates		
a)	Nominal Stone size 13.2 mm (passing 22.4 mm sieve and retained on 11.2 mm sieve)	0.18 m ³
b)	Nominal Stone size 11.2 mm (passing 13.2 mm sieve and retained on 5.6 mm sieve)	0.09 m ³
	Total	0.27 m³
Binder		
a)	For 0.18 m ³ of 13.2 mm nominal size stone of 52 kg bitumen per m ³	9.5 kg
b)	For 0.09 m ³ of 11.2 mm nominal size stone of 56 kg bitumen per m ³	5.1 kg
	Total	14.6 kg

510.1.3 Construction Operations**510.1.3.1 Weather and Seasonal Limitations**

Clause 501.5.1 shall apply.

510.1.3.2 Preparation of Surface

The underlying surface on which the bituminous surfacing is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross-section in accordance with Clause 501. A prime coat where needed shall be applied in accordance with Clause 502 as directed by the Engineer.

510.1.3.3 Tack Coat

A tack coat complying with Clause 503, shall be applied over the base preparatory to laying of the surfacing.

510.1.3.4 Preparation of Premix

Hot mix plant of appropriate capacity and type shall be used for the preparation of the mix material. The hot mix plant shall have separate dryer arrangement for heating aggregate.

The temperature of the binder and aggregate at the time of mixing, laying and compaction shall be in conformity with the temperature given in Table 500-3. The difference in temperature between the binder and aggregate shall at no time exceed 14°C. Mixing shall be thorough to ensure that a homogeneous mix is obtained in which all particles of the aggregates are coated uniformly.

The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or hand barrows. The vehicles employed for transport shall be clean and the mix being transported covered in transit if so directed by the Engineer.

510.1.3.5 Spreading and Rolling

The pre mixed material shall be spread on a previously prepared base to Clause 501 by a paver unless specified otherwise in the Contract to the desired thickness, grades and crossfall (camber). The cross-fall should be checked by means of camber boards and irregularities levelled out. Excessive use of blades or rakes should be avoided. As soon as sufficient length of bituminous material has been laid, rolling shall commence with 8–10 tonne rollers, smooth wheel tandem type or other approved equipment. Rolling shall begin at the edge and progress towards the centre longitudinally, except that on superelevated and uni-directional cambered portions, it shall progress from the lower to upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions, which become apparent, shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled and all the roller marks eliminated. In each pass of the roller the preceding track shall be overlapped uniformly by at least one-third width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels. In no case shall fuel/lubricating oil be used for this purpose. Excess use of water for this purpose shall also be avoided.

Rollers shall not stand on newly laid material. Rolling operations shall be completed in every respect before the temperature of the mix falls below the rolling temperature indicated in Table 500-3.

510.1.3.6 Seal Coat

A seal coat conforming to Clause 511 of the type specified in the Contract shall be applied to the surface immediately after laying the surfacing.

510.1.4 Opening to Traffic

No traffic shall be allowed on the road until the seal coat has been laid. After the seal coat is laid, the road may be opened to traffic according to Clause 511.4.

510.1.5 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

510.1.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

510.1.7 Measurement for Payment

Open graded premix surfacing shall be measured as finished work, for the area instructed to be covered, in square metres.

510.1.8 Rate

The contract unit rate for open-graded premix surfacing shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

510.2 Open Graded Premix Surfacing Using Cationic Bitumen Emulsion**510.2.1 Scope**

This work shall consist of the preparation, laying and compaction of an open graded premix surfacing of 20 mm thickness composed of small-sized aggregate premixed with a cationic bitumen emulsion on a previously prepared surface, in accordance with the requirements of these Specifications to serve as a wearing course.

510.2.2 Materials**510.2.2.1 Binder**

The binder for Premix wearing course shall be Cationic Bitumen emulsion of Medium Setting (MS) grade complying with IS:8887 or as specified in the Contract.

510.2.2.2 Aggregate

The requirements of Clause 511.1.2.2 shall apply.

510.2.3 Proportioning of Materials

The materials shall be proportioned as per quantities given in Tables 500-24.

Table 500-24 : Quantities of Aggregate for 10 m² Area

Aggregates		
a)	Coarse aggregate nominal 13.2 mm size, passing IS 22.4 mm sieve and retained on IS 11.2 mm sieve	0.18 m ³
b)	Coarse aggregate nominal 11.2 mm size; passing IS 13.2 mm sieve and retained on IS 5.6 mm sieve	0.09 m ³
	Binder	20 to 23 kg

510.2.4 Construction Operations**510.2.4.1 Weather and Seasonal Limitations**

Clause 501.5.1 shall apply except that the minimum air temperature for laying shall be 10°C. Cationic bitumen emulsions shall not normally be stored below 0°C.

510.2.4.2 Preparation of Surface

The underlying surface on which the premix surfacing is to be laid shall be prepared, in accordance with the requirements of Clause 504.3.2 for a newly primed surface, and in accordance with Clause 505.4.2 where an existing bituminous surface is to be overlaid.

510.2.4.3 Preparation of Binder

Before opening, the cationic bitumen emulsion drums shall be rolled at a slow speed, to and fro at least 5 times, for a distance of about 10 metres, to distribute any storage sedimentation.

510.2.4.4 Tack Coat

A tack coat complying with Clause 503, shall be applied over the surface preparatory to laying of the surfacing where specified in the Contract, as directed by the Engineer.

510.2.4.5 Preparation of Premix

Premixing of cationic bitumen emulsion and aggregates can be carried out in a suitable mixer such as cold mixing plant as per IS:5435 (Revised) or concrete mixer or by pay loaders in exceptional cases where approved by the Engineer. Where specified in the Contract, continuous mixing operation shall be done either in batch or continuous hot mix plant suitable for emulsion mixes.

When using concrete mixer for preparing the premix, 0.135 cu.m (0.09 cu.m of 13.2 mm size and 0.045 cu.m of 11.2 mm size) of aggregates per batch shall be used. This quantity will be for 5 sq.m of road surface with 20 mm average thickness.

The aggregates required for one batch shall be prepared adjacent to the mixer.

The coarse aggregate of 13.2 mm size shall be placed into the mixer followed by 5 to 6.5 kg of Cationic bitumen emulsion and then the 11.2 mm size aggregate shall be added, followed by 5 to 6.5 kg of Cationic bitumen emulsion. After the materials have been mixed thoroughly, the mix shall be immediately transported to the laying site in suitable vehicles. Too much mixing shall be avoided.

510.2.4.6 Spreading and Rolling

The premixed cationic bitumen emulsion and aggregates shall be spread uniformly by a paver within 10 minutes of applying the tack coat. All levelling, raking etc. should be completed within 20 minutes of the time of mixing.

The mix shall be spread uniformly to the desired thickness, grades and crossfall (camber). The crossfall shall be checked by means of camber boards and irregularities levelled out. Too much raking is to be avoided.

The rolling shall start immediately after laying the premix. A smooth wheeled tandem roller of 8-10 tonnes shall be used, unless other compaction methods are approved by the Engineer, based on the results of laying trials, if necessary. While rolling, wheels of roller should be clean and kept moist to prevent the premix from adhering to the wheels. In no case shall fuel/lubricating oil be used for this purpose. Use of water for this purpose shall be strictly limited to an absolute minimum.

Rolling shall commence at the edges and progress towards the centre longitudinally except in the case of superelevated and uni-directionally cambered sections where rolling shall be carried out from the lower edge towards the higher edge parallel to the centre line of the road.

After one pass of roller over the whole area, depressions or uncovered spots should be corrected by adding premix material. Rolling shall be continued until the entire surface has been rolled, to maximum compaction and all the roller marks eliminated. In each pass of the roller, the preceding track shall be overlapped uniformly by at least one-third width. Roller(s) shall not stand on newly laid material. Joints, both longitudinal and transverse to the road sections laid and compacted earlier, shall be cut vertically to their full depth so as to expose fresh surface which shall be painted with a thin coat of binder before the new mix is laid.

510.2.5 Seal Coat

A seal coat, conforming to Clause 511, as specified in the Contract, shall be applied immediately after laying the premix carpet.

510.2.6 Opening to Traffic

Traffic should not be allowed over the premix surface till seal coat is laid. After the seal coat is laid, traffic may be allowed in accordance with Clause 511.4.

510.2.7 Surface Finish and Quality Control

The surface finish of construction shall conform to the requirements of Clause 902. For control of the quality of materials and work carried out, relevant provision of Section 900 shall apply.

510.2.8 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

510.2.9 Measurement for Payment

Open graded premix surfacing shall be measured as finished work, for the area instructed to be covered, in square metres. All allowances for wastage in cutting of joints shall be deemed to be included in the rate.

510.2.10 Rate

The contract unit rate for premix carpet shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

511 SEAL COAT**511.1 Scope**

This work shall consist of the application of a seal coat for sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall (camber).

Seal coat shall be of either of the two types specified below:

- A) Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chips.
- B) Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

511.2 Materials**511.2.1 Binder**

The requirements of Clauses 510.1.2.1 and 510.2.2.1 shall apply.

The quantity of bitumen per 10 square metres, shall be 9.8 kg for Type A, and 6.8 kg for Type B seal coat. Where bituminous emulsion is used as a binder, the quantities for Type A and Type B seal coats shall be 15 kg and 10.5 kg respectively.

511.2.2 Stone Chips for Type A Seal Coat

The stone chips shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of soft or disintegrated stone, organic or other deleterious matter. Stone chips shall be of 6.7 mm size defined as 100 percent passing through 11.2 mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 0.09 cubic metre per 10 square metre area. The chips shall satisfy the quality requirements

given in Table 500-8 except that the upper limit for water absorption value shall be 1 percent.

511.2.3 Aggregate for Type B Seal Coat

The aggregate shall be sand or grit and shall consist of clean, hard, durable, uncoated dry particles, and shall be free from dust, soft or flaky/elongated material, organic matter or other deleterious substances. The aggregate shall pass 2.36 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cum per 10 sqm area.

511.3 Construction Operations

511.3.1 Weather and Seasonal Limitations

The requirements of Clause 501.5.1 shall apply.

511.3.2 Preparation of Surface

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat materials, the surface shall be cleaned free of any dust or other extraneous matter.

511.3.3 Construction of Type A Seal Coat

The construction operations shall be the same as described in Clause 509.3.3 to 509.3.5.

511.3.4 Construction Type B Seal Coat

511.3.4.1 Using Paving Bitumen

The construction operations shall be the same as in Clause 510.1.3.

511.3.4.2 Using Emulsion

The construction operations shall be the same as in Clause 510.2.4.

511.4 Opening to Traffic

In the case of Type B seal coat, traffic may be allowed soon after final rolling when the premixed material has cooled down to the surrounding temperature. In the case of Type A seal coat, traffic shall not be permitted to run on any newly sealed area until the following day.

In special circumstances, however, the Engineer may open the road to traffic immediately after rolling, but in such cases traffic shall be rigorously limited to 20 km per hour until the following day.

511.5 Surface Finish and Quality Control Work

The surface of construction shall conform to the requirements of Clause 902.

For control on the quality of materials and the works carried out, the relevant provisions of **Section 900** shall apply.

511.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

511.7 Measurement for Payment

Seal coat, Type A or B shall be measured as finished work, over the area specified to be covered, in square metres at the thickness specified in the Contract.

511.8 Rate

The contract unit rate for seal coat Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

512 SLURRY SEAL

512.1 Scope

The work consists of design and laying a mixture of mineral aggregate, slow setting cationic bitumen emulsion, water and additives, if needed, proportioned, mixed and uniformly spread over a previously prepared surface. The finally laid slurry seal shall have a homogenous mat, adhere firmly to the prepared surface and provide friction resistant surface texture throughout its surface life.

512.2 Type of Slurry Seals and Applications

Different types of slurry seal and their applications are given in Table 500-25. The type and application of the slurry seal shall be specified in the Contract.

Table 500-25 : Different Types of Slurry Seals

Items	Type I (2 – 3 mm)	Type II (4 – 6 mm)	Type III (6-8 mm)**
Application	Filling of hair cracks	Filling of surface cracks 1- 3 mm and preventive/ renewal treatment (upto 450 CVPD)***	Filling of surface cracks 3-6 mm and preventive/renewal treatment (upto 1500 CVPD)***
Quantity* of slurry (kg/m ²)	4.3 to 6.5	8.4 to 9.8	10.1 to 12
Residual binder (% by weight of dry aggregate)	10 to 16	7.5 to 13.5	6.5 to 12

* In terms by weight of dry aggregate

** Indicative only

*** CVPD : Commercial Vehicles per day

512.3 Materials

The materials for slurry seal shall conform to the following requirements.

512.3.1 Bitumen Emulsion

The bitumen emulsion shall be a cationic slow setting type SS 2, conforming to the requirements of IS:8887.

512.3.2 Aggregates

The mineral aggregates shall be crushed stone dust, clean, sharp, hard, durable and uncoated dry particles and shall be free from soft pieces and organic and other deleterious substances. The aggregate shall satisfy the requirement given in Table 500-26. The target grading shall conform to one of the three types given in Table 500-27.

Table 500-26 : Properties of Aggregates

Properties	Test Method	Specification
Sand Equivalent Value	IS:2720 (Part 37)	Min 50 percent
Water absorption*	IS:2386 (Part 3)	Max 2 percent
Soundness with- Sodium sulphate Magnesium sulphate	IS:2386 (Part 5)	Max 12 percent Max 18 percent

* In case water absorption exceeds 2% but is less than 4%, same may be permitted subject to conformity of soundness test and wet stripping test

Table 500-27 : Aggregate Grading

Sieve Size (mm)	Percentage by Mass Passing (Minimum Layer Thickness)		
	Type I (2-3 mm)	Type II (4-6 mm)	Type III (6-8 mm)
9.5	–	–	100
6.3	–	100	90–100
4.75	100	90–100	70–90
2.36	90–100	65–90	45–70
1.18	65–90	45–70	28–50
0.600	40–65	30–50	19–34
0.300	25–42	18–30	12–25
0.150	15–30	10–21	7-18
0.075	10–20	5–15	5–15

Tolerances : Percent passing each sieve shall not vary by more than the tolerance limit indicated in Table 500-28 and shall remain within the gradation band.

Table 500-28 : Tolerances for Slurry Seal

Description	Tolerance
Aggregate passing 4.75 mm	±5%
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	±5%
Aggregate passing 0.3 mm	±4%
Aggregate passing 0.15 mm	±3%
Aggregate passing 0.075 mm	±2%

If more than one nominal size aggregate is used to produce the required grading, the correct amount of each type of aggregate used shall be proportioned separately to meet the requirements of grading as per Table 500-27, prior to adding other materials in the mixture. After target gradation has been submitted, the percent passing each sieve shall not vary by more than the tolerance limits given in Table 500-29, and shall remain within the gradation band. The aggregate will be acceptable based on average of five gradation tests at the job location.

512.3.3 Filler

Mineral filler shall be Ordinary Portland Cement. The quantity of filler shall be in the range of 0.5 to 2 percent by weight of dry aggregate.

512.3.4 Water

Water shall be potable, free from harmful salt and contaminants. The pH of the water shall be in the range of 6 to 7.

512.3.5 Additives

Chemical additives may be used to accelerate or retard the break-set time of the slurry or to improve the resulting surface finish. The quantity of additive, if used, shall be decided by mix design and to be adjusted as per the site/climate conditions. The specifications for additive shall be supplied by the supplier of the emulsion. The additive and emulsion shall be compatible with each other.

512.4 Mix Design

The compatibility of aggregate, emulsion, filler and additive(if needed) shall be verified by mix design for a selected type and grading of aggregate as specified in Tables 500-27 and 500-28. the design criteria for slurry seal mixture is specified in Table 500-29. The proposed slurry seal mix shall conform to the specified requirements, when tested in accordance with tests specified in Table 500-30. The mix design report shall clearly show the proportions of aggregate, filler, water and residual bitumen content based on the dry weight of the aggregates, additive usage (if any).

Table 500-29 : Mix Design Criteria for Slurry Seal Mix

Requirement	Specifications	Test Method
Mix Time, minimum	180 seconds	Appendix 1 IRC:SP:81
Consistency, maximum	3 cm	Appendix 3 IRC:SP:81
Wet cohesion, pass % minimum	20 kg.cm	Appendix 4 IRC:SP:81
Wet striping, Pass %, minimum	90	Appendix 5 IRC:SP:81
Wet Track abrasion loss, (one hour soak), maximum	800 g/m ²	Appendix 6 IRC:SP:81

Aggregate, bitumen emulsion, water and additive including set control additive (if needed), shall be proportioned by weight utilizing the mix design approved by the Engineer. The final mixture, after addition of water and additive (if used) shall be such that the slurry seal mixture has proper workability and permit traffic within four hours (without leading to ravelling after placement). Trial mix shall be prepared and laid at site for the designed mix and observed for breaking and setting time. Indicative limits of various ingredients for job mix of slurry seal shall be as given in Table 500-30.

Table 500-30 : Indicative Quantity of Ingredients

Ingredients	Limits (Percent by Weight of Dry Aggregates)
Cationic Bitumen Emulsion	10 to 16 for type I 7.5 to 13.5 for Type II 6.5 to 12 for Type III
Water	6 to 12
Filler	1.0 to 2.0
Additive	0.5 to 2.0

512.5 Construction**512.5.1 Weather and Seasonal Limitations**

Laying of slurry seal shall not be undertaken, if either the pavement temperature or air temperature is below 10°C. However during a dry spell, slurry seal may be laid in rainy season also, even if the surface is wet but there is no stagnant water on the pavement surface.

512.5.2 Surface Preparation

The underlying surface on which the slurry seal is to be applied shall be cleaned of all loose material, mud spots, vegetation and extraneous matter and shall be prepared and shaped to the needed profile. It is essential to pre-treat cracks on the pavement surface with an appropriate crack sealing material prior to application of slurry seal, if it is used for preventive/renewal treatment. The surface should be swept clean by removing caked earth and other foreign matter with wire brushes, sweeping with mechanical brooms and finally dusting with air jet or other means approved by the Engineer

512.5.3 Application of Tack Coat

Tack coat is not required normally for flexible pavements, unless surface is extremely hungry and dry. In case it is needed, Clause 503 shall apply.

512.5.4 Machine

The machine shall be specially designed and manufactured to lay slurry seal. It shall be self propelled equipment, truck mounted, consisting of following sub-assemblies used to manufacture and simultaneously spread these mixes on the surface:

- i) Aggregate bin.

- ii) Filler bin.
- iii) Water and Emulsion Tanks.
- iv) Additive Tanks.
- v) Aggregates and filler conveyors to supply the mixer box.
- vi) Pump or compressed air system to supply the emulsion/water.
- vii) Mixer Box.
- viii) Spreader box to place the mixed slurry on the job.

512.5.5 Calibration of Machine

Slurry seal laying machine shall be calibrated for flow of all the constituents as per the job mix in presence of Engineer. No machine shall be allowed to work on the project until the calibration has been completed and accepted by the engineer. 2 kg samples of slurry seal mix will be taken and verified for proportioning and mix consistency. The verification for application rate shall also be carried out in presence of the Engineer. The procedure for calibration and verification is as given in Appendix 7 of IRC:SP:81.

512.5.6 Application of Slurry Seal

A calibrated slurry seal machine, as per requirements of job mix, shall be used to spread the material. The surface shall be pre-wetted by fogging ahead of the spreader box (if required under hot weather conditions). The rate of application shall be adjusted during the day to suit temperature, surface texture and humidity. The mixture shall be agitated and mixed uniformly in the spreader box by means of twin shafted paddles or spiral augurs fixed in spreader box. A front seal shall be provided to ensure no loss of the mixture at the road contact point. The rear seal shall act as final strike off and shall be adjustable. The spreader box and rear strike off shall be so designed and operated that a uniform consistency is achieved to produce free flow of material to the rear strike off. A secondary strike off shall have the same adjustment as the spreader box. The spreader box shall have the suitable means provided to side shift the box to compensate for variation in pavement geometry. Sufficient amount of material shall be carried in all parts of spreader box at all times so that a complete coverage is obtained. Overloading of the spreader box shall be avoided. No lumping, balling and unmixed aggregates shall be permitted. No streak, caused by oversized aggregates shall be left on the finished surface. Longitudinal joints shall correspond with the edges of existing traffic lanes. Other patterns of longitudinal joints may be permitted, if pattern will not adversely affect the quality of finished surface. In case streak is formed, it shall be corrected immediately by fresh material and with use of squeeze. Longitudinal joints, common to two traffic lanes shall be butt joints with overlap not exceeding an average of 60-100 mm. The mixture shall be uniform and homogeneous after spreading on existing surfaces and shall not show separation of the emulsion and aggregates after setting.

512.5.7 Rate of Application

The rate of application shall be as per Table 500-26 (by weight of dry aggregates).

512.5.8 Rolling

Generally rolling is not required. Where rolling is felt necessary due to inadequate cohesion, a pneumatic tyred roller having individual wheel load between 0.75 to 1.5 tonne shall be used. Rolling shall commence as soon as the slurry has set.

512.6 Surface Finish and Quality Control

The surface finish of construction shall conform to the requirements of Clause 902. For control of the quality of materials and work carried out, relevant provision of Section 900 shall apply.

512.6.1 Opening to Traffic

Surface shall be opened to traffic after slurry is in a completely set condition. The maximum setting time shall be 4 hours. Speed of traffic shall be restricted to 20 km per hour for next 12 hours.

512.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

512.8 Measurement for Payment

Slurry seal shall be measured as finished work as specified, in square metres.

512.9 Rate

The contract unit rate for slurry seal shall be payment in full for carrying out the required operations including full compensation for the specified rate of application of the mix and the quantity of residual binder. The variation in rates of actual application shall be suitably adjusted plus or minus as provided in the Contract. The contract unit rate shall cover all operations listed in Clause 501.8.8.2.

513 FOG SPRAY**513.1 Scope**

The work covers a very light application of low viscosity bitumen emulsion for purposes of sealing cracks less than 3 mm wide or incipient fretting or disintegration in an existing

bituminous surfacing, and to help reduce loosening of chips by traffic on newly finished surface dressing.

513.2 Material

The bitumen emulsion shall be as specified in the Contract or as instructed by the Engineer. The emulsion shall be SS-1 complying with the requirements of IS:8887.

513.3 Weather and Seasonal Limitations

Spraying shall not take place when the temperature is below 10°C, nor in windy or dusty conditions, nor when it is raining or the surface to be sprayed is wet (a damp surface is acceptable but refer to Clause 513.4.2.).

513.4 Construction Operations

513.4.1 Equipment

The fog spray shall be applied by means of a self-propelled or towed bitumen pressure sprayer complying with the requirements of the Manual for Construction and Supervision of Bituminous Works. The spray bar should be protected from gusts of wind by means of a hood.

513.4.2 Preparation of Surface

The surface on which the fog spray is to be applied shall be thoroughly cleaned with compressed air, scrubbers etc. The cracks shall be cleaned with a pressure air jet to remove all dirt, dust etc.

513.4.3 Application

The fog seal shall be applied at a rate of 0.5-1.0 litres/m², using equipment such as pressure tank, flexible hose and spray bar or lance.

513.5 Blinding

If specified in the Contract or ordered by the Engineer, the fog spray shall be blinded with graded grit of 3 mm size and under, coated with about 2 percent of the emulsion by weight. The pre coated grit shall be allowed to be cured for at least one week or until they become non-sticky and can be spread easily.

513.6 Quality Control of Work

For control of quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

513.7 Arrangements for Traffic

During the spraying operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112. The surface should not be opened to traffic for 24 hours after spraying. If pick-up does occur a light blinding of crusher dust or sand should be applied.

513.8 Measurement of Payment

Fog spray and blinding (if used) shall be measured in terms of surface area of application, for the area covered, in square metres.

513.9 Rate

The contract unit rate for fog spray and blinding (if used) shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2. (i) to (xi) as applicable to the work specified in these Specifications.

514 MICRO-SURFACING**514.1 Scope**

The work shall consist of design, testing and construction of micro-surfacing composed of modified bitumen emulsion, mineral aggregate, water and necessary additives (if needed), proportioned, mixed and uniformly spread over a properly prepared surface for surface treatment of pavements in accordance with these Specifications.

514.2 Type of Mirco-Surfacing

Micro-surfacing is applied on an existing pavement surface which is structurally sound but the surface shows signs of premature ageing, aggregate loss, cracking, high degree of polishing etc, It may be used as surface sealing treatment to improve skid resistance, surface durability, to seal fine and medium cracks and for preventive maintenance and periodic renewal treatment on low and medium traffic roads. Types of micro-surfacing and rates of application are given in Table 500-31.

Table 500-31 : Types of Micro-Surfacing and Rate of Application

Items	Type II (4 to 6 mm)**	Type III (6 to 8 mm)**
Application	Preventive and Renewal Treatment for Roads Carrying <1500 CVPD	Preventive and Renewal Treatment for Roads Carrying 1500 to 4500 CVPD
Quantity of mix* (kg/m ²)	8.4 to 10.8	11.1 to 16.3
Residual binder (percentage by weight of dry aggregate)	6.5 to 10.5	5.5 to 10.5

* By weight of dry aggregate.

** Indicative only.

514.3 Materials**514.3.1 Binder**

The bitumen emulsion shall be a modified bitumen emulsion conforming to requirements specified in Table 500-32. The modifier shall be polymer/rubber, preferably synthetic or natural rubber latex.

Table 500-32 : Requirement of Modified Bitumen Emulsion for Micro-Surfacing

Requirements	Specifications	Method of test
Residue on 600 micron IS sieve (percent by mass), maximum	0.05	IS: 8887
Viscosity by Say bolt Furol Viscometre, at 25°C, in second	20-100	IS :8887
Coagulation of emulsion at low temperature	Nil	IS :8887
Storage stability after 24 h (168 h), % maximum	2(4)	IS :8887
Particle charge, + ve/-ve	+ ve	IS :8887
Tests on residue:		
a) Residue by evaporation, % minimum	60	IS :8887
b) Penetration at 25°C/100 g/5 s	40-100	IS :1203
c) Ductility at 27°C, cm, minimum	50	IS :1208
d) Softening point, in °C, minimum	57	IS :1205
e) Elastic recovery*, %, minimum	50	IS :15462
f) Solubility in tri-chloroethylene, % minimum	97	IS :1216

* In case, elastic recovery is tested for Torsional Elasticity Recovery as per Appendix-8 of IRC:81, the minimum value shall be 20 percent.

514.3.2 Aggregates

As per Clause 512.3.2 (Type II and Type III Grading, Table 500-27).

514.3.3 Filler

As per Clause 512.3.3.

514.3.4 Water

As per Clause 512.3.4.

514.3.5 Additives

As per Clause 512.3.5.

514.4 Design and Proportioning of Micro-Surfacing Mix

514.4.1 The design criteria for micro-surfacing mixture is specified in Table 500-33. The mix design report shall clearly show the proportions of aggregate, filler, water and residual bitumen content based on the dry weight of aggregates and additives used (if any). The set time shall be determined by the method given in Appendix-2 of IRC:SP:81.

Table 500-33 : Mix Design Criteria for Micro-Surfacing Mix

Requirements	Specifications	Method of Test as given in IRC:SP:81
Mix time, minimum	120 s	Appendix-1
Consistency, maximum	3 cm	Appendix-3
Wet Cohesion, within 30 min, minimum.	12 kg cm	Appendix-4
Wet Cohesion, within 60 min, minimum	20 kg cm	Appendix-4
Wet stripping, pass %, minimum	90	Appendix-5
Wet track abrasion loss (one hour soak), maximum	538 g/m ²	Appendix-6

514.4.2 Aggregate, modified bitumen emulsion, water and additive (if used), shall be proportioned by weight of aggregate utilizing the mix design approved by the Engineer. If more than one type of aggregates is used, the correct amount of each type of aggregate used to produce the required grading shall be proportioned separately prior to adding other materials of the mixture, in a manner that will result in a uniform and homogenous blend. Final completed mixture, after addition of water and any additive, if used shall be such that the micro-surfacing mixture has proper workability and permit traffic within a short period depending upon the weather conditions without occurrence of ravelling and bleeding. Trial mixes shall be prepared and laid for the designed mix and observed for breaking time and setting time. The wet track abrasion test is used to determine the minimum residual bitumen content. Indicative limits of various ingredients for job mix of micro-surfacing shall be as given in Table 500-34.

Table 500-34 : Indicative ingredients in mix

Ingredients	Limits (Percent Weight of Aggregate)
Residual bitumen	6.5 to 10.5 for type II and 5.5 to 10.5 for Type III
Mineral filler	0.5 to 3.0
Additive	As needed
Water	As needed

514.5 Construction

As per Clause 512.5.

514.5.1 Weather and Seasonal Limitations

As per Clause 512.5.1.

514.5.2 Surface Preparation

As per Clause 512.5.2.

514.5.3 Application of Tack Coat

As per Clause 512.5.3.

514.5.4 Machine

As per Clause 512.5.4.

514.5.5 Calibration of Machine

As per Clause 512.5.5.

514.5.6 Application of Micro-Surfacing

A calibrated micro-surfacing machine as per requirements of job mix shall be used to spread the material. The surface shall be pre-wetted (if required under extreme hot weather conditions) by spraying water ahead of the spreader box. The rate of application of spray shall be adjusted during the day to suit temperature, surface texture and humidity. The application of micro-surfacing shall be as per Clause 512.5.6.

514.5.7 Rate of Application

The micro-surfacing mixture shall be of proper consistency at all times so as to provide the application rate required by the surface condition. The quantities of micro-surfacing mix (by weight of dry aggregate) to be used shall be as given in Table 500-31.

514.5.8 Rolling

As per Clause 512.5.8.

514.5.9 Quality Control and Surface Finish

The surface finish of construction shall conform to the requirements of Clause 902. For control of the quality of materials and work carried out, relevant provision of Section 900 shall apply.

514.6 Control of Traffic

Micro-surfacing mix requires about 2 hours to set. Traffic may be opened only after 2 hours restricting the speed to 20 km/h till 12 hours thereafter.

514.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

514.8 Measurement for Payment

Micro-surfacing shall be measured as finished work as specified, in square metres.

514.9 Rate

The contract unit rate for micro-surfacing shall be payment in full for carrying out the required operations including full compensation for the specified rate of application of the mix and the quantity of residual binder. The variation in rates of actual application shall be suitably adjusted plus or minus as provided in the Contract. The contract unit rate shall include full compensation for all operations listed in Clause 501.8.8.2.

515 STONE MATRIX ASPHALT (SMA)**515.1 Scope**

This work shall consist of construction in a single or multiple layer of fibre-stabilized SMA for use as wearing course/ binder course on a previously prepared bituminous bound surface. The 13 mm SMA in this Specification shall be used for wearing course with nominal layer thickness of 40 to 50 mm. The 19 mm SMA shall be used for binder (or intermediate) course with nominal layer thickness of 45 to 75 mm.

515.2 Materials**515.2.1 Bitumen**

The bitumen for fibre-stabilized SMA shall be viscosity grade paving bitumen conforming to Indian Standard Specification IS:73 or Modified Bitumen complying with IS:15462 and IRC:SP:53 of appropriate type and grade capable of yielding the design mix requirements, and as per Table 500-2.

515.2.2 Coarse Aggregates

The coarse aggregates shall consist of crushed rock retained on 2.36 mm sieve. It shall be clean, hard, durable, of cubical shape and free from dust and soft organic and other deleterious substances. The aggregates shall satisfy the physical requirements given in Table 500-35.

Table 500-35 : Physical Requirements for Coarse Aggregates for Stone Matrix Asphalt

Property	Text	Method	Specification
Cleanliness	Grain Size Analysis	IS:2386 (P-1)	< 2% passing 0.075 mm sieve
Particle Shape	Combined Flakiness and Elongation Index	IS:2386 (P-1)	< 30%
Strength	Los Angeles Abrasion Value	IS:2386(P-4)	< 25%
	Aggregate Impact Value	IS:2386 (P-4)	< 18%
Polishing	Polished Stone Value	IS:2386 (P-114)	> 55%
Durability	Soundness (either Sodium or Magnesium) - 5 cycles		
	Sodium Sulphate	IS:2386 (P-5)	< 12%
	Magnesium Sulphate	IS:2386 (P-5)	
Water Absorption	Water Absorption	IS:2386 (P-3)	< 2%

* Polishing requirement does not apply when the coarse aggregate is used for intermediate (binder) course.

515.2.3 Fine Aggregates

Fine aggregates (passing 2.36 mm sieve and retained on 0.075 mm sieve) shall consist of 100 percent crushed, manufactured sand resulting from crushing operations. The fine aggregate shall be clean, hard, durable, of fairly cubical shape and free from soft pieces, organic or other deleterious substances. The Sand Equivalent Test (IS:2720, Part 37) value for the fine aggregate shall not be less than 50. The fine aggregates shall be non plastic.

515.2.4 Mineral Filler

Mineral filler shall consist of finely divided mineral matter such as stone dust and/or hydrated lime. Fly ash shall not be permitted as a filler. The filler shall be graded within the limits indicated in Table 500-36.

Table 500-36 : Grading Requirement of Mineral Filler

IS Sieve (mm)	Cumulative % Passing by Weight of Total Aggregate
0.6	100
0.3	95-100
0.075	85-100

The filler shall be inert material free from organic impurities and shall have plasticity index not greater than 4. Plasticity index requirement will not apply if filler is hydrated lime. Where the complete SMA mixture fails to satisfy the requirement of Moisture Susceptibility Test (AASHTO T 283), at least 2 percent by total weight of aggregate of hydrated lime shall be used as filler and the percentage of fine aggregate reduced accordingly.

515.2.5 Stabilizer Additive

Only pelletized cellulose fibres shall be utilized. The dosage rate for cellulose fibres is 0.3 percent minimum by weight (on loose fibre basis) of the total mix. The dosage rate shall be confirmed so that the bitumen draindown does not exceed 0.3 percent when the designed mix is tested in accordance with ASTM D 6390.

515.2.6 The cellulose fibres to be used in pellets shall meet the following requirements:

- Maximum fibre length - 8 mm
- Ash content - maximum of 20 percent nonvolatile
- Oil absorption - more than 4 times of the fibre weight
- Moisture content - less than 5 percent by weight

When the Contractor submits the proposed job-mix formula for SMA for approval, it shall include the fibre manufacturer’s most recently dated actual test data showing that the fibres meet the above requirements. The contractor shall protect the cellulose from moisture and contamination prior to incorporating it into the SMA.

515.3 SMA Mix Design

515.3.1 The combined grading of the coarse aggregate, fine aggregate and mineral filler (including hydrated lime if used) shall be within the limits shown in Table 500-37.

Table 500-37 : Composition of Stone Matrix Asphalt

SMA Designation	13 mm SMA	19 mm SMA
Course where used	Wearing course	Binder (intermediate) course
Nominal aggregate size	13 mm	19 mm
Layer thickness	40-50 mm	45-75 mm
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	Cumulative % by weight of total aggregate passing
26.5	–	100
19	100	90-100
13.2	90-100	45-70
9.5	50-75	25-60
4.75	20-28	20-28
2.36	16-24	16-24
1.18	13-21	13-21
0.600	12-18	12-18
0.300	10-20	10-20
0.075	8-12	8-12

515.3.2 The SMA mixture will be designed using AASHTO MP8, Standard Specification for Designing Stone Matrix Asphalt and AASHTO PP 41, Standard Practice for Designing Stone Matrix Asphalt. The SMA mixture shall be compacted with 50 blows on each side using the Marshall procedure given in the Asphalt Institute MS-2 (Sixth edition). The designed mix shall meet the requirements given in Table 500-38.

Table 500-38 : SMA Mix Requirements

Mix Design Parameters	Requirement
Air void content, percent	4.0
Bitumen content, percent	5.8 min.
Celluloid fibres	0.3 percent minimum by weight of total mix
Voids in mineral aggregate (VMA), percent	17 min.
Voids in Coarse Aggregates (VCA) mix, percent	Less than VCA (dry rodded)
Asphalt drain down, percent ASTM D 6390 (Annex C of IRC:SP:79)	0.3 max.
Tensile Strength Ratio (TSR), per cent AASHTO T 283 (Annex E of IRC:SP:79)	85 min.

515.4 SMA Production**515.4.1 Mixing**

The SMA mix shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregate.

When viscosity grade bitumen is used, the mix temperature shall range from 150°C to 165°C. In case of modified bitumen, the temperature of mixing and compaction shall be higher than the mix with viscosity grade bitumen. The exact temperature depends upon the type and amount of modifier used and shall be adopted as per the recommendations of the manufacturer. In order to ensure uniform quality of mix, the plant shall be calibrated from time to time.

515.4.2 Handling Mineral Filler

Adequate dry storage will be provided for the mineral filler and provisions shall be made for proportioning the filler into the mixture uniformly and in the desired quantities. This is necessary because relatively large amounts of mineral filler are required in SMA mixes.

515.4.3 Fibre Additive

For batch plant, the fibre will be added directly into the weigh hopper above the pugmill. Adequate dry mixing time is required to disperse the fiber uniformly throughout the hot aggregate. Dry mixing time will be increased by 5 to 10 seconds. Wet mixing time shall be increased by at least 5 seconds. For drum mix plant, a separate fibre feeding system shall be utilized that can accurately and uniformly introduce fibre into the drum at such a rate as not to limit the normal production of mix through the drum. At no time shall there be any evidence of fibre in the baghouse/wasted baghouse fines.

515.5 SMA Placement and Compaction**515.5.1 Preparation of Existing Bituminous Surface**

The existing bituminous surface shall be cleaned of all loose extraneous matter by means of mechanical broom and high-pressure air jet from compressor or any other approved equipment/method. Any potholes and/or cracks shall be repaired and sealed.

515.5.2 Tack Coat

Clause 503 shall apply.

515.5.3 Transportation

Clause 501.4 shall apply.

515.5.4 Laying**515.5.4.1 Weather and Seasonal Limitations**

Clause 501.5.1 shall apply.

515.5.4.2 Spreading

Clause 501.5.3 shall apply.

515.5.5 Compaction

Clause 501.6. shall apply, except that the use of pneumatic roller shall not be permitted if there is a possibility of pick-up.

The density of the finished paving layer shall be determined by taking 150 mm diameter cores. The density of finished paving layer shall not be less than 94 percent of the average (sample size N=2) theoretical maximum specific gravity of the loose mix (G_{mm}) obtained on that day in accordance with ASTM D2041. That is, no more than 6 percent air voids shall be allowed in the compacted SMA mat.

515.5.6 Joints

Clause 501.7 shall apply.

515.6 Quality Control and Surface Finish

The surface finish of construction shall conform to the requirements of Clause 902. For control of the quality of materials supplied and work carried out, relevant portion of Section 900 shall apply.

515.7 Control of Traffic

It shall be ensured that traffic is not allowed on the SMA surface until the paved mat has cooled to ambient temperature in its entire depth.

515.8 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

515.9 Measurement for Payment

SMA shall be measured as finished work in sq.m at this specified thickness or in cu.m as specified in the Contract.

515.10 Rate

The contract unit rate for SMA shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

516 MASTIC ASPHALT**516.1 Scope**

This work shall consist of constructing a single layer of mastic asphalt wearing course for road pavements and bridge decks.

Mastic asphalt is an intimate homogenous mixture of selected well-graded aggregates, filler and bitumen in such proportions as to yield a plastic and void less mass, which when applied hot can be trowelled and floated to form a very dense impermeable surfacing.

516.2 Materials**516.2.1 Binder**

Subject to the approval of the Engineer, the binder shall be a paving/ Industrial grade bitumen meeting the requirements given in **Table 500-39**.

Table 500-39 : Requirements for Physical Properties of Binder

Property	Test Method	Requirements
Penetration at 25°C	IS:1203	15 ± 5*
Softening point, °C	IS:1205	65 ± 10
Loss on heating for 5h at 163°C, % by mass Max.	IS:1212	2.0
Solubility in trichloroethylene, % by mass Min.	IS:1216	95
Ash (mineral matter), % by mass Max.	IS:1217	1.0

* In cold climatic regions (temperature less than 10°C), VG 40 grade bitumen may be used.

516.2.2 Coarse Aggregates

The coarse aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, hard, durable, of fairly cubical shape, uncoated and free from soft, organic or other deleterious substances. They shall satisfy the physical requirements given in Table 500-6.

The percentage and grading of the coarse aggregates to be incorporated in the mastic asphalt depending upon the thickness of the finished course should be as specified in Table 500-40.

Table 500-40 : Grade and Thickness of Mastic Asphalt Paving and Grading of Coarse Aggregates

Application	Thickness Range (mm)	Nominal Size of Coarse Aggregate (mm)	Coarse Aggregate Content, % by Mass of Total Mix
Roads and bridge decks	25–50	13	40±10
Heavily stressed areas i.e. Junctions and toll plazas	40–50	13	45±10
Nominal size of coarse aggregate IS Sieve (mm)		13 mm	Cumulative % passing by weight
19		100	
13.2		88–96	
2.36		0-5	

Fine Aggregates : The fine aggregates shall be the fraction passing the 2.36 mm and retained on the 0.075 mm sieve consisting of crusher run screening, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry, and free from soft or flaky pieces and organic or other deleterious substances.

Filler : The filler shall be limestone powder passing the 0.075 mm sieve and shall have a calcium carbonate content of not less than 80 percent by weight when determined in accordance with IS:1514.

The grading of the fine aggregate inclusive of filler shall be as given in Table 500-41.

Table 500-41 : Grading of Fine Aggregate (Inclusive of Filler)

IS Sieve	Percentage by weight of aggregate
Passing 2.36 mm but retained on 0.600 mm	0 – 25
Passing 0.600 mm but retained on 0.212 mm	10 – 30
Passing 0.212 mm but retained on 0.075 mm	10 – 30
Passing 0.075 mm	30 – 55

516.3 Mix Design**516.3.1 Hardness Number**

The mastic asphalt shall have a hardness number at the time of manufacture of 50 to 70 at 25°C prior to the addition of coarse aggregate and 10 to 20 at 25°C at the time of laying after the addition of coarse aggregate.

The hardness number shall be determined in accordance with the method specified in IS:1195-1978.

516.3.2 Binder Content

The binder content shall be so fixed as to achieve the requirements of the mix specified in Clause 516.3.1 and shall be in the range of 14 to 17 percent by weight of total mix as indicated in Table 500-42.

Table 500-42 : Composition of Mastic Asphalt Blocks without Coarse Aggregate

IS Sieve	Percentage by Weight of Mastic Asphalt	
	Minimum	Maximum
Passing 2.36 mm but retained on 0.600 mm	0	22
Passing 0.600 mm but retained on 0.212 mm	4	30
Passing 0.212 mm but retained on 0.075 mm	8	18
Passing 0.075 mm	25	45
Bitumen Content % by mass	14	17

516.3.3 Job Mix Formula

The Contractor shall submit to the Engineer for approval at least one month before the start of the work the job mix formula proposed to be used by him for the work, indicating the source and location of all materials, proportions of all materials such as binder and aggregates, single definite percentage passing each sieve for the mixed aggregate and results of the tests recommended in the various Tables and Clauses of this Specification.

516.4 Construction Operations**516.4.1 Weather and Seasonal Limitations**

The provisions of Clause 501.5.1 shall apply, except that laying shall not be carried out when the air temperature at the surface on which the Mastic Asphalt is to be laid is below 10°C.

516.4.2 Preparation of the Base

The base on which mastic asphalt is to be laid shall be prepared, shaped and conditioned to the profile required, in accordance with Clause 501 or 902 as appropriate or as directed by the Engineer. In the case of a cement concrete base, the surface shall be thoroughly power brushed clean and free of dust and other deleterious matter. Under no circumstances shall mastic asphalt be spread on a base containing a binder which might soften under high application temperatures. If such material exists, the same shall be cut out and repaired before the mastic asphalt is laid.

516.4.3 Tack Coat

A tack coat in accordance with Clause 503 shall be applied on the base or as directed by the Engineer.

516.4.4 Preparation of Mastic Asphalt

Preparation of mastic asphalt consists of two stages. The first stage shall be mixing of filler and fine aggregates and then heating the mixture to a temperature of 170°C to 210°C. Required quantity of bitumen shall be heated to 170°C to 180°C and added to the heated aggregated. They shall be mixed and cooked in an approved type of mechanically agitated mastic cooker for some time till the materials are thoroughly mixed. Initially the filler alone is to be heated in the cooker for an hour and then half the quantity of binder is added. After heating and mixing for some time, the fine aggregates and the balance of binder are to be added and further cooked for about one hour. The second stage is incorporation of coarse aggregates and cooking the mixtures for a total period of 3 hours. During cooking and mixing care shall be taken to ensure that the contents in the cooker are at no time heated to a temperature exceeding 210°C.

Where the material is not required for immediate use it shall be cast into blocks consisting of filler, fine aggregates and binder, but without the addition of coarse aggregate, weighing about 25 kg each. Before use, these blocks shall be reheated to a temperature of not less than 175°C and not more than 210°C, thoroughly incorporated with the requisite quantity of coarse aggregates and mixed continuously. Mixing shall be continued until laying operations are completed so as to maintain the coarse aggregates in suspension. At no stage during the process of mixing shall the temperature exceed 210°C.

The mastic asphalt blocks (without coarse aggregate) shall show on analysis a composition within the limits as given in Table 500-42.

The mix shall be transported to the laying site in a towed mixer transporter having arrangements for stirring and keeping the mix hot during transportation.

516.4.5 Spreading

The mastic asphalt shall be laid, normally in one coat, at a temperature between 175°C and 210°C and spread uniformly by hand using wooden floats or by machine on the prepared surface. The thickness of the mastic asphalt and the percentage of added coarse aggregate shall be in accordance with Table 500-40 or as specified by the Engineer. Where necessary, battens of the requisite dimensions should be employed. Any blow holes that appear in the surface shall be punctured while the material is hot, and the surface made good by further floating.

Laying surface over existing bridge deck : Before laying bitumen over existing bridge deck, the existing cross fall/camber, expansion joint members and water drainage spouts shall be carefully examined for their proper functioning in the bridge deck structure and any deficiency found shall be removed. Loose elements in the expansion joint shall be firmly secured. The existing wearing coat shall be removed, as per Clause 2809. The cracks in the concrete surface, if any, shall be repaired and filled up properly or replaced by new concrete of specified grade before laying the bitumen mastic over bridge deck.

Laying over new bridge deck : New concrete bridge deck which is not in camber/cross fall shall first be provided with required camber and cross fall by suitable concrete or bituminous treatment.

Treatment where mastic asphalt is laid over a concrete surface : In case of laying over concrete surface, following measures shall be taken :

- 1) For proper bond with new concrete deck, surface shall be roughened by means of stiff broom or wire brush and it shall be free from ridges and troughs.
- 2) A thin bituminous tack coat (with bitumen of grade VG 30) shall be applied on the concrete deck before pouring mastic. The deck shall be dry. The quantity of bitumen for tack coat shall be as per Table 500-6.
- 3) After applying tack coat, chicken-mesh reinforcement of 1.5 mm dia steel wire with hexagonal or rectangular openings of 20-25 mm shall be placed and held properly in position on the concrete surface before pouring mastic.

516.4.6 Joints

All construction joints shall be properly and truly made. These joints shall be made by warming existing mastic asphalt by the application of an excess quantity of the hot mastic asphalt mix which afterwards shall be trimmed to leave it flush with the surfaces on either side.

516.4.7 Surface Finish

The mastic asphalt surface can have poor skid resistance after floating. In order to provide resistance to skidding, the mastic asphalt after spreading, while still hot and in a plastic condition, shall be covered with a layer of stone aggregate. This aggregate shall be 13.2 mm size (passing the 19.0 mm sieve and retained on the 6.7 mm sieve) or 9.5 mm size (passing the 13.2 mm sieve and retained on the 6.7 mm sieve) subject to the approval of the Engineer. Hard stone chips, complying with the quality requirements of Table 500-16, shall be precoated with bitumen at the rate of 2 ± 0.4 percent of VG 30 grade. The addition of 2 percent of filler complying with Table 500-9 may be required to enable this quantity of binder to be held without draining. The chips shall then be applied at the rate of 0.005 cu.m per 10 sq.m and rolled or otherwise pressed into the surface of the mastic layer when the temperature of the mastic asphalt is not less than 100°C.

516.5 Opening of Traffic

Traffic may be allowed after completion of the work when the mastic asphalt temperature of the completed layer has cooled to the daytime maximum ambient temperature.

516.6 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Clause 902.

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

The surface of the mastic asphalt, tested with a straight edge 3 m long, placed parallel to the centre line of the carriageway, shall have no depression greater than 7 mm. The same shall also apply to the transverse profile when tested with a camber template.

516.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

516.8 Measurement for Payment

Mastic asphalt shall be measured as finished work in square metres at a specified thickness, or by weight in tonnes as stated in the Contract.

516.9 Rate

The contract unit rate for mastic asphalt shall be payment in full for carrying out the required operations including full compensation for all components listed under Clause 501.8.2.2.

517 CRACK PREVENTION COURSES**517.1 Scope**

The work shall consist of providing one or two coats of an elastomeric rubber membrane known as Stress Absorbing Membrane (SAM) over a cracked surface, followed by a covering of aggregate chips, and a Stress Absorbing Membrane Interlayer (SAMI), which is a material similar to SAM or which consists of a bitumen impregnated geotextile, as specified in the Contract.

517.2 Materials**517.2.1 Binder**

Binder shall be a modified binder complying with the requirements of IS:15462 and IRC:SP:53, according to the requirements of the Contract, except that viscosity grade VG 10 complying with the requirements of IS:73 shall be used in the case of a bitumen impregnated geotextile.

517.2.2 Aggregate

The requirements of Clause 510.2.2 apply except that the Polished Stone Value requirement does not apply in the case of SAMI. Where required by the contract, aggregates shall be pre-coated by mixing them with 0.75 to 1.0 percent of paving bitumen by weight of chips in a suitable mixer, the chips being heated to 160°C and the bitumen to its application temperature. The pre-coated chips shall be allowed to cure for at least one week or until they become non-sticky and can be spread easily.

517.2.3 Rates of Spread of Binder and Aggregate

The rate of spread of binder and aggregate shall be as given in Table 500-43, as required by the Contract.

517.2.4 Geotextile

The geotextile as prescribed shall conform to the requirements of Clause 703.3.

517.3 Construction Operations**517.3.1 Weather and Seasonal Limitations**

Clause 501.5.1 shall apply.

517.3.2 Preparation of Base

The base on which the SAM, SAMI or bitumen impregnated geotextile is to be laid shall be prepared, in accordance with Clause 501 and as directed by the Engineer. The surface shall be thoroughly cleaned either by using a mechanical brush or any other equipment/method approved by the Engineer. Dust removed in the process shall be blown off with compressed air.

517.3.3 Application of Binder

517.3.3.1 The equipment and general procedures shall all be in accordance with the Manual for Construction and Supervision of Bituminous Works. The application temperature for modified binder shall be 160°-170°C. Binder for bitumen impregnated geotextile shall be applied according to Clause 703.4.4. The surface on which the binder is to be applied shall be dry.

Table 500-43 : Quantity of Materials Required for 10 sq.m of Road Surface for Stress Absorbing Membrane

S. No.	Type and Width of Crack	Specification of SAM to be Applied	Quantity of Binder Kg/10m ²	Quantity of Chipping
1)	Hair cracks and map cracks upto 3 mm width	Single coat SAM or 2 nd coat of two coat SAM	8 – 10	0.10 m ³ of 5.6 mm chips
2)	Map cracks or alligator cracks 3 mm to 6 mm width	Single coat SAM	10 – 12	0.11m ³ of 5.6 mm chips
3)	Map cracks or alligator cracks 6 mm to 9 mm width	Two coat SAM 1 st coat 2 nd coat	12 – 14 8 – 10	0.12 m ³ of 5.6 mm and 11.2 mm chips in 1:1 ratio 0.10 m ³ of 5.6 mm chips
4)	Cracks above 9 mm width and cracked area above 50 percent	Two coat SAM 1 st coat 2 nd coat	14 – 16 8 – 10	0.12 m ³ of 11.2 mm chips 0.10 m ³ of 5.6 mm chips
5)	All types of cracks with crack width below 6 mm	Single coat SAM I	8 – 10	0.10 m ³ of 5.6 mm chips
6)	All types of cracks with crack width above 6 mm	Single coat SAM I	10 – 12	0.10 m ³ of 11.2 mm chips

517.3.3.2 Binder quantity for bitumen impregnated geotextile shall be in the range 0.9 to 1.2 litres/m². Binder quantity outside this range is permitted according to the geotextile manufacturer's instructions and subject to the agreement of the Engineer.

517.3.4 Application of Aggregates

The equipment and general procedures shall all be in accordance with the Manual for Construction and Supervision of Bituminous Works. Immediately after application of the modified binder, clean, dry aggregate shall be spread uniformly on the surface.

517.3.5 Sweeping

The surface of SAMs and SAMIs shall be swept to ensure uniform spread of aggregate and that there are no loose chips on the surface.

517.3.6 Two Coat SAM or SAMI

Where a two coat SAM or SAMI is required by the Contract, the second coat shall be applied within 90 days of the first coat.

517.3.7 Geotextile Placement

For bitumen impregnated geotextile, the requirements of Clause 703.4.4 shall apply.

517.4 Opening to Traffic

Traffic may be permitted over a SAM or SAMI 2 hours after rolling, but the speed shall be limited to 20 km/h, until the following day. Speed control measures are to be approved by the Engineer, prior to laying. Traffic shall not be allowed on the bitumen impregnated geotextile layer unless it is overlaid.

517.5 Surface Finish and Quality Control of Work

The surface finish shall conform to the requirements of Clause 902.

For control on the quality of materials and the works carried out, the relevant provisions of **Section 900** shall apply.

517.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

517.7 Measurement for Payment

Each application of SAM, SAMI or bitumen impregnated geotextile shall be measured as finished work, for the area specified, in square metres.

517.8 Rate

The contract unit rate for SAM, SAMI or bitumen impregnated geotextile shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2.

518 BITUMINOUS COLD MIX (INCLUDING GRAVEL EMULSION)**518.1 The Design Mix**

The work shall consist of providing a bituminous cold mix consisting of a mixture of unheated mineral aggregate and emulsified or cutback bitumen, laid in a single layer of 25-75 mm. The mix shall either be a design mix or a recipe mix.

518.2 Materials**518.2.1 Binder**

The binder shall be a slow/ medium setting bitumen emulsion conforming to IS:8887 or a medium curing cut-back conforming to IS:217.

The final selection of the binder shall be made only after laboratory evaluation with the aggregates to be used. A general guide for the selection of the binder is given in the Manual for Construction and Supervision of Bituminous Works.

The binder with the highest residual viscosity at ambient temperatures that can reasonably be handled by the mixing and laying equipment proposed shall be used.

518.2.1.1 Aggregates

The aggregates shall comply with the requirements of Clauses 505.2.2. and 505.2.3. If the aggregates are not properly coated with the binder, a small amount of hydrated lime or an approved antistripping agent (see Appendix 4) shall be proposed by the Contractor, for the approval of the Engineer.

518.2.1.2 Aggregate Grading and Binder Content

The combined aggregate grading for the particular mixture, when tested in accordance with IS:2386 Part I, (wet sieving method), shall fall within the limits shown in Table 500-44.

518.2.2 Mix Design**518.2.2.1 Requirements for the Mixture**

Apart from conformity with the grading and quality requirements for individual ingredients, the mix shall meet the requirements set out in Table 500-45.

Table 500-44 : Aggregate Grading and Bitumen Content

Nominal Maximum Size (mm)	9.5	13.2	19.0
Allowable Thickness (mm)	25-35	36-50	51-75
IS Sieve (mm)	Cumulative % by weight of total aggregate passing		
37.5	–	–	–
26.5	–	–	100
19.0	–	100	90-100
13.2	100	90-100	–
9.5	90-100	–	60-80
4.75	60-80	45-70	35-65
2.36	35-65	25-55	20-50
0.30	6-25	5-20	3-20
0.075	2-10	2-9	2-8
	Binder content, percent by weight of total mix		
Cutback		4–6	
Emulsion		7–10	

The binder content shall be determined by the modified Marshall Test.

Table 500-45 : Mix Requirements for Designed Cold Mix

Parameter	Emulsion ¹	Cutback ²
Minimum Stability	2.2 kN at 22.2°C for paving	2.2 kN at 25°C for maintenance 3.3 kN at 25°C for paving
Percent maximum stability loss on soaking	50 ³	25 ⁴
Minimum flow (mm)	2	2
Compaction level (number of blows)	50	75
Per cent air voids	3-5 ⁵	3–5
Per cent voids in mineral aggregate (VMA)	See Table 500-46	
Per cent minimum coating ⁶	50	

Notes: ¹Using Marshall method for emulsified asphalt-aggregate cold mix design".

Appendix F, MS-14

²Using "Marshall method for cut-back asphalt-aggregate cold mix design", Appendix H, MS-14

³With vacuum saturation and immersion

⁴Four days soak at 25°C.

⁵Refers to total voids in the mix occupied by air and water

⁶Coating Test, Appendix F, MS-14.

Table 500-46 : Minimum Percent Voids in Mineral Aggregate (VMA)

Nominal Maximum Particle Size IS Sieve (mm)	Minimum VMA (Percent)
9.5	16.0
12.5	15.0
19.0	14.0
25.0	13.0
37.5	12.0

518.2.2.2 Binder Content

The binder content shall be optimized by the Modified Marshall Test to achieve the requirements of the mix set out in Table 500-45. The method adopted shall be that described in Appendix F and H of Asphalt Institute's Manual, MS-14.

518.2.2.3 Job Mix Formula

The Contractor shall submit to the Engineer for approval at least one month before the start of the work, the job mix formula proposed for use in the works together with the following details:

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows where each is applicable:
 - a) Binder, as percentage by weight of total mix;
 - b) Coarse aggregate/fine aggregate as percentage by weight of total aggregate;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The results of tests enumerated in Table 500-46 as obtained by the Contractor;

- v) Test results of the physical characteristics of the aggregates to be used;
- vi) Spraying temperature of binder if appropriate.

While working out the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mix and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples selected jointly with the Engineer of all ingredients of the mix shall be furnished by the Contractor as required by the former.

The approved job mix formula shall remain effective unless and until modified by the Engineer. Should a change in the source of materials be proposed, a new job mix formula shall be established by the Contractor and approved by the Engineer before actually using the materials.

518.2.2.4 Permissible Variation from the Job Mix Formula

It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula, subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used, within the limits as specified in Tables 500-13 and 500-18. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

518.2.3 Construction operations

518.2.3.1 Weather and Seasonal Limitations

Construction with cold mix must not be undertaken when ambient temperatures below 10°C are expected, during rain, in standing water, or generally when poor weather is predicted. Bitumen emulsions and cutbacks depend on the evaporation of water and/or solvent for the development of their curing and adhesion characteristics. Cold weather, rain and high humidity slow down the rate of curing. Extra manipulation may be required to remove volatiles in cool and humid conditions. Wind increases the rate of evaporation.

518.2.3.2 Preparation of the Base

The base on which cold mix is to be laid shall be prepared, shaped and levelled to the required profile in accordance with Clauses 501 and 902 as appropriate, and a prime coat, where specified, shall be applied in accordance with Clause 502 or as directed by the Engineer.

518.2.3.3 Tack Coat

A tack coat in accordance with Clause 503 shall be applied over the base on which the cold mix is to be laid where specified in the Contract.

518.2.3.4 Preparation and Transportation of the Mix

Mixing can be carried out using one of the following types of mixer, which is provided with equipment for spraying the binder at a controlled rate and, if necessary, for heating the binder to a temperature at which it can be applied uniformly to the aggregate:

- a) rotary drum type concrete mixer for small jobs or asphalt cold mix plant;
- b) batch or continuous type mixer without dryer

A sufficient number of haul trucks with smooth, clean beds should be available to ensure continuous operation of the mixing plant. The type of truck used for transporting the mixture from the mixer to the road site shall suit to the Contractor's proposed laying procedure methodology.

518.2.3.5 Spreading

Designed cold mix shall be placed by a paver or grader as specified in the Contract. The mix shall not be placed on any wet surface or when weather conditions will otherwise prevent its proper handling or finishing.

If spreading by motor grader, the grader shall have a blade that is straight and sharp and long enough to ensure finishing to close, straight, transverse tolerances and all joints and linkages must be in good condition. The grader must be heavy enough to hold the blade firmly and uniformly on the surface while spreading the mix.

If climatic conditions and aggregate grading do not permit evaporation of moisture or volatiles without aeration by manipulation, a grader shall be used to place designed cold mix.

Other methods of spreading may be used as approved by the Engineer.

518.2.3.6 Compaction

Initial compaction of the laid material shall preferably be carried out using a pneumatic-tired roller of a weight appropriate to the layer thickness to be compacted with single layer thickness being 25-100 mm and all compaction being in accordance with Clauses 501.6 and 501.7. Smooth tyres shall be used. Final rolling and smoothing of the surface should be completed using steel wheel rollers. The Contractor shall demonstrate at laying trials that his proposed laying and compaction methods can achieve a satisfactory result.

518.2.4 Opening to Traffic

Traffic shall not be allowed to run on new work until all the water or volatiles in the mix have evaporated, as determined by the Engineer. The rate of evaporation will be influenced by the temperature, humidity and wind conditions.

518.2.5 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

518.2.6 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

518.2.7 Measurement for Payment

Designed Cold Mix shall be measured as finished work, for the area covered, in cubic metres, by weight in metric tonnes, or by square metres at a specified thickness as specified in the Contract.

518.2.8 Rate

The contract unit rate for Designed Cold Mix shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2. The rate shall cover the provision of the specified grade of cutback in the mix at 5 percent of the weight of the total mix or emulsion at 8 percent of the weight of the total mix. However any variation in quantity of binder will be assessed on the basis of the amount agreed by the Engineer and the payment adjusted, plus or minus, as per the rate for cutback or emulsion quoted in the Bill of Quantities.

518.3 Recipe Cold Mix**518.3.1 Scope**

The work consists of construction of Recipe Cold Mixes composed of aggregate and emulsion binder which are laid immediately after mixing and while the emulsion is still substantially in an unbroken state. These mixes are considered suitable for emergency and repair work and temporary road surface improvement.

518.3.2 Materials**518.3.2.1 Binder**

Emulsions of sufficient stability for mixing with the particular graded aggregate should be used. Bitumen emulsion shall be slow/ medium setting conforming to IS:8887.

518.3.2.2 Aggregates

Any normal, clean, but not necessarily dry, aggregate shall be used, conforming to Clauses 505.2.2 and 505.2.3 provided that it has sufficiently high crushing strength with regard to the traffic to be carried. Typical gradings are given in Table 500-47.

518.3.2.3 Aggregate Grading and Binder Content

When tested in accordance with IS:2386 Part 1 (wet sieving methods) the combined aggregate grading for the particular mix shall fall within the limits shown in Table 500-47. The actual quantity of emulsion to be used shall be approved by the Engineer after seeing the results of trial mixes made in the laboratory.

518.3.3 Construction Operations**518.3.3.1 Weather and Seasonal Limitations**

As per Clause 518.2.3.1.

518.3.3.2 Preparation of Base

As per Clause 518.2.3.2.

518.3.3.3 Tack Coat

A tack coat in accordance with Clause 503 shall be applied over the base on which the cold mix is to be laid if specified in the Contract or required by the Engineer.

518.3.3.4 Preparation and Transportation of the Mix

As per Clause 518.2.3.4.

518.3.3.5 Spreading

As per Clause 518.2.3.5.

Table 500-47 : Composition of Recipe Mixes

Nominal Size (mm) and Type of Course	40 Single Course	40 Open Textured Base Course	14 Open Textured Wearing Course	6 Medium Textured Wearing Course
Allowable Thickness (mm)	75	75	31-50	21-30
IS Sieve Size mm	Cumulative % by weight of total aggregate passing			
45	100	100	–	–
37.5	90-100	90-100	–	–
26.5	55-90	55-85	–	–
19	–	–	100	–
13.2	35-55	15-35	90-100	–
9.5	–	–	55-75	100
6.3	20-30	–	25-45	90-100
3.35	10-20	0-10	15-25	45-65
2.36	–	–	–	75-100
1.18	–	–	–	10-30
0.60	–	–	–	–
0.30	2-10	–	–	–
0.15	–	–	–	–
0.075	–	–	2-6	2-8
Emulsion grade and quantity				
Quantity ⁽¹⁾ Kg/ tonne	55 to 70	45 to 65	70 to 90	85 to 100

518.3.3.6 Compaction

As per Clause 518.2.3.6.

518.3.4 Opening to Traffic

As per Clause 518.2.4.

518.3.5 Surface Finish and Quality Control of Work

As per Clause 518.2.5.

518.3.6 Arrangements for Traffic

As per Clause 518.2.6.

518.3.7 Measurement for Payment

As per Clause 518.2.7.

518.3.8 Rate

The contract unit rate for Recipe Cold Mix shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2. The rate shall cover the provision of the specified grade of emulsion at the lower quantity in the range for each type of mix indicated in Table 500-47. However any variation of quantity in emulsion will be assessed on the basis of the amount agreed by the Engineer and the payment adjusted plus or minus, as per the rate for emulsion quoted in the Bill of Quantities.

519 RECYCLING OF BITUMINOUS PAVEMENT**519.1 Scope**

This work covers the recycling of existing bituminous pavement materials to upgrade an existing bituminous pavement which has served its initially intended purpose. The work shall be performed on such widths and lengths as shall be directed by the Engineer and may consist of pavement removal, stockpiling of materials from the old pavement, addition of new bitumen and untreated aggregates in the requisite proportions, mixing, spreading and compaction of the blended materials.

These specifications cover the hot process.

519.2 Reclaimed Bituminous Materials for Central Plant Recycling

519.2.1 The reclaimed bituminous material shall be used in the production of bituminous macadam and dense bituminous macadam subject to the Clauses 519.2.3 to 519.2.8, and subject to satisfactory completion of full investigations in respect of all related materials entirely at the Contractor's cost and subject to the approval of the Engineer. For

estimation purposes, an amount not greater than 60 per cent of reclaimed bituminous material shall be assumed.

519.2.2 Materials for Recycled Pavement

The recycled materials shall be a blend of reclaimed and new materials proportioned to achieve a paving mixture with the specified engineering properties. The reclaimed materials shall be tested and evaluated to find the optimum blend meeting the mixture requirements. Such testing and evaluation shall be carried out on representative sample, either cores sampled from the carriageway or samples taken from stockpiles in accordance with current practice. The sampling frequency should be sufficient to determine how consistent the reclaimed material is and to provide representative samples for composition analysis and measurement of properties of recovered binder. As an absolute minimum, one sample to represent 500 m two lane carriageway shall be taken.

519.2.3 Bitumen Extraction

The procedure described in ASTM D-2172 shall be used to quantitatively separate aggregates and bitumen from any representative sample of reclaimed bituminous pavement.

519.2.4 Aggregate Evaluation

Mechanical sieve analysis (IS:2386, Part I, wet sieving method) shall be performed on the aggregate portion of the reclaimed bituminous pavement sample to determine the grading. It is essential that the reclaimed materials to be recycled are consistent, as variable materials will cause problems with the control of quality and impede the efficiency of the recycling operation. Suitable sources of consistent material either in existing pavements, from stockpiled of known origin or from another suitable source shall be identified before a decision can be made on the optimum percentage of reclaimed material.

After selecting the proportion of reclaimed materials to be recycled, the grading of the mixture may need adjustment, to meet Specification requirements, by the addition of selected aggregate sizes.

519.2.5 Evaluation of Bitumen

When the amount of reclaimed bituminous materials to be used in the mixture exceeds 10 percent, the penetration value of the recovered binder from the reclaimed bituminous material, before mixing, shall exceed 15 pen, after recovery of binder in accordance with the requirements of BS:2000:Part 397, when tested in accordance with IS:1203. Provided the

above requirement is met, hardening of the old binder, during the original mixing process or through ageing, can be compensated for by adding softer bitumen, to obtain the appropriate final grade of binder.

The determination of the type and amount of binder required to be added in the final mix is essentially a trial and error procedure.

After mixing with recycled materials, the binder recovered from the mixture shall have a recovered penetration value not less than the value specified in Table 500-48.

Table 500-48 : Minimum Recovered Binder Penetration of Recycled Mixture

Specified Grade of Binder Viscosity Grade	Minimum Recovered Penetration Value of Binder after Mixing
40 (45 pen)	27
30 (65 pen)	39
10 (90 pen)	54

519.2.6 Rejuvenators

The use of rejuvenators, and a test to measure their effectiveness, is given in Clause 519.6.3.

519.2.7 Untreated Aggregates

If necessary, fresh untreated aggregates shall be added to the reclaimed bituminous pavement to produce a mix with the desired grading. The aggregate shall be checked for quality requirements in accordance with Table 500-7 or Table 500-10 as appropriate. Reclaimed aggregate, if any, or any aggregate normally used for the desired bituminous mix, or both, may be used for this purpose.

519.2.8 Combined Aggregate Grading

The blend reclaimed and new aggregate shall meet the grading criteria specified in the relevant parts of Clauses 505 or 506, as appropriate and as approved by the Engineer. The blend of aggregates shall be checked for resistance to stripping as specified in Tables 500-7 or 500-10 as appropriate.

519.3 Mixture Design

The combined aggregate grading and binder content shall comply with the relevant tables in Clauses 504 or 505 as appropriate. The mix design shall also comply with the requirements of Table 500-10. There may be a variation on three to four sieves with respect to percent passing, the permissible variation shall not exceed 3 to 4 percent per sieve.

519.4 Reclaiming Old Pavement Materials

The removal of pavement materials to the required depth shall be accomplished either at ambient temperature (cold process) or at an elevated temperature (hot process), as approved by the Engineer.

519.4.1 Cold Removal Process

In the cold process, the ripping and crushing operations shall be carried out using scarifiers, grid rollers, or rippers or by any other means as directed by the Engineer. The removed materials shall be loaded and hauled for crushing to the required size as directed by the Engineer. Alternatively, cold milling or planning machines can be used to reclaim bituminous pavement to controlled depths. Thereafter the bituminous layers are removed, any remaining aggregate materials that are to be incorporated in the recycled hot mix shall be scarified and removed. When the pavement material removal is completed, any drainage deficiencies shall be corrected. After that, the base/sub-base, as the case may be, shall be cut, graded and compacted to the required profile and density.

519.4.2 Hot Removal Process

In the hot process, the road surface shall be heated, by infra-red/ hot-air heating system, before scarification. A self propelled plant fitted with suitable arrangement for heating the existing bituminous surface shall be used. A milling drum shall follow the planer for removing the heated soft bituminous layer. The depth, width and speed of travel shall be adjusted to suit specific requirements as directed by the Engineer. During the heating process, the surface temperature of the road shall not exceed 200°C for more than 5 minutes.

519.4.3 Stockpiling

In the cold process, the reclaimed bituminous pavement material shall be stockpiled with height of stockpiles not exceeding 3 m. The reclaimed untreated aggregate base/sub-base material shall be stockpiled in the same manner as new aggregate. The number and location of stockpiles shall be carefully planned for efficient operation of the hot-mix plant.

519.5 Mixing and Laying

the requirements of Clauses 504.3 or 505.4, as appropriate shall apply.

519.6 In Situ Recycling – The Remix and Repave Processes**519.6.1 Scope**

In the process of repaving, the existing surface is preheated and scarified but the scarified material is not removed. A layer of fresh bituminous mix material prepared in the integrated mixing unit of the plant is then spread evenly on the scarified surface to give a uniform profile. The spread material should be compacted as soon as possible after laying. In the process, the total thickness of the pavement is increased by up to 50 mm.

In the remix process, the scarified material should be taken from the mixing unit of the plant where it is recycled with fresh binder, aggregate and recycling agent. Then the recycled mixture is spread on the preheated surface and tamped and compacted to the required profile.

519.6.2 Heating and Scarifying

Surfaces to be treated shall be heated by plant with surfaces insulated and fully enclosed. The heated width of surfacing shall exceed the scarified width by at least 75 mm on each side, except against the edge of the carriageway or kerb face. When new surfacing material is spilled onto the road surface it shall be removed before the existing surface is heated and scarified. Areas of unscarified material shall not exceed 50 mm x 50 mm.

The depth of scarification shall be such that the bottom of the scarified layer is parallel to and below the finished road surface level by the thickness of wearing course material specified. A tolerance of ± 6 mm is permissible.

Where street furniture and other obstructions occur, these shall be suitably protected or removed and the void covered. Surface dressing and large areas of road markings shall be removed by milling, planning scarifying or by similar approved processes.

The heated surface shall be evenly scarified to comply with the requirements of this Clause. When street furniture is left in place or raised, the adjacent area shall be scarified by other means, with the material either left in place or removed, prior to passage of the machine. If furniture needs to be repositioned on completion of work, the new wearing course material shall be used to make good the road surface for a maximum width of 200 mm around the obstruction.

During the reheating process, the surface temperature of the road shall not exceed 200°C for more than 5 minutes.

519.6.3 Rejuvenator

For Remix, when required, rejuvenator shall be uniformly sprayed across the fullwidth of the processed material. The machine shall incorporate a metre for continuous verification of quantities which shall be within $\pm 5\%$ of the specified rate. The volume of rejuvenator shall vary in relation to the operating speed of the machine, which shall be related to the volume of material mixed or scarified.

The rejuvenator shall be a non-emulsified aromatic extract. Its properties shall be verified using the Rolling Thin Film Oven Test.

Rejuvenation of the existing pavement may also be performed by adding new hot-mix bituminous material containing a soft binder for restoring the binder in the existing pavement to the required viscosity. Use of rejuvenating oil may be resorted to in case the target values of viscosity, penetration and softening are not met.

519.6.4 Mixing

When required, new hot-mix material shall be mixed with the heated and scarified road pavement material in a pugmill within the Remix machine, observing the mixing temperatures specified in Table 500-2.

After mixing, the recycled bituminous materials shall be automatically led to a finishing unit, which spreads and levels the mixture to the specified thickness and cross-section. The new bituminous concrete wearing course shall comply with Clause 507.

519.6.5 Additional Material (General)

The proportion of new hot-mix bituminous material, and the proportion of existing bituminous pavement material shall be as directed by the Engineer, together with the amount the road surface level is to be raised (if any).

The type and quantity of the new hot-mix material shall be determined by using the Marshall Mix Design procedure specified in the Asphalt Institute Manual MS-2, before work commences. Remix designs shall incorporate the stated proportion of material sampled from the existing road surface.

When additional coarse or fine aggregate or filler are required to be added, they shall comply with the requirements of Clause 508.2. The amount of additional coarse or fine aggregate or filler to be added to the existing bituminous pavement material shall be notified to the Engineer.

519.6.6 Additional Aggregate (Remix Process)

The coarse aggregate, fine aggregate and filler added to the Remixed material shall comply with the requirements of Clause 507.2.

519.6.7 New Surfacing (Repave and Remix/Repave Processes)

New surfacing material shall be bituminous concrete wearing course complying with Clause 508, or other wearing course material approved by the Engineer.

The new surfacing material shall be laid on, and compacted with, the reprofiled surfacing, which shall be at a temperature within the range of 100°C to 150°C.

519.6.8 Binder

The binder shall be recovered from samples taken from each layer of material laid. The method of recovery shall be in accordance with BS:2000: Part 397 or an equivalent test. The penetration of the binder shall be in the range 35-70 pen.

519.6.9 Mixture Design

The surfacing material shall be sampled from the paver hopper or augers. Care shall be taken that only the material forming the new surface layer is sampled. The sample shall be reduced at site by rifling or quartering to approximately 5 kg and placed loose in an air-tight container.

The sample shall only be reheated once whilst within the container. As soon as the sample reaches the required temperature, the reheated material shall be remixed and three Marshall test specimens prepared in accordance with the procedures specified in MS-2.

The bulk density of each specimen shall be measured before Marshall Stability testing. The mean stability and flow of the three specimen measured in accordance with the procedures specified in MS-2, shall comply with the requirements of Table 500-11.

The three Marshall specimens shall be combined and the maximum theoretical specific gravity (G_{mm}) of the mix shall be determined in accordance with ASTM D 2041. This maximum theoretical specific gravity (G_{mm}) corresponds to 0% air voids in the mix. The percent air voids (P_a) in the specimen of the compacted mixture given by $P_a = (G_{mm} - G_{mb}) \times 100 / G_{mm}$ shall meet the requirements of air voids laid down in Table 500-10, where G_{mb} is the actual bulk specific gravity of a Marshall specimen determined in the Laboratory.

519.7 Opening to Traffic

For recycled material forming the base or binder course layer, Clauses 504.5 or 505.5 shall apply as appropriate. For recycled material forming the wearing course layer, Clause 508.4 shall apply.

519.8 Surface Finish and Quality Control

The surface finish of the completed construction shall conform to the requirements of Clause 902.

For control of the quality of materials and the works carried out the relevant provisions of Section 900 shall apply.

519.9 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

519.10 Measurement for Payment

The recycled pavement work shall be measured in cubic metres or tonnes of finished work as stated in the Contract.

519.11 Rate

The contract unit rate for recycled pavement shall be payment in full for carrying out the required operations including full compensation for all items as Clause 501.8.8.2.

520 SUPPLY OF STONE AGGREGATES FOR PAVEMENT COURSES**520.1 Scope**

This Clause shall apply to the supply of stone aggregates only. The work shall consist only of collection, transportation and stacking the stone aggregates and stone filler for subsequent use in pavement courses. The actual work of laying the pavement courses shall, however, be governed by the individual Specification Clause for the actual work, given elsewhere in these Specifications. The size and quantities of the aggregates to be supplied shall be so selected by the Engineer that the grading requirements set forth in the individual Specification Clauses for the pavement courses, for which the supply is intended, are satisfied.

All the materials shall be procured from approved sources and shall conform to the physical requirements, specified in the respective Specification Clauses for the individual items given elsewhere in these Specifications.

520.2 Sizes of Stone Aggregates

The stone aggregates shall be designated by their standard sizes in the Contract and shall conform to the requirements shown in Table 500-49.

520.3 Stacking

520.3.1 Coarse Aggregates

Only the aggregates satisfying the Specifications requirements shall be conveyed to the roadside and stacked. Each size of aggregate shall be stacked separately. Likewise, materials obtained from different quarry sources shall be stacked separately and in such a manner that there is no contamination of one source with another.

Table 500-49 : Size Requirements for Coarse Stone Aggregates

S. No.	Nominal Size of Aggregate	Designation of Sieve Through which the Aggregates shall Wholly Pass	Designation of Sieve on which the Aggregates shall be Wholly Retained
1)	75 mm	106 mm	63 mm
2)	63 mm	90 mm	53 mm
3)	45 mm	53 mm	26.5 mm
4)	26.5 mm	45 mm	22.4 mm
5)	22.4 mm	26.5 mm	13.2 mm
6)	13.2 mm	22.4 mm	11.2 mm
7)	11.2 mm	13.2 mm	6.7 mm
8)	6.7 mm	11.2 mm	2.8 mm

520.3.2 Fine Aggregate

As stated in the individual relevant Specification Clauses.

The aggregates shall be stacked clear of the roadway on even clear hard ground, or on a platform prepared in advance for the purpose by the Contractor at his own cost and in a manner that allows correct and ready measurement. If the stockpile is placed on ground

where the scraping action of the loader can contaminate the material with underlying soil, then the stockpile shall be rejected by the Engineer. Materials shall not be stacked in locations liable to inundation or flooding.

The dimensions of the stockpiles and their locations shall be approved by the Engineer. Where the material is improperly stacked, the Engineer shall direct complete re-stacking of the materials in an approved manner at the Contractor's cost.

Stone filler shall be supplied in a dry state in bags or other suitable containers approved by the Engineer and shall be protected from the environment, so as to prevent deterioration in quality.

520.4 Quality Control of Materials

The Engineer shall exercise control over the quality of the materials so as to ascertain their conformity with the Specifications requirements, by carrying out tests for the specified properties in accordance with Section 900 of these Specifications.

Materials shall only be brought to site from a previously tested and approved source, and any materials not conforming to the requirements of the Specification shall be rejected by the Engineer and removed from the work site at the cost of the Contractor.

520.5 Measurement for Payment

Coarse and fine aggregates supplied to the site shall be paid for in cubic metres. The actual volume of the aggregates to be paid for shall be computed after deducting the specified percentages in Table 500-50, from the volume computed by stack measurements, to allow for bulking.

Table 500-50 : Percent Reduction In Volume of Aggregates

S. No.	Standard Size of Aggregates	Percentage Reduction in Volume Computed by Stack Measurements to Arrive at the Volume to be Paid for
1)	75 mm and 63 mm	12.5
2)	45 mm and 26.5 mm	10.0
3)	22.4 mm, 13.2 mm, 11.2 mm and 6.7 mm	5.0
4)	Fine aggregate	5.0

Unless otherwise directed by the Engineer, measurements shall not be taken until sufficient materials for use on the road have been collected and stacked. Immediately after measurement, the stacks shall be marked by white wash or other means as directed by the Engineer.

Stone filler as delivered to the site shall be measured in tonnes.

520.6 Rates

The contract unit rates for different sizes of coarse aggregate, fine aggregate and stone filler shall be payment in full for collecting, conveying and stacking or storing at the site including full compensation for:

- i) all royalties, fees, rents where necessary;
- ii) all leads and lifts; and
- iii) all labour, tools, equipment and incidentals to complete the work to the specifications.
- iv) All necessary testing of material, both initial, to approve the source, and regular control testing thereafter.

600

CONCRETE PAVEMENT

601 DRY LEAN CEMENT CONCRETE SUB-BASE**601.1 Scope**

601.1.1 The work shall consist of construction of (zero slump) dry lean concrete sub-base for cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations, in connection with the work, as approved by the Engineer.

601.1.2 The design parameters of dry lean concrete sub-base, viz., width, thickness, grade of concrete, details of joints, if any, etc. shall be as stipulated in the drawings.

601.2 Materials**601.2.1 Sources of Materials**

The Contractor shall indicate to the Engineer the source of all materials with relevant test data to be used in the dry lean concrete work sufficiently in advance and the approval of the Engineer for the same shall be obtained at least 45 days before the scheduled commencement of the work in trial length. If the Contractor later proposes to obtain the materials from a different source during the execution of main work, he shall notify the Engineer with relevant test data for his approval at least 45 days before such materials are to be used.

601.2.2 Cement

Any of the following types of cement may be used with prior approval of the Engineer:

S. No.	Type	Conforming to
i)	Ordinary Portland Cement 43 Grade	IS:8112
ii)	Portland Slag Cement	IS:455
iii)	Portland Pozzolana Cement	IS:1489-Part I

If the subgrade soil contains soluble sulphates in a concentration more than 0.5 percent, sulphate resistant cement conforming to IS:6909 shall be used.

Cement to be used may preferably be obtained in bulk form. It shall be stored in accordance with stipulations contained in Clause 1014 and shall be subjected to acceptance test prior to its immediate use.

601.2.3 Fly-ash

Fly-ash upto 20 percent by weight of cementitious material (cement+flyash) may be used

along with 43/53 grade cement may be used to replace OPC cement grade 43 upto 30 percent by weight of cement. Fly-ash shall conform to IS:3812 (Part 1) and its use shall be permitted only after ensuring that facilities exist for uniform blending through a proper mechanical facility with automated process control like batch mix plant conforming to IS:4925 and IS:4926.

601.2.4 Aggregates

601.2.4.1 Aggregates for lean concrete shall be natural material complying with IS:383. The aggregates shall not be alkali reactive. The limits of deleterious materials shall not exceed the requirements set forth in Table 600-2. In case the Engineer considers that the aggregates are not free from dirt, the same may be washed and drained for at least 72 hours before batching, or as directed by the Engineer.

601.2.4.2 Coarse Aggregates

Coarse aggregates shall comply with Clause 602.2.6.2, except that the maximum size of the coarse aggregate shall be 26.5 mm, and aggregate gradation shall comply with Table 600-1.

601.2.4.3 Fine Aggregates

The fine aggregate shall comply with Clause 602.2.6.3.

601.2.4.4 The material after blending shall conform to the grading as indicated in Table 600-1.

Table 600-1 : Aggregate Gradation for Dry Lean Concrete

Sieve Designation	Percentage by Weight Passing the Sieve
26.50 mm	100
19.0 mm	75-95
9.50 mm	50-70
4.75 mm	30-55
2.36 mm	17-42
600 micron	8-22
300 micron	7-17
150 micron	2-12
75 micron	0-10

601.2.5 Water

Water used for mixing and curing of concrete shall comply with Clause 602.2.7.

601.2.6 Storage of Materials

All materials shall be stored in accordance with the provisions of Clauses 602.2.12 of these Specifications and other relevant IS Specifications.

601.3 Proportioning of Materials for the Mix

601.3.1 The mix shall be proportioned with a maximum aggregate cementitious material ratio of 15:1. The water content shall be adjusted to the optimum as per Clause 601.3.2 for facilitating compaction by rolling. The strength and density requirements of concrete shall be determined in accordance with Clauses 601.7 and 601.8 by making trial mixes. Care should be taken to prevent one size of aggregate falling into the other size of the hopper of the feeding bin while loading the individual size of aggregates into the bins.

601.3.2 Moisture Content

The optimum water content shall be determined and demonstrated by rolling during trial length construction and the optimum moisture content and degree of compaction shall be got approved from Engineer. While laying in the main work, the lean concrete shall have a moisture content between the optimum and optimum +2 percent, keeping in view the effectiveness of compaction achieved and to compensate for evaporation losses.

601.3.3 Cement Content

The cement content in the dry lean concrete shall be such that the strength specified in Clause 601.3.4 is achieved. The minimum cement content shall be 150 kg/cu.m of concrete. In case flyash is blended at site as part replacement of cement, the quantity of flyash shall not be more than 20 percent by weight of cementitious material and the content of OPC shall not be less than 120 kg/cu.m.

If this minimum is not sufficient to produce dry lean concrete of the specified strength, it shall be increased as necessary by the Contractor at his own cost.

601.3.4 Concrete Strength

The average compressive strength of each consecutive group of 5 cubes made in accordance with Clause 903.5.1.1 shall not be less than 10 MPa at 7 days. In addition, the minimum compressive strength of any individual cube shall not be less than 7.5 MPa at 7 days. The design mix complying with the above Clauses shall be got approved from the Engineer and demonstrated in the trial length construction.

601.4 Sub-grade

The sub-grade shall conform to the grades and cross-sections shown on the drawings and shall be laid and compacted in accordance with Clause 305. The subgrade strength shall

correspond to the design strength specified in the Contract. As far as possible, the construction traffic shall be avoided on the prepared sub-grade.

601.5 Drainage Layer

A drainage layer conforming to Clause 401 shall be laid above the subgrade before laying the Dry Lean Concrete sub-base, as specified in the drawings and the Contract.

601.6 Construction

601.6.1 General

The Dry Lean Concrete shall be laid on the prepared granular drainage layer. The pace and programme of the Dry Lean Concrete sub-base construction shall be matching suitably with the programme of construction of the cement concrete pavement over it. The Dry Lean Concrete sub-base shall be overlaid with concrete pavement only after 7 days of sub-base construction.

601.6.2 Batching and Mixing

The batching plant shall be capable of proportioning the materials by weight, each type of material being weighed separately in accordance with Clauses 602.9.2, 602.9.3.1 and 602.9.3.2.

The design features of Batching Plant should be such that the plant can be shifted quickly.

601.6.3 Transporting

Plant mix lean concrete shall be discharged immediately from the mixer, transported directly to the point where it is to be laid and protected from the weather by covering the tipping trucks with tarpaulin during transit. The concrete shall be transported by tipping trucks, sufficient in number to ensure a continuous supply of material to feed the laying equipment to work at a uniform speed and in an uninterrupted manner. The lead of the batching plant to paving site shall be such that the travel time available from mixing to paving as specified in Clause 601.6.5.2 will be adhered to. Tipping truck shall not have old concrete sticking to it. Each tipping truck shall be washed with water jet before next loading as and when required after inspection.

601.6.4 Placing

Lean concrete shall be placed by a paver with electronic sensor on the drainage layer or as specified in the Contract. The equipment shall be capable of laying the material in one layer

in an even manner without segregation, so that after compaction the total thickness is as specified. The paving machine shall have high amplitude tamping bars to give good initial compaction to the sub-base. One day before placing of the dry lean cement concrete sub-base, the surface of the granular sub-base/drainage layer shall be given a fine spray of water and rolled with a smooth wheeled roller.

Preferably the lean concrete shall be placed and compacted across the full width of the two lane carriageway, by constructing it in one go. In roads with carriageway more than 2 lanes a longitudinal joint shall be provided. Transverse butt type joint shall be provided at the end of the construction in a day. Transverse joints in the concrete pavement shall not be coterminous with the transverse construction joint of the Dry Lean Concrete.

The Dry Lean Concrete shall be laid in such a way that it is at least 750 mm wider on each side than the proposed width including paved shoulders of the concrete pavement. The actual widening shall be decided based on the specifications of the paver, such that the crawler moves on the Dry Lean Concrete, and the cost of extra width shall be borne by the Contractor.

601.6.5 Compaction

601.6.5.1 The compaction shall be carried out immediately after the material is laid and levelled. In order to ensure thorough compaction, rolling shall be continued on the full width till there is no further visible movement under the roller and the surface is well closed. The minimum dry density obtained shall not be less than 98 percent of that achieved during the trial length construction in accordance with Clause 601.7. The densities achieved at the edges i.e. 0.5 m from the edge shall not be less than 96 percent of that achieved during the trial construction.

601.6.5.2 The spreading, compacting and finishing of the lean concrete shall be carried out as rapidly as possible and the operation shall be so arranged as to ensure that the time between the mixing of the first batch of concrete in any transverse section of the layer and the final finishing of the same shall not exceed 90 minutes when the temperature of concrete is between 25°C and 30°C, and 120 minutes if less than 25°C. This period may be reviewed by the Engineer in the light of the results of the trial run but in no case shall it exceed 120 minutes. Work shall not proceed when the temperature of the concrete exceeds 30°C. If necessary, chilled water or addition of ice may be resorted to for bringing down the temperature. It is desirable to stop concreting when the ambient temperature is above 35°C. After compaction has been completed, roller shall not stand on the compacted surface for the duration of the curing period except during commencement of next day's work near the location where work was terminated the previous day.

601.6.5.3 Double drum smooth-wheeled vibratory rollers of minimum 80 to 100 kN

static weight are suitable for rolling dry lean concrete. In case any other roller is proposed, the same shall be got approved from the Engineer, after demonstrating its performance. The number of passes required to obtain maximum compaction depends on the thickness of the dry lean concrete, the compactibility of the mix and the weight and type of the roller and the same as well as the total requirement of rollers for the jobs shall be determined during trial run by measuring in-situ density and the scale of the work to be undertaken.

Except on super elevated portions where rolling shall proceed from the inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First, the edge/edges shall be compacted with a roller running forward and backward. The roller shall then move inward parallel to the centerline of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

601.6.5.4 A preliminary pass without vibration to bed the Dry Lean Concrete down shall be given followed by the required number of passes to achieve the desired density and, a final pass without vibration to remove roller with vibration marks and to smoothen the surface.

Special care and attention shall be exercised during compaction near joints, kerbs, channels, side forms and around gullies and manholes. In case adequate compaction is not achieved by the roller at these locations, use of plate vibrators shall be made, if so directed by the Engineer.

601.6.5.5 The final lean concrete surface on completion of compaction shall be well closed, free from movement under roller and free from ridges, low spots, cracks, loose material, pot holes, ruts or other defects. The final surface shall be inspected immediately on completion and all loose, segregated or defective areas shall be corrected by using fresh lean concrete material, laid and compacted. For repairing honeycombed/hungry surface, concrete with aggregates of size 10 mm and below shall be spread and compacted as per Specifications. It is necessary to check the level of the rolled surface for compliance. Any level/thickness deficiency shall be corrected after applying concrete with aggregates of size 10 mm and below after roughening the surface. Surface regularity also shall be checked with 3 m straight edge. Strength tests shall be carried out, and if deficiency in strength is noticed, at least three (evenly spread) cores of minimum 100 mm dia per km shall be cut to check deficiency in strength. The holes resulting from cores shall be restored by filling with concrete of the specified strength and compacted by adequate rodding.

601.6.5.6 Segregation of concrete in the tipping trucks shall be controlled by moving the dumper back and forth while discharging the mix into the same or by any appropriate means. Paving operation shall be such that the mix does not segregate.

601.6.6 Joints

Construction and longitudinal joints shall be provided as per the drawings.

Transverse butt type joint shall be provided at the end of the construction in a day. Longitudinal construction joint shall be provided only when full width paving is not possible. Transverse joints in Dry Lean concrete shall be staggered from the construction butt type joint in Concrete pavement by 800-1000 mm.

Longitudinal joint in Dry Lean Concrete shall be staggered by 300-400 mm from the longitudinal joint of concrete pavement.

At longitudinal or transverse construction joints, unless vertical forms are used, the edge of compacted material shall be cut back to a vertical plane where the correct thickness of the properly compacted material has been obtained.

601.6.7 Curing

As soon as the lean concrete surface is compacted, curing shall commence. One of the following methods shall be adopted:

- a) Curing may be done by covering the surface by gunny bags/hessian, which shall be kept wet continuously for 7 days by sprinkling water.
- b) The curing shall be done by spraying with approved resin based aluminized reflective curing compound conforming to ASTM-C 309-81 in accordance with Clause 602.9.12. As soon as the curing compound has lost its tackiness, the surface shall be covered with wet hessian for three days. The rate of application shall be as recommended by the supplier.
- c) Wax-based white pigmented curing compound with water retention index of not less than 90 percent shall be used to cure the dry lean concrete. The curing compound shall conform to BS:7542. The compound shall be applied uniformly with a mechanical sprayer and with a hood to protect the spray from the wind. The curing compound shall be applied over the entire exposed surface of the Dry Lean Concrete, including sides and edges, at the rate of 0.2 litres/sq.m, or as recommended by the supplier.

The first application, referred to as curing application shall be applied immediately after the final rolling of Dry Lean Concrete is completed. As soon as the curing compound loses tackiness, the surface shall be covered with wet hessian for three days. The second application of curing compound also referred to as the debonding application, shall be applied 24 to 48 hours prior to the placement of the concrete pavement. Any damaged Dry Lean Concrete shall be corrected prior to the second application. Normally, the manufacturer's instructions shall be followed for its application.

601.7 Trial Mixes

The Contractor shall make trial mixes of dry lean concrete with moisture contents like 5.0, 5.5, 6.0, 6.5 and 7.0 percent using specified cement content, specified aggregate grading and aggregate-cement ratio specified in Clause 601.3.1. Optimum moisture and density shall be established by preparing cubes with varying moisture contents. Compaction of the mix shall be done in three layers with vibratory hammer fitted with a square or rectangular foot as described in Clause 903.5.1.1. After establishing the optimum moisture, a set of six cubes shall be cast at optimum moisture for the determination of compressive strength on the third and the seventh day. Trial mixes shall be repeated if the strength is not satisfactory by increasing cement content. After the mix design is approved, the Contractor shall construct a trial section in accordance with Clause 601.8.

If during the construction of the trial length, the optimum moisture content determined as above is found to be unsatisfactory, the Contractor may make suitable changes in the moisture content to achieve the satisfactory mix. The cube specimens prepared with the changed mix content should satisfy the strength requirement. Before production of the mix, natural moisture content of the aggregate should be determined on a day-to-day basis so that the moisture content could be adjusted. The mix finally designed should neither stick to the rollers nor become too dry resulting in ravelling of surface.

601.8 Trial Length

601.8.1 The trial length shall be constructed at least 14 days in advance of the proposed date of commencement of work. At least 30 days prior to the construction of the trial length, the Contractor shall submit for the Engineer's approval a "Method Statement" giving detailed description of the proposed materials, plant, equipment, mix proportions, and procedure for batching, mixing, laying, compaction and other construction procedures. The Engineer shall also approve the location and length of trial construction which shall be a minimum of 100 m length laid in two days and for full width of the pavement. The trial length shall be outside the main works. The trial length shall contain the construction of at least one transverse construction joint involving hardened concrete and freshly laid Dry Lean Concrete sub-base. The construction of trial length shall be repeated till the Contractor proves his ability to satisfactorily construct the Dry Lean Concrete sub-base.

601.8.2 After the construction of the trial length, the in-situ density of the freshly laid material shall be determined by sand replacement method. Three density holes shall be made at locations equally spaced along a diagonal that bisects the trial length and average of these densities shall be determined. The density holes shall not be made in the strip 500 mm from the edges. The average density obtained from the three samples collected shall be the reference density and is considered as 100 percent. The field density of regular work will be compared with this reference density in accordance with Clauses 601.6.5.1 and 903.5.1.2.

601.8.3 The hardened concrete shall be cut over 3 m width and reversed to inspect the bottom surface for any segregation taking place. The trial length shall be constructed after making necessary changes in the gradation of the mix to eliminate segregation of the mix. The lower surface shall not have honey-combing and the aggregates shall not be held loosely at the edges.

601.8.4 The main work shall not start until the trial length has been approved by the Engineer. After approval has been given, the materials, mix proportions, moisture content, mixing, laying, compaction plant and construction procedures shall not be changed without the approval of the Engineer.

601.9 Tolerances for Surface Regularity, Level, Thickness, Density and Strength

Control of quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

601.10 Traffic

No heavy commercial vehicles like trucks and buses shall be permitted on the dry lean concrete sub-base. Construction vehicles at slow speed may be permitted after 7 days of its construction with the prior approval of the Engineer.

601.11 Measurement for Payment

The unit of measurement for dry lean concrete pavement shall be in cubic metre of concrete placed, based on the net plan area for the accepted thickness shown on the drawings or as directed by the Engineer.

601.12 Rate

The Contract unit rate payable for dry lean concrete sub-base shall be for carrying out the required operations including full compensation for all labour, materials and equipment, mixing, transport, placing, compacting, finishing, curing, rectification of defective surface testing and incidentals such as trial length to complete the work as per Specifications, all royalties, fees, storage and rents where necessary and all leads and lifts.

602 CEMENT CONCRETE PAVEMENT

602.1 Scope

602.1.1 The work shall consist of construction of un-reinforced, dowel jointed, plain

cement concrete pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross sections shown on the drawings. The work shall include furnishing of all plant and equipment, materials and labour and performing all operations in connection with the work, as approved by the Engineer.

602.1.2 The design parameters, viz., thickness of pavement slab, grade of concrete, joint details etc. shall be as stipulated in the drawings.

602.2 Materials

602.2.1 Source of Materials

The Contractor shall indicate to the Engineer the source of all materials to be used in the concrete work with relevant test data sufficiently in advance, and the approval of the Engineer for the same shall be obtained at least 45 days before the scheduled commencement of the work in trial length. If the Contractor subsequently proposes to obtain materials from a different source during the execution of main work, he shall notify the Engineer, with relevant test data, for his approval, at least 45 days before such materials are to be used.

602.2.2 Cement

Any of the following types of cement capable of achieving the design strength may be used with prior approval of the Engineer, but preference shall be to use at least the 43 grade or higher.

S.No.	Type	Conforming to
i)	Ordinary Portland Cement 43 Grade	IS:8112
ii)	Ordinary Portland Cement 53 Grade	IS:12269
iii)	Portlant slag cement	IS:455
iv)	Portland Pozzolana Cement	IS:1489-Part I

If the soil around concrete pavement has soluble salts like sulphates in excess of 0.5 percent, the cement used shall be sulphate resistant and shall conform to IS:12330.

Cement to be used may preferably be obtained in bulk form. If cement in paper bags is proposed to be used, there shall be bag-splitters with the facility to separate pieces of paper bags and dispose them off suitably. No paper pieces shall enter the concrete mix. Bulk cement shall be stored in accordance with Clause 1014. The cement shall be subjected to acceptance test.

Fly-ash upto 20 percent by weight of cementitious material may be used in Ordinary Portland

Cement 43 and 53 Grade as part replacement of cement provided uniform blending with cement is ensured. The fly ash shall conform to IS:3812 (Part I).

Site mixing of fly ash shall be permitted only after ensuring availability of the equipments at site for uniform blending through a specific mechanised facility with automated process control like batch mix plants conforming to IS:4925 and IS:4926. Site mixing will not be allowed otherwise.

The Portland Pozzolana Cement produced in factory as per IS:1489-Part I shall not have fly-ash content more than 20 percent by weight of cementitious material. Certificate from the manufacturer to this effect shall be produced before use.

602.2.3 Chemical Admixtures

Admixtures conforming to IS:9103 and IS:6925 shall be permitted to improve workability of the concrete and/or extension of setting time, on satisfactory evidence that they will not have any adverse effect on the properties of concrete with respect to strength, volume change, durability and have no deleterious effect on steel bars. The particulars of the admixture and the quantity to be used, must be furnished to the Engineer in advance to obtain his approval before use. Satisfactory performance of the admixtures should be proved both on the laboratory concrete trial mixes and in the trial length paving. If air entraining admixture is used, the total quantity of air shall be 5 ± 1.5 percent for 31.5 mm maximum nominal size aggregate (in air-entrained concrete as a percentage of the volume of the mix).

602.2.4 Silica Fumes

Silica fume conforming to a standard approved by the Engineer may be used as an admixture in the proportion of 3 to 10 percent of cement. Silica fume shall comply with the requirements given in IS:15388-2003, IS:456-2000, IRC:SP:76 and IRC:44-2008.

602.2.5 Fibres

Fibres may be used subject to the provision in the design/approval by the Engineer to reduce the shrinkage cracking and post-cracking. The fibres may be steel fibre as per IRC:SP:46 or polymeric Synthetic fibres within the following range of specifications:

Effective Diameter	10 micron – 100 micron
Length	6-48 mm
Specific gravity	more than 1.0
Suggested dosage	0.6-2.0 kg/cu.m (0.2 - 0.6% by weight of cement in mix) Usage will be regulated as stipulated in IRC:44/IS:456
Water absorption	less than 0.45 percent
Melting point of this fibre shall not be less than 160°C.	
The aspect ratio generally varies from 200 to 2000.	
These synthetic fibres will have good alkali and UV light resistance.	

When fibres are used, the mix shall be so designed that the slump of concrete at paving site is 25 ± 15 mm.

602.2.6 Aggregates

602.2.6.1 Aggregates for pavement concrete shall be natural material complying with IS:383 but with a Los Angeles Abrasion Test value not exceeding 35 percent. The limits of deleterious materials shall not exceed the requirements set out in Table 600-2.

Table 600-2 : Permissible Limits of Deleterious Substances in Fine and Coarse Aggregates

S. No.	Deleterious Substance	Method of Test	Fine Aggregate Percentage by Weight, (Max)		Coarse Aggregate Percentage by Weight (Max)	
			Uncrushed	Crushed*	Uncrushed	Crushed*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Coal and lignite	IS:2386 (Part II)-1963	1.0	1.0	1.0	1.0
ii)	Clay lumps	do	1.0	1.0	1.0	1.0
iii)	Materials finer than 75 μ IS Sieve	IS:2386 (Part I)-1963	3.0	8.0	3.0	3.0
iv)	Soft fragments	IS:2386 (Part II)-1963	–	–	3.0	–
v)	Shale	IS:2386 (Part II)-1963	1.0	–	–	–
vi)	Total of percentages of all deleterious materials (except mica) including SI No. (i) to (v) for col 4, 6 and 7 and SI No. (i) and (ii) for col 5 only		5.0	2.0	5.0	5.0

* Crushed aggregate at least one face fractured

Note: The presence of mica in the fine aggregate has been found to reduce considerably the durability and compressive strength of concrete and further investigations are underway to determine the extent of the deleterious effect of mica. It is advisable, therefore, to investigate the mica content of fine aggregate and make suitable allowances for the possible reduction in the strength of concrete or mortar; in cases where the stretch of the project road passes through micaceous belt.

The aggregates shall be free from chert, flint, chalcedony or other silica in a form that can react with the alkalis in the cement. In addition, the total chlorides content expressed as chloride ion content shall not exceed 0.06 percent by weight and the total sulphate content expressed as sulphuric anhydride (SO_3) shall not exceed 0.25 percent by weight. In case the Engineer considers that the aggregates are not free from dirt, the same may be washed and drained for atleast 72 hours before batching, as directed by the Engineer.

602.2.6.2 Coarse Aggregates

Coarse aggregates shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone or crushed gravel and shall be devoid of pieces of disintegrated stone, soft, flaky, elongated, very angular or splintery pieces. The maximum size of coarse aggregate shall not exceed 31.5 mm for pavement concrete. No aggregate which has water absorption more than 2 percent shall be used in the concrete mix. The aggregates shall be tested for soundness in accordance with IS:2386 (Part-5). After 5 cycles of testing, the loss shall not be more than 12 percent if sodium sulphate solution is used or 18 percent if magnesium sulphate solution is used. The Los Angeles Abrasion value shall not exceed 35. The combined flakiness and elongation index of aggregate shall not be more than 35 percent.

602.2.6.3 Fine Aggregates

The fine aggregates shall consist of clean natural sand or crushed stone sand or a combination of the two and shall conform to IS:383. Fine aggregate shall be free from soft particles, clay, shale, loam, cemented particles, mica and organic and other foreign matter. The fine aggregates shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part 37).

602.2.6.4 Combined Gradation of Fine and Coarse Aggregates

The combined gradation of fine and coarse aggregates shall be as per Table 600-3.

Table 600-3 : Aggregate Gradation for Pavement Quality Concrete

Sieve Designation	Percentage by Weight Passing the Sieve
31.5 mm	100
26.5 mm	85-95
19.0 mm	68-88
9.5 mm	45-65
4.75 mm	30-55
600 micron	8-30
150 micron	5-15
75 micron	0-5

602.2.7 Water

Water used for mixing and curing of concrete shall be clean and free from injurious amount of oil, salt, acid, vegetable matter or other substances harmful to the finished concrete. It shall meet the requirements stipulated in IS:456.

602.2.8 Steel for Dowels and Tie Bars

Steel shall conform to the requirements of IS:432 and IS:1786 as relevant. The dowel bars shall conform to IS:432 of Grade I. Tie bars shall be either High yield Strength Deformed bars conforming to IS:1786 and grade of Fe 500 or plain bars conforming to IS:432 of Grade I. The steel shall be coated with epoxy paint for protection against corrosion.

602.2.9 Joint Filler Board

Synthetic Joint filler board for expansion joints shall be used only at abutting structures like bridges and shall be of 20-25 mm thickness within a tolerance of ± 1.5 mm and of a firm compressible material and complying with the requirements of IS:1838, with a compressibility more than 25 percent. It shall be 25 mm less in depth than the thickness of the slab within a tolerance of ± 3 mm and provided to the full width between the side forms. It shall be in suitable lengths which shall not be less than one lane width. If two pieces are joined to make up full width, the joint shall be taped such that no slurry escapes through the joint. Holes to accommodate dowel bars shall be accurately bored or punched out to give a sliding fit on the dowel bars.

602.2.10 Joint Sealing Compound

The joint sealing compound shall be of hot poured, elastomeric type or cold polysulphide/polyurethane/silicone type having flexibility, resistance to age hardening and durability as per IRC:57. Manufacturer's certificate shall be produced by the Contractor for establishing that the sealant is not more than six months old and stating that the sealant complies with the relevant standard mentioned below. The samples shall meet the requirements as mentioned in IRC:57.

If sealant is of hot poured type, it shall conform to

Hot applied sealant : IS:1834 or ASTM : 3406-95, as applicable

Cold poured sealants shall be one of the following :

- | | | |
|------|--------------|--------------------------------------|
| i) | polysulphide | IS:11433 (Part I), BS:5212 (Part II) |
| ii) | polyurethane | BS:5212 |
| iii) | silicone | ASTM 5893-04 |

602.2.11 Preformed Seals

The pre-formed joint sealing material shall be a vulcanized elastomeric compound using polychloroprene (Neoprene) as the base polymer.

The joint seal shall conform to requirements of ASTM D 2628 as given in Table 600-4.

Table 600-4 : Requirement of Preformed Seals as per ASTM D 2628

S. No.	Description	Requirements	ASTM Test Methods
1)	Tensile strength, min	13.8 MPa	D 412
2)	Elongation at break	Min. 250%	D 412
3)	Hardness, Type A durometer	55 +/-5 points	D 2240
4)	Oven aging, 70 h at 100°C Tensile strength loss	20% max	D 573
5)	Elongation loss	20% max	
6)	Hardness Change Type A durometer	0 to +10 points	D 471
7)	Oil Swell, ASTM Oil 3, 70 h at 100°C Weight Change	45% max	D 1149
8)	Ozone resistance 20 percent strain, 300 pphm in air, 70 h at 40°C	No cracks	D 2240
9)	Low temperature stiffening, 7 days at -10°C Hardness Change type A durometer	0 to +15 points	
10)	Low temperature recovery, 22h at -10°C, 50% deflection	88% min	D 2628
11)	Low temperature recovery, 22h at -29°C, 50% deflection	83% min	D 2628
12)	Low temperature recovery, 70h at -100°C, 50% deflection	85% min	D 2628
13)	Compression, deflection, at 80% of normal width (min)	613 N/m	D 2628

602.2.12 Storage of Materials

All materials shall be stored in accordance with the provisions of Clause 1014 of the Specifications. All efforts shall be made to store the materials in proper places so as to prevent their deterioration or contamination by foreign matter and to ensure their satisfactory quality and fitness for the work. The platform where aggregates are stock piled shall be paved and elevated from the ground atleast by 150 mm. The area shall have slope to drain off rain water. The storage space must also permit easy inspection, removal and storage of the materials. Aggregates of different sizes shall be stored in partitioned stack-yards. All such

materials even though stored in approved godowns must be subjected to acceptance test as per Clause 903 of these Specifications prior to their use.

602.3 Proportioning of Concrete

602.3.1 After approval by the Engineer of all the materials to be used in the concrete, the Contractor shall submit the mix design based on weighed proportions of all ingredients for the approval of the Engineer vide Clause 602.3.4. The mix design shall be submitted at least 30 days prior to the paving of trial length and the design shall be based on laboratory trial mixes using the approved materials and methods as per IRC:44 or IS:10262. The target mean strength for the design mix shall be determined as indicated in Clause 602.3.3.1. The mix design shall be based on the flexural strength of concrete.

602.3.2 Cement Content

When Ordinary Portland Cement (OPC) is used the quantity of cement shall not be less than 360 kg/cu.m. In case fly ash grade I (as per IS:3812) is blended at site as part replacement of cement, the quantity of fly ash shall be upto 20 percent by weight of cementitious material and the quantity of OPC in such a blend shall not be less than 310 kg/cu.m. The minimum of OPC content, in case ground granulated blast furnace slag cement blended, shall also not be less than 310 kg/m³. If this minimum cement content is not sufficient to produce concrete of the specified strength, it shall be increased as necessary by the contractor at his own cost.

602.3.3 Concrete Strength

602.3.3.1 The characteristic flexural strength of concrete shall not be less than 4.5 MPa unless specified otherwise. Target mean flexural strength for mix design shall be more than $4.5 \text{ MPa} + 1.65s$, where s is standard deviation of flexural strength derived by conducting test on minimum 30 beams. While designing the mix in the laboratory, correlation between flexural and compressive strengths of concrete shall be established on the basis of at least thirty tests on specimens. However, quality control in the field shall be exercised on the basis of flexural strength. It may, however, be ensured that the materials and mix proportions remain substantially unaltered during the daily concrete production. The water content shall be the minimum required to provide the agreed workability for full compaction of the concrete to the required density as determined by the trial mixes or as approved by the Engineer and the maximum free water cement ratio shall be 0.45 when only OPC is used and 0.50 when blended cement (Portland Pozzolana Cement or Portland Slag Cement or OPC blended with fly ash or Ground Granulated Blast Furnance Slag, at site) is used.

602.3.3.2 The ratio between the 7 and 28 day strength shall be established for the mix to be used in the slab in advance, by testing pairs of beams and cubes at each stage on at least six batches of trial mix. The average strength of the 7 day cured specimens shall be divided by the average strength of the 28 day specimens for each batch, and the ratio "R" shall be determined. The ratio 'R' shall be expressed to three decimal places.

If during the construction of the trial length or during some normal working, the average value of any four consecutive 7 day test results falls below the required 7 day strength as derived from the value of 'R' then the cement content of the concrete shall, without extra payment, be increased by 5 percent by weight or by an amount agreed by the Engineer. The increased cement content shall be maintained at least until the four corresponding 28 day strengths have been assessed for in conformity with the requirements as per Clause 602.3.3.1. Whenever the cement content is increased, the concrete mix shall be adjusted to maintain the required workability.

602.3.4 Workability

602.3.4.1 The workability of the concrete at the point of placing shall be adequate for the concrete to be fully compacted and finished without undue flow. The optimum workability for the mix to suit the paving plant being used shall be determined by the Contractor and approved by the Engineer. The control of workability in the field shall be exercised by the slump test as per IS:1199.

602.3.4.2 The workability requirement at the batching and mixing plant and paving site shall be established by slump tests carried during trial paving. These requirements shall be established from season to season and also when the lead from batching and mixing plant site to the paving site changes. The workability shall be established for the type of paving equipment available. A slump value in the range of 25 ± 15 mm is reasonable for paving works but this may be modified depending upon the site requirement and got approved by the Engineer. These tests shall be carried out on every tipping truck/dumper at batching and mixing plant site and paving site initially when the work commences but subsequently the frequency can be reduced to alternate tipping trucks or as per the instructions of the Engineer.

602.3.5 Design Mix

602.3.5.1 The Contractor shall carry out laboratory trials of design mix with the materials from the approved sources to be used as per IRC:44. Trial mixes shall be made in presence of the Engineer or his representative and the design mix shall be subject to the approval of the Engineer. They shall be repeated, if necessary, until the proportions, that will produce a concrete which complies in all respects with these Specifications, and conform to the requirements of the design/drawings.

602.3.5.2 The proportions determined as a result of the laboratory trial mixes may be adjusted, if necessary, during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer.

602.3.5.3 Any change in the source of materials or mix proportions proposed by the Contractor during the course of work shall be assessed by making laboratory trial mixes and the construction of a further trial length of length not less than 50 m unless approval is given by the Engineer for minor adjustments like compensation for moisture content in aggregates or minor fluctuations in the grading of aggregate.

602.4 Sub-base

The cement concrete pavement shall be laid over the sub-base constructed in accordance with the relevant drawings and Specifications. It shall be ensured that the sub-base is not damaged before laying the concrete pavement. If the dry lean concrete sub-base is found damaged at some places or it has cracks wider than 10 mm, it shall be repaired with fine cement concrete (aggregate size 10 mm and down) or bituminous concrete before laying separation membrane layer.

602.5 Separation Membrane

A separation membrane shall be used between the concrete slab and the sub-base. Separation membrane shall be impermeable PVC sheet 125 micron thick transparent or white in colour laid flat with minimum creases. Before placing the separation membrane, the sub-base shall be swept clean of all the extraneous materials using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300 mm and any damaged sheathing shall be replaced at the Contractor's cost. The separation membrane may be nailed to the lower layer with concrete nails. The separation membrane shall be omitted when two layers of wax-based curing compound is used.

602.6 Joints

602.6.1 The locations and type of joints shall be as shown in the drawing. Joints shall be constructed depending upon their functional requirement. The location of the joints should be transferred accurately at the site and mechanical saw cutting of joints done as per stipulated dimensions. It shall be ensured that the required depth of cut is made from edge-to-edge of the pavement. Transverse and longitudinal joints in the pavement and Dry Lean Concrete sub-base shall be staggered so that they are not coincident vertically and are at least 800 to 1000 mm and 300 to 400 mm apart respectively. Sawing of joints shall be carried out with diamond studded blades soon after the concrete has hardened to take the load of the sawing machine and crew members without damaging the texture of the pavement.

Sawing operation could start as early as 4-8 hours after laying of concrete pavement but not later than 8 to 12 hours depending upon the ambient temperature, wind velocity, relative humidity and required maturity of concrete achieved for this purpose.

When the kerb is cast integrally with the main pavement slab, the joint cutting shall also be extended to the kerb.

Where the use of maturity meter is specified, sawing should not be initiated when the compressive strength of the concrete is less than 2 MPa and should be completed before it attains the compressive strength of 7 MPa.

602.6.2 Transverse Joints

602.6.2.1 Transverse joints shall be contraction, construction and expansion joints constructed at the spacing described in the drawings. Transverse joints shall be straight within the following tolerances along the intended line of joints.

- i) Deviations of the performed filler board (IS:1838) in the case of expansion joints from the intended line of the joint shall not be greater than ± 10 mm.
- ii) The best fit straight line through the joint grooves as constructed shall be not more than 25 mm from the intended line of the joint.
- iii) Deviations of the joint groove from the best fit straight line of the joint shall not be greater than 10 mm.
- iv) Transverse joints on each side of the longitudinal joint shall be in line with each other and of the same type and width. Transverse joints shall have a sealing groove which shall be sealed in compliance with Clause 602.10.

602.6.2.2 Contraction Joints

The contraction joints shall be placed transversely at pre-specified locations as per drawings/design using dowel bars. These joints shall be cut as soon as the concrete has undergone initial hardening and is hard enough to take the load of joint sawing machine without causing damage to the slab.

Contraction joints shall consist of a mechanical sawn joint groove, 3 to 5 mm wide and one-fourth to one-third depth of the slab ± 5 mm or as stipulated in the drawings and dowel bars complying with Clause 602.6.5.

Contraction joint shall be widened subsequently to accommodate the sealant as per Clause 602.10, to dimensions shown on drawings or as per IRC:57.

602.6.2.3 Expansion Joints

The expansion joint shall consist of a joint filler board complying with Clause 602.2.9 and dowel bars complying with Clause 602.6.5 and as detailed in the drawings. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the

joint within the tolerances given in Clause 602.6.2.1. The adjacent slabs shall be completely separated from each other by the joint filler board.

602.6.3 Transverse Construction Joint

Transverse construction joint shall be placed whenever concreting is completed after a day's work or is suspended for more than 30 minutes. These joints shall be provided at location of contraction joints using dowel bars. If sufficient concrete has not been mixed to form a slab extending upto a contraction joint, and if an interruption occurs, the concrete placed shall be removed upto the last preceding joint and disposed of. At all construction joints, steel bulk heads shall be used to retain the concrete. The surface of the concrete laid subsequently shall conform to the grade and cross sections of the previously laid pavement. When positioning of bulk head/stop-end is not possible, concreting to an additional 1 or 2 m length may be carried out to enable the movement of joint cutting machine so that joint grooves may be cut and the extra 1 or 2 m length is cut out and removed subsequently after concrete has hardened.

After minimum 14 days of curing, in case OPC cement is used and 16 days of curing when flyash or blended cement is used, the construction joint shall be widened to accommodate the sealant as per Clause 602.10 to dimensions shown on drawing or as per IRC:57.

602.6.4 Longitudinal Joint

602.6.4.1 The longitudinal joints shall be constructed by forming or by sawing as per details of the joints shown in the drawing. Sawed longitudinal joints shall be constructed when the concrete pavement placement width exceeds 4.5 m. The groove may be cut after the final set of the concrete. Joints should be sawn to at least one-third the depth of the slab ± 5 mm as indicated in the drawing. The joint shall be widened subsequently to dimensions shown on the drawings.

Where adjacent lanes of pavement are constructed separately using slip form pavers or side forms, the tie bars may be bent at right angles against the vertical face/ side of the first lane constructed and straightened before placing concrete in the adjacent lane. Broken or damaged tie bars shall be repaired or replaced as required.

The groove for sealant shall be cut in the pavement lane placed later.

602.6.4.2 Tie Bars

Tie bars shall be provided at the longitudinal joints as per dimensions and spacing shown in the drawing and in accordance with Clause 602.6.6. The direction of the tie bars at curves shall be radial in the direction of the radius.

602.6.5 Dowel Bars

602.6.5.1 Dowel bars shall be mild steel rounds in accordance with Clause 602.2.8 with details/dimensions as indicated in the drawings and free from oil, dirt, loose rust or scale. They shall be straight, free of irregularities and burring restricting slippage in the concrete. The sliding ends shall be sawn or cropped cleanly with no protrusions outside the normal diameter of the bar. Any protrusions shall be removed by grinding the ends of the dowel bars. The dowel bar shall be supported on cradles/dowel chairs in pre-fabricated joint assemblies positioned prior to the construction of the slabs or mechanically inserted with vibration into the plastic concrete by a method which ensures correct placement of the bars besides full re-compaction of the concrete around the dowel bars.

602.6.5.2 Unless shown otherwise on the drawings, dowel bars shall be positioned at mid depth of the slab within a tolerance of ± 20 mm, and centered equally about intended lines of the joint within a tolerance of ± 25 mm. They shall be aligned parallel to the finished surface of the slab and to the centre line of the carriageway and to each other within tolerances given here-in-under, the compliance of which shall be checked as per Clause 602.11.7.

- i) For bars supported on cradles prior to the laying of the slab:
 - a) All bars in a joint shall be within ± 2 mm per 300 mm length of bar
 - b) 2/3rd of the number of bars shall be within ± 3 mm per 500 mm length of bar
 - c) No bar shall differ in alignment from an adjoining bar by more than 3 mm per 300 mm length of bar in either the horizontal or vertical plane
 - d) Cradles supporting dowel bar shall not extend across the line of joint i.e. no steel bar of the cradle assembly shall be continuous across the joint.
- ii) For all bars inserted after laying of the slab except those inserted by a Dowel Bar Inserter the tolerance for alignment may be twice as indicated in (i) above.

The transverse joints at curves shall be radial in the direction of the radius.

602.6.5.3 Dowel bars, supported on cradles in assemblies, when subject to a load of 110 N applied at either end and in either the vertical or horizontal direction (upwards and downwards and in both directions horizontally) shall conform to be within the limits given in Clause 602.6.5.2.

602.6.5.4 The assembly of dowel bars and supporting cradles, including the joint filler

board in the case of expansion joints, shall have the following degree of rigidity when fixed in position:-

- i) For expansion joints, the deflection of the top edge of the filler board shall be not greater than 13 mm, when a load of 1.3 kN is applied perpendicular to the vertical face of the joint filler board and distributed over a length of 600 mm by means of a bar or timber packing, at mid depth and midway between individual fixings, or 300 mm from either end of any length of filler board, if a continuous fixing is used. The residual deflection after load shall be not more than 3 mm.
- ii) The fixings for joint assembly shall not fail under 1.3 kN load and shall fail before the load reaches 2.6 kN when applied over a length of 600 mm by means of a bar or timber packing placed as near to the level of the line of fixings as practicable.
- iii) Fixings shall be deemed to fail when there is displacement of the assemblies by more than 3 mm with any form of fixing, under the test load. The displacement shall be measured at the nearest part of the assembly to the centre of the bar or timber packing.

602.6.5.5 Dowel bars in the contraction joints, construction joints and expansion joints shall be covered by a thin plastic sheath. The thickness of the sheath shall not exceed 0.5 mm and shall be tightly fitted on the bar for at least two-thirds of the length from one end for dowel bars in contraction/construction joints and half the length plus 50 mm for expansion joints. The sheathed bar shall comply with the following pull-out tests:

Four bars shall be taken at random from stock and without any special preparation shall be covered by sheaths as required in this Clause. The ends of the dowel bars which have been sheathed shall be cast centrally into concrete specimens 150 mm x 150 mm x 600 mm, made of the same mix proportions to be used in the pavement, but with a maximum nominal aggregate size of 20 mm and cured in accordance with IS:516. At 7 days a tensile load shall be applied to achieve a movement of the bar of at least 0.25 mm. The average bond stress to achieve this movement shall not be greater than 0.14 MPa.

602.6.5.6 For expansion joints, a closely fitting cap 100 mm long consisting of waterproofed cardboard or an approved synthetic material like PVC or GI pipe shall be placed over the sheathed end of each dowel bar. An expansion space (about 25 mm) at least equal in length to the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar by using compressible sponge. To block the entry of cement slurry into the annular space between the sheathing and dowel bar shall be taped around its mouth.

602.6.6 Tie Bars

602.6.6.1 Tie bars in longitudinal joints shall be deformed steel bars of strength 500 MPa complying with IS:1786 and in accordance with the requirements given in this Clause. The bars shall be free from oil, dirt, loose rust and scale.

602.6.6.2 Tie bars projecting across the longitudinal joint shall be protected from corrosion for 75 mm on each side of the joint by a protective coating of bituminous paint with the approval of the Engineer. The coating shall be dry when the tie bars are used. In the case of coastal region and high rainfall areas, tie bars shall be epoxy coated in their full length as per IS:13620.

602.6.6.3 Tie bars in longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during the construction of the slab. Alternatively, tie bars at longitudinal joints may be mechanically or manually inserted into the plastic concrete from above by vibration using a method which ensures correct placements of the bars and recompaction of the concrete around the tie bars.

602.6.6.4 Tie bars shall be positioned to remain in the middle from the top or within the upper middle third of the slab depth as indicated in the drawings and approximately parallel to the surface and approximately perpendicular to the line of the joint, with the centre of each bar on the intended line of the joints within a tolerance of ± 50 mm, and with a minimum cover of 30 mm below the joint groove. Spacing of tie bars on curves of radius less than 360 m shall not be less than 350 mm.

602.6.6.5 To check the position of the tie bars, one metre length, 0.5 m on either side of the longitudinal joint shall be opened when the concrete is green (within 20 to 30 minutes). The pit shall be refilled with the fresh concrete of same mix after checking.

602.7 Weather and Seasonal Limitations

602.7.1 Concreting during Monsoon Months

Concreting should be avoided during rainy season. However, when concrete is being placed during monsoon months and when it may be expected to rain, sufficient supply of tarpaulin or other waterproof cloth shall be provided along the line of the work. Any time when it rains, all freshly laid concrete which had not been covered for curing purposes shall be adequately protected. Any concrete damaged by rain shall be removed and replaced. If the damage is limited to texture, it shall be retextured in accordance with the directions of the Engineer.

602.7.2 Temperature Limitation

No concreting shall be done when the temperature of the concrete reaching the paving site is above 30°C. Besides, in adverse conditions like high temperature, low relative humidity, excessive wind velocity, imminence of rains etc., tents on mobile trusses may be provided over the freshly laid concrete for a minimum period of 3 hours as directed by the Engineer. To bring down the temperature, if necessary, chilled water or ice flakes should be made use of. When the ambient temperature is more than 35°C, no concreting shall be permitted. The ice

flakes should not be manufactured from chlorinated water. Generally the rate of evaporation of water shall not exceed 1 kg/sqm/hour as per IRC:15.

No concreting shall be done when the concrete temperature is below 5°C and the temperature is further falling.

602.8 Fixed Form Paving

602.8.1 Side Forms and Rails

These shall be provided in case of fixed form paving. All side forms shall be of mild steel of depth equal to the thickness of pavement or slightly less to accommodate the surface irregularity of the sub-base. The forms can be placed in series of steel packing plates or shims to take care of irregularity of sub-base. They shall be sufficiently robust and rigid to support the weight and pressure caused by a paving equipment. Side forms for use with wheeled paving machines shall incorporate metal rails firmly fixed at a constant height below the top of the forms. The forms and rails shall be firmly secured in position by not less than 3 stakes/pins for every 3 m length so as to prevent movement in any direction. Forms and rails shall be straight within a tolerance of 3 mm in 3 m and when in place shall not settle in excess of 1.5 mm in 3 m while paving is being done. Forms shall be cleaned and oiled immediately before each use. The forms shall be bedded on a continuous bed of low moisture content lean cement mortar or concrete and set to the line and levels shown on the drawings within tolerances ± 10 mm and ± 3 mm respectively. The bedding shall not extend under the slab and there shall be no vertical step between adjacent forms of more than 3 mm. The forms shall be got inspected by the Engineer for his approval 12 hours before construction of the slab and shall not be removed until at least 12 hours afterwards. No concreting shall commence till formwork has been approved by the Engineer.

602.8.2 At all times sufficient forms shall be used and set to the required alignment for at least 300 m length of pavement immediately in advance of the paving operations, or the anticipated length of pavement to be laid within the next 24 hours whichever is more.

602.8.3 Slip Form Paving

602.8.3.1 Use of Guidewires

Where slip form paving is proposed, a guidewire shall be provided along both sides of the slab. Each guidewire shall be at a constant height above and parallel to the required edges of the slab as described in the contract drawing within a vertical tolerance of ± 3 mm. Additionally, one of the wires shall be kept at a constant horizontal distance from the required edge of the pavement as indicated in the contract drawing within a lateral tolerance of ± 10 mm.

602.8.3.2 The guidewires shall be supported on stakes 5–6 m apart by connectors capable of fine horizontal and vertical adjustment. The guidewire shall be tensioned on the stakes so that a 500 gm weight shall produce a deflection of not more than 20 mm when suspended at the mid point between any pair of stakes. The ends of the guidewires shall be anchored to fixing point or winch and not on the stakes. On the curves, the stakes shall be fixed at not more than 3 m centre-to-centre.

602.8.3.3 The stakes shall be positioned and hammered into the ground and the connectors will be maintained at their correct height and alignment from 12 hours on the day before concreting takes place till after finishing of texturing and spraying of curing compound on the concrete.

However, the guidewire shall be erected and tensioned on the connectors at any section for at least 2 hours before concreting that section.

602.8.3.4 The Contractor shall submit to the Engineer for his approval of line and level, the stakes and connectors which are ready for use in the length of road to be constructed next day. Such approval shall be obtained atleast 12 hours before commencement of paving operation. Any deficiencies noted by the Engineer shall be rectified by the Contractor who shall then re-apply for approval of the affected stakes. Work shall not proceed until the Engineer has given his approval. It shall be ensured that the stakes and guidewires are not affected by the construction equipment when concreting is in progress.

602.9 Construction

602.9.1 General

A systems approach may be adopted for construction of the pavement, and the Method Statement for carrying out the work, detailing all the activities, indication of time-cycle, equipment, personnel etc., shall be got approved from the Engineer before the commencement of the work. This shall include the type, capacity and make of the batching and mixing plant besides the hauling arrangement and paving equipment. The capacity of paving equipment, batching plant as well as all the ancillary equipment shall be adequate for a paving rate of atleast 500 m in one day. The paving speed of slip-form paver shall not be less than 1.0 m per minute. The concreting should proceed continuously without stops and starts.

602.9.2 Batching and Mixing

Batching and mixing of the concrete shall be done at a central batching and mixing plant with automatic controls, located at a suitable place which takes into account sufficient space for stockpiling of cement, aggregates and stationary water tanks. This shall be located at an approved distance, duly considering the properties of the mix and the transporting arrangements available with the Contractor.

602.9.3 Equipment for Proportioning of Materials and Paving

602.9.3.1 Proportioning of materials shall be done in the batching plant by weight, each type of material being weighed separately. The cement from the bulk stock may be weighed separately from the aggregates. Water shall be measured by volume. Specified percentage of plasticizer in volume will be added by weight of cement. Wherever properly graded aggregate of uniform quality cannot be maintained as envisaged in the mix design, the grading of aggregates shall be controlled by appropriate blending techniques. The capacity of batching and mixing plant shall be at least 25 percent higher than the proposed capacity of the laying/paving equipment.

602.9.3.2 Batching Plant and Equipment :

- 1) **General :** The batching plant shall include minimum four bins, weighing hoppers, and scales for the fine aggregates and for each size of coarse aggregate. If cement is used in bulk, a separate scale for cement shall be included. There shall be a separate bin for flyash, if this additive is specified. The weighing hoppers shall be properly sealed and vented to preclude dust during operation. Approved safety devices shall be provided and maintained for the protection of all personnel engaged in plant operation, inspection and testing. The batch plant shall be equipped with a suitable non-resettable batch counter which will correctly indicate the number of batches proportioned. A continuous type of mixing plant can also be used provided the ingredients are weighed through electronic sensors before feeding.
- 2) **Automatic weighing devices :** Batching plant shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices using load cells. The weighing devices shall have an accuracy within $\pm 1\%$ in respect of quantity of cement, admixtures and water and $\pm 2\%$ in respect of aggregates and the accuracy shall be checked at least once a month.
- 3) **Mixer :** Mixers shall be pan type, reversible type or any other mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging the mix, without segregation. Each stationary mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed in 90 seconds or as per the manufacturer's recommendation. The mixer shall be equipped with a

suitable non-resettable batch counter which shall correctly indicate the number of batches mixed.

The mixer shall be cleaned at suitable intervals. The pick-up and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 20 mm or more. The Contractor shall (1) have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth, or (2) provide permanent marks on blade to show points of 20 mm wear from new conditions. Drilled holes of 5 mm diameter near each end and at midpoint of each blade are recommended. Batching Plant shall be calibrated in the beginning and thereafter at suitable interval not exceeding 1 month.

- 4) **Control cabin** : An air-conditioned centralized computer control cabin shall be provided for automatic operation of the equipment.
- 5) The design features of the batching plant should be such that it can be shifted quickly.

602.9.3.3 Paving Equipment

The concrete shall be placed with an approved fixed form or slip form paver with independent units designed to (i) spread, (ii) consolidate, screed and float-finish, (iii) texture and cure the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary and so as to provide a dense and homogeneous pavement in conformity with the plans and Specifications. The paver shall be equipped with electronic sensor controls to control the line and grade from either one side or both sides of the machine.

Vibrators shall operate at a frequency of 8000-10000 impulses per minute under load at a maximum spacing of 600 mm. The variable vibration setting shall be provided in the machine.

602.9.3.4 Concrete Saw

The Contractor shall provide adequate number of concrete saws with sufficient number of diamond-edge saw blades. The saw machine shall be either electric or petrol/diesel driven type. A water tank with flexible hose and pump shall be made available for this activity on priority basis. The Contractor shall have at least one standby saw in good working condition. The concreting work shall not commence if the saws are not in working condition.

602.9.4 Hauling and Placing of Concrete

602.9.4.1 Freshly mixed concrete from the central batching and mixing plant shall be

transported to the paver site by means of tipping trucks or transit mixers of sufficient capacity and approved design in sufficient numbers to ensure a constant supply of concrete. Covers shall be used for protection of concrete against the weather. While loading the concrete truck shall be moved back and forth under the discharge chute to prevent segregation. The tipping trucks shall be capable of maintaining the mixed concrete in a homogeneous state and discharging the same without segregation and loss of cement slurry. The feeding to the paver is to be regulated in such a way that the paving is done in an uninterrupted manner with a uniform speed throughout the day's work. Tipping trucks shall be washed at a regular frequency as prescribed by the Engineer to ensure that no left-over mix of previous loading remains stuck.

602.9.4.2 Placing of Concrete

The total time taken from the addition of the water to the mix, until the completion of the surface finishing and texturing shall not exceed 120 minutes when concrete temperature is less than 25°C and 90 minutes when the concrete temperature is between 25°C and 30°C. When the time between mixing and laying exceed these values, the concrete shall be rejected and removed from the site. Tipping trucks delivering concrete shall normally not run on plastic sheathing nor shall they run on completed slabs until after 28 days of placing the concrete.

The placing of concrete in front of the PQC paver should preferably be from the side placer to avoid damage to DLC by concrete tipping trucks. In case of unavoidable situation, truck supplying concrete to the paver may be allowed to ply on the DLC with the approval of the Engineer. The paver shall be capable of paving the carriageway as shown in the drawings, in a single pass and lift.

602.9.4.3 Where fixed form pavers are to be used, forms shall be fixed in advance as per Clause 602.8. Before any paving is done, the site shall be shown to the Engineer, in order to verify the arrangement for paving besides placing of dowels, tie-bars etc., as per the relevant Clauses of these Specifications. The mixing and placing of concrete shall progress only at such a rate as to permit proper finishing, protecting and curing of the concrete in the pavement.

602.9.4.4 In areas inaccessible to paving equipment, the pavement shall be constructed using side forms, as per Clause 602.9.7.

602.9.4.5 In all cases, the temperature of the concrete shall be measured at the point of discharge from the delivery vehicle.

602.9.4.6 The addition of water to the surface of the concrete to facilitate the finishing operations will not be permitted except with the approval of the Engineer when it shall be applied as a mist by means of approved equipment.

602.9.4.7 If considered necessary by the Engineer, the paving machines shall be provided with approved covers to protect the surface of the slab under construction from direct sunlight and rain or hot wind.

602.9.4.8 While the concrete is still plastic, its surface shall be textured by brush or tines as per the instructions of the engineer in compliance with Clause 602.9.11. The surface and edges of the slab shall be cured by the application of a sprayed liquid curing membrane in compliance with Clause 602.9.12. After the surface texturing, but before the curing compound is applied, the concrete slab shall be marked with the chainage at every 100 m interval by embossing.

602.9.4.9 As soon as the side forms are removed, edges of the slabs shall be corrected wherever irregularities have occurred by using fine concrete composed of 1:1:2, cement : sand : coarse agg (10 mm down) with water cement ratio not more than 0.4 under the supervision of the Engineer.

602.9.4.10 If the requirement of Clause 902.4. for surface regularity fails to be achieved on two consecutive working days, then normal working shall cease until the cause of the excessive irregularity has been identified and remedied.

602.9.5 Construction by Slip Form Paver

602.9.5.1 The slip form paving train shall consist of a power machine which spreads, compacts and finishes the concrete in a continuous operation. The slip form paving machine shall compact the concrete by internal vibration and shape it between the side forms with either a conforming plate or by vibrating and oscillating finishing beams. The concrete shall be deposited without segregation in front of slip form paver across the whole width and to a height which at all times is in excess of the required surcharge. The deposited concrete shall be struck off to the necessary average and differential surcharge by means of the strike off plate or a screw auger device extending across the whole width of the slab. The equipment for striking-off the concrete shall be capable of being rapidly adjusted for changes of the average and differential surcharge necessitated by change in slab thickness or crossfall.

602.9.5.2 The level of the conforming plate and finishing beams shall be controlled automatically from the guide wires installed as per Clause 602.8 by sensors attached at the four corners of the slip form paving machine. The alignment of the paver shall be controlled automatically from the guide wire by at least one set of sensors attached to the paver. The alignment and level of ancillary machines for finishing, texturing and curing of the concrete shall be automatically controlled relative to the guide wire or to the surface and edge of the slab.

602.9.5.3 Slip-form paving machines shall have vibrators of variable output, with a

maximum energy output of not less than 2.5 KW per metre width of slab per 300 mm depth of slab for a laying speed upto 1.5 m per minute. The machines shall be of sufficient mass to provide adequate reaction during spreading and paving operations on the traction units to maintain forward movements during the placing of concrete in all situations. Normal paving speed shall be maintained as per Clause 602.9.1.

602.9.5.4 If the edges of the slip formed slab slump to the extent that the surface of the top edge of the slab does not comply with the requirements of Clause 902.3, the work shall be stopped until such time as the Contractor can demonstrate his ability to slip form the edges to the required levels. The deficient edge shall be temporarily supported by a side form and the thickness deficiency shall be made good by adding fresh concrete to the newly formed edge and compacting.

602.9.5.5 Slip-form pavers with adequate width to pave the entire carriageway width in one go shall be employed unless specified in the Contract. In situations where full-width paving is not possible, paving in part widths may be permitted by the Engineer. Paving in part will be avoided, except in unavoidable circumstances. In case of part width paving, care shall be taken to ensure that while laying the next lane, bond between the remaining half length of tie bar or subsequently inserted tie bars and the newly laid concrete is adequately developed. Care shall be taken to avoid damage to the previous lane.

602.9.5.6 In case paving in separate lanes is allowed, work on the adjacent lane shall be permitted when the previously paved lane is cured for at least 14 days and is in a position to bear the weight of paving machine. When the wheels or crawler tracks are to ply on the already paved surface, necessary precautions shall be taken by placing protective pads of rubber or similar material so that texture is not damaged. The wheel or track shall be reasonably away from the edge to avoid damage to the previously laid slab.

602.9.5.7 Tube Floating

Upon the instructions of the Engineer, Contractor shall scrape the concrete surface when in plastic state with a 3 m long tube float fixed with a long and stable handle before texturing. Tube float shall be of an alloy steel tube of 50 to 60 mm diameter with a long and stable handle. The length of tube float shall preferably be longer than half the length of slab i.e., half the distance between two transverse contraction joints. This operation shall be done to minimise surface irregularity caused due to varied causes like frequent stoppages of work, surface deformation due to plastic flow etc. The tube float shall be placed at the centre of the slab parallel to longitudinal joint and pulled slowly and uniformly towards the edges. After the use of float tube, it shall be frequently cleaned before further use. The slurry removed shall be discarded. This activity shall be advanced laterally by providing an overlap of half the length of tube float. The removal of the cement slurry from the surface shall be sufficient enough such that the texture is formed on a firm surface and is more durable. This operation, however, shall be carried out after removing bleeding water.

602.9.6 Construction by Fixed Form Paver

602.9.6.1 The fixed form paving train shall consist of separate powered machines which spread, compact and finish the concrete in a continuous operation.

602.9.6.2 The concrete shall be discharged without segregation into a hopper spreader which is equipped with means for controlling its rate of deposition on to the sub-base. The spreader shall be operated to strike off concrete upto a level requiring a small amount of cutting down by the distributor of the spreader. The distributor of spreader shall strike off the concrete to the surcharge adequate to ensure that the vibratory compactor thoroughly compacts the layer. If necessary, poker vibrators shall be used adjacent to the side forms and edges of the previously constructed slab. The vibratory compactor shall be set to strike off the surface slightly high so that it is cut down to the required level by the oscillating beam. The machine shall be capable of being rapidly adjusted for changes in average and differential surcharge necessitated by changes in slab thickness or crossfall. The final finisher shall be able to finish the surface to the required level and smoothness as specified, care being taken to avoid bringing up of excessive mortar to the surface by over working.

602.9.7 Semi-mechanised Construction

Areas in which hand-guided methods of construction become indispensable shall be got approved by the Engineer in writing in advance. Such work may be permitted only in restricted areas in small lengths. Work shall be carried out by skilled personnel as per methods approved by the Engineer. The acceptance criteria regarding level, thickness, surface regularity, texture, finish, strength, of concrete and all other quality control measures shall be the same as in the case of machine laid work. Guidelines on the use of plants, equipment, tools, hauling of mix, compaction floating, straight edging, texturing, edging etc. shall be as per IRC:15.

602.9.8 Transition Slabs

At the interface of rigid and flexible pavement, at least 3 m long reinforced buried slab shall be provided to give a long lasting joint at the interface. The details shall be as given in IRC:15.

602.9.9 Anchor Beam and Terminal Slab Beam Adjoining Bridge Structures

RCC anchor beams shall be provided in the terminal slab adjoining bridge structures as per drawings and IRC:15.

602.9.10 The Treatment of Concrete Pavement on Culverts

The concrete pavement shall be taken over the culverts. At both ends of the culvert slab, a contraction joint shall be provided in the concrete pavement. Nominal reinforcement of

10 mm dia bars at 150 mm spacing in both directions shall be provided at 50 mm below the top of the slab. The reinforcement shall be stopped 50 mm short of the contraction joint. Such reinforcement shall also be provided in the next slab panel on either side.

602.9.11 Surface Texture

602.9.11.1 Tining

After final floating and finishing of the slab and before application of the liquid curing membrane, the surface of concrete slabs shall be textured either in the transverse direction (i.e., at right angles to the longitudinal axis of the road) or in longitudinal direction (i.e., parallel to the centreline of the roadway). The texturing shall be done by tining the finished concrete surface by using rectangular steel tines. A beam or a bridge mounted with steel tines shall be equipped and operated with automatic sensing and control devices from main paver or auxiliary unit. The tining unit shall have facility for adjustment of the download pressure on the tines as necessary to produce the desired finish. The tining rakes shall be cleaned often to remove snots of slurry. The tines shall be inspected daily and all the damaged and bent tines shall be replaced before commencing texturing. Tined grooves shall be 3 mm wide and 3 to 4 mm deep. Before commencing texturing, the bleeding water, if any, shall be removed and texturing shall be done on a firm surface. The measurement of texture depth shall be done as per Clause 602.12.

- a) **Transverse tining** : When the texturing is specified in transverse direction, a beam of at least 3 m length mounted with tines shall be moved in transverse direction to produce the texture. The grooves produced shall be at random spacing of grooves but uniform in width and depth. The spacing shall conform to a pattern shown below:

Random spacing in mm

10	14	16	11	10	13	15	16	11	10	21	13	10
----	----	----	----	----	----	----	----	----	----	----	----	----

The above pattern shall be repeated. Texturing shall be done at the right time such that the grooves after forming shall not close and they shall not get roughened. Swerving of groove patterns will not be permitted. The completed textured surface shall be uniform in appearance.

- b) **Longitudinal tining** : Longitudinal tining shall be done, if specified in the Contract. The texturing bridge shall be wide enough to cover the entire width of the carriageway but within 75 mm from the pavement edge. The centre to centre spacing between the tines shall be 18 to 21 mm. The width of tine texture shall be 3 mm and depth shall be 3 to 4 mm.

602.9.11.2 Brush Texturing

Alternatively on the instructions of the Engineer, the brush texturing shall be applied. The brushed surface texture shall be applied evenly across the slab in one direction by the use of a wire brush not less than 450 mm wide but wider brushes normally of 3 m length are preferred. The brush shall be made of 32 gauge tape wires grouped together in tufts placed at 10 mm centres. The tufts shall contain an average of 14 wires and initially be 100 mm long. The brush shall have two rows of tufts. The rows shall be 20 mm apart and the tufts in one row shall be opposite the centre of the gap between tufts in the other row. The brush shall be replaced when the shortest tuft wears down to 90 mm long.

The texture depth shall be determined by the Sand Patch Test as described in the Clause 602.12. This test shall be performed at least once for each day's paving and wherever the Engineer considers it necessary at times after construction as under:

Five individual measurements of the texture depth shall be taken at least 2 m apart anywhere along a diagonal line across a lane width between points 50 m apart along the pavement. No measurement shall be taken within 300 mm of the longitudinal edges of a concrete slab constructed in one pass.

Texture depths shall not be less than the minimum required depth when measurements are taken as given in Table 600-5 nor greater than an average of 1.25 mm.

Table 600-5 : Texture Depth

Time of Test		Number of Measurements	Required Texture Depth (mm)	
			Specified Value	Tolerance
1)	Between 24 hours and 7 days after the construction of the slab or until the slab is first used by vehicles	An average of 5 measurements	1.00	±0.25
2)	Not later than 6 weeks before the road is opened to traffic	An average of 5 measurements	1.00	+0.25 -0.35

After the application of the brushed texture, the surface of the slab shall have a uniform appearance.

Where the texture depth requirements are found to be deficient, the Contractor shall make good the texture across the full lane width over the length directed by the Engineer, by retexturing the hardened concrete surface in an approved manner.

602.9.12 Curing

602.9.12.1 Immediately after the surface texturing, the surface and sides of the slab shall be cured by the application of approved resin-based aluminized reflective curing compound which hardens into an impervious film or membrane with the help of mechanical sprayer.

602.9.12.2 The curing compound shall not react chemically with the concrete and the film or membrane shall not crack, peel or disintegrate within three weeks of application. Immediately prior to use, the curing compound shall be thoroughly agitated in its containers. The rate of spread shall be in accordance with the manufacturer's instructions checked during the construction of the trial length and subsequently whenever required by the Engineer. The mechanical sprayer shall incorporate an efficient mechanical device for continuous agitation and mixing of the compound during spraying. The curing compound shall be sprayed in two applications to ensure uniform spread.

Curing compounds shall contain sufficient flake aluminum in finely divided dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The compound shall become stable and impervious to evaporation of water from the surface of the concrete within 60 minutes of application and shall be of approved type. The curing compounds shall have a water retention efficiency index not less than 90 percent in accordance with BS Specification No. 7542 or as per ASTM C-309-81 Type 2.

602.9.12.3 In addition to spraying of curing compound, the fresh concrete surface shall be protected for at least 3 hours by covering the finished concrete pavement with tents mounted on mobile trusses as described in Clause 602.7.2, during adverse weather conditions as directed by the Engineer. After three hours, the pavement shall be covered by moist hessian laid in two layers and the same shall then be kept damp for a minimum period of 14 days after which time the hessian may be removed. The hessian shall be kept continuously moist. All damaged/torn hessian shall be removed and replaced by new hessian on a regular basis.

602.9.12.4 The Contractor shall be liable at his cost to replace any concrete damaged as a result of incomplete curing or cracked on a line other than that of a joint as per procedure in IRC:SP:83.

602.10 Preparation and Sealing of Joint Grooves

602.10.1 General

All joints shall be sealed using sealants described in Clause 602.2.10.

602.10.2 Preparation of Joint Grooves for Sealing

602.10.2.1 Grooves are saw cut in the first instance just to provide minimum width (3-5 mm) to facilitate development of crack at joint locations, as shown in the drawing.

Subsequently before sealing, grooves are widened by sawing as per the dimensions in the drawing. Dimension of the grooves shall be controlled by depth/width gauge.

602.10.2.2 If rough arrises develop when grooves are made, they shall be ground to provide a chamfer approximately 5 mm wide. If the groove is at an angle upto 10° from the perpendicular to the surface, the overhanging edge of the groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10 degree, the

joint sealing groove shall be sawn wider and perpendicular to the surface to encompass the defects upto a maximum width, including any chamfer, of 20 mm for transverse joints and 10 mm for longitudinal joints. If the spalling cannot be so eliminated then the arises shall be repaired by an approved thin bonded arrises repair using cementitious/epoxy mortar materials.

602.10.2.3 All grooves shall be cleaned of any dirt or loose material by air blasting with filtered, oil-free compressed air. The Engineer shall instruct cleaning by pressurized water jets. Depending upon the requirement of the sealant manufacturer, the sides of the grooves shall be sand blasted to increase the bondage between sealant and concrete.

602.10.2.4 The groove shall be cleaned and dried at the time of priming and sealing. If sand blasting is recommended by the supplier, the same shall be carried out.

602.10.2.5 Before sealing the temporary seal provided for blocking the ingress of dirt, soil etc., shall be removed. A highly compressible heat resistant paper-backed debonding strip as per drawing shall be inserted in the groove to serve the purpose of breaking the bond between sealant and the bottom of the groove and to plug the joint groove so that the sealant may not leak through the cracks. The width of debonding strip shall be more than the joint groove width so that it is held tightly in the groove. In the case of longitudinal joints, heat resistant tapes may be inserted to block the leakage through bottom of the joint where hot poured sealant is used. When cold poured sealant is used a debonding tape of 1.0-2.0 mm thickness and 6 to 8 mm width shall be inserted to plug the groove so that the sealant does not enter in the initially cut groove.

602.10.3 Sealing with Sealants

602.10.3.1 When sealants are applied, an appropriate primer shall also be used if recommended by the manufacturer and it shall be applied in accordance with his instructions. The sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. Priming and sealing with applied sealants shall not be carried out when the naturally occurring temperature in the joint groove to be sealed, is below 7°C.

602.10.3.2 If hot applied sealant is used it shall be heated and applied from a thermostatically controlled, indirectly heated preferably with oil jacketed melter and pourer having recirculating pump and extruder. For large road projects, sealant shall be applied with extruder having flexible hose and nozzle. The sealant shall not be heated to a temperature higher than the safe heating temperature and not for a period longer than the safe heating period, as specified by the manufacturer. The dispenser shall be cleaned out at the end of each day in accordance with the manufacturer's recommendations and reheated material shall not be used. The Movement Accomodation Factor of the sealant shall be more than 10 percent.

602.10.3.3 Cold applied sealants with chemical formulation like polysulphide/ polyurethane/ silicone as per IRC:57 shall be used These shall be mixed and applied within

the time limit specified by the manufacturer. If primers are recommended they shall be applied neatly with an appropriate brush. The Movement Accomodation Factor shall be more than 25 percent.

602.10.3.4 The sealants applied at contraction phase of the slabs would result in bulging of the sealant over and above the slab. Therefore, the Contractor in consultation with the Engineer, shall establish the right temperature and time for applying the sealant. Thermometer shall be hung on a pole at the site for facilitating control during the sealing operation.

602.10.3.5 Sealant shall be applied, slightly to a lower level than the slab with a tolerance of 3 ± 1 mm.

602.10.3.6 During sealing operation, it shall be seen that no air bubbles are introduced in the sealant either by vapours or by the sealing process. The sealant after pouring, shall be allowed to cure for 7 days or for a period as per instructions of manufacturers.

602.11 Trial Length

602.11.1 The trial shall be constructed at least one month in advance of the proposed start of concrete paving work. At least one month prior to the construction of the trial length, the Contractor shall submit for the Engineer's approval a detailed method statement giving description of the proposed materials, plant, equipment and construction methods. All the major equipments like paving train, batching plant, tipping trucks etc., proposed in the construction are to be approved by the Engineer before their procurement. No trials of new materials, plant, equipment or construction methods, nor any development of them shall be permitted either during the construction of trial length or in any subsequent paving work, unless they form part of further trials. The trial lengths shall be constructed away from the carriageway.

602.11.2 The Contractor shall demonstrate the materials, plant, equipment and methods of construction that are proposed for concrete paving, by first constructing a trial length of slab, at least 100 m long for mechanised construction and at least 50 m long for hand guided methods. The width of the trial section shall be the full carriageway width as shown in the drawings. If the first trial is unsatisfactory, the Contractor shall have to demonstrate his capability to satisfactorily construct the pavement in subsequent trials.

602.11.3 The trial length shall be constructed in two parts over a period comprising at least part of two separate working days, with a minimum of 50 m constructed each day for mechanised construction and a minimum of 25 m on each day for hand guided construction. The trial length shall be constructed at a paving rate which is proposed for the main work.

602.11.4 Transverse joints including expansion joint and longitudinal joint that are proposed in the main work shall be constructed and assessed in the trial length.

602.11.5 The trial length shall comply with the Specifications in all respects including the test requirement of Table 900-6 with the following additions.

602.11.5.1 Surface Levels and Regularity

- a) In checking for compliance with Clause 902.3 the levels shall be taken at intervals at the locations specified in this Clause along any line or lines parallel to the longitudinal centre line of the trial length.
- b) The maximum number of permitted irregularities of pavement surface shall comply with the requirements of Clause 902.4. Shorter trial lengths shall be assessed pro-rata based on values for a 300 m length.

602.11.5.2 Joints

- a) Alignment of dowel bars shall be inspected in any two consecutive transverse joints in a trial length construction by removing the fresh concrete in a width of 0.5 m on either side of the joint. The joint pit shall be refilled with freshly prepared concrete, after inspection. Alternatively, it can be tested by suitable device like MIT SCAN with the permission of the Engineer. If the position or alignment of the dowel bars at one of these joints does not comply with the requirements and if that joint remains the only one that does not comply after the next 3 consecutive joints of the same type have been inspected, then the method of placing dowels shall be deemed to be satisfactory. In order to check sufficient joints for dowel bar alignment without extending the trial length unduly joints may be constructed at more frequent joint intervals than the normal spacing required in trial slabs.
- b) If there are deficiencies in the first expansion joint that is constructed as a trial, the next expansion joint shall be a trial joint. Should this also be deficient, further trial of expansion joints shall be made as part of the trial length which shall not form part of the permanent works, unless agreed by the Engineer.

602.11.5.3 Density

In-situ density in trial length shall be assessed as described in Clause 903.5.2.2 from at least 3 cores drilled from each part of the trial length when the concrete is not less than 7 days old. Should any of the cores show honey-combing in the concrete, the trial length shall be rejected and the construction in the main carriageway shall not be permitted until further trials have shown that modification has been made which would result in adequate compaction.

602.11.5.4 Strength

Minimum of thirty (30) beams for flexural strength and thirty (30) cubes for compressive strength shall be prepared from the concrete delivered in front of the paving plant. Each pair of beams and cubes shall be from the same location/batch but different sets of beams and cubes shall be from different locations/batches. Compressive and flexural strength shall be tested after 28 days water curing in the laboratory.

At the age of 28 days, thirty (30) cores with diameter 150 mm shall be cut from the pavement slab when the thickness of concrete pavement is more than 300 mm. In case the concrete pavement thickness is less than 300 mm, the dia of core shall be 100 mm. The cores shall be suitably cut at both ends to provide a specimen of plain surface on both ends. The dia to height ratio of core shall be 1 to 2. For cylindrical specimen of PQC of dia 150 mm, the variation in dia shall be ± 0.5 mm, a tolerance on height shall be ± 1 mm for a specimen of height 300 mm or more. For cylindrical specimen of dia 100 mm, the variation in dia shall be ± 0.3 mm, and a tolerance on height shall be ± 1 mm for a specimen height of 200 mm. The compressive strength test shall be conducted as per IS:516.

Concrete in the member represented by a core test shall be considered acceptable, if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength (characteristic strength) of the grade of the concrete specified for the corresponding age of 28 days and no individual core has a strength less than 75 percent.

202.11.6 Approval and Acceptance

602.11.6.1 Approval of the materials, plant, equipment and construction methods shall be given when the trial length complies with the Specifications. The Contractor shall not proceed with normal working until the trial length has been approved. If the Engineer does not notify the Contractor of any deficiencies in any trial length within 7 days after the completion of that trial length, the Contractor may assume that the trial length, and the materials, plant, equipment and construction methods adopted are acceptable, provided that the 28 days strength of cubes and cores extracted from trial length meet the requirement of the Specified strength.

602.11.6.2 When approval has been given, the materials, plant, equipment and construction methods shall not thereafter be changed, except for normal adjustments and maintenance of plant, without the approval of the Engineer. Any changes in materials, plant, equipment, and construction methods shall entitle the Engineer to require the Contractor to lay a further trial length as described in this Clause to demonstrate that the changes will not adversely affect the permanent works.

602.11.6.3 Trial lengths which do not comply with the Specifications, with the exception of areas which are deficient only in surface texture and which can be remedied in accordance with Clause 602.9.11.6 shall be removed immediately upon notification of deficiencies by the Engineer and the Contractor shall construct a further trial length.

602.11.7 Inspection of Dowel Bars

602.11.7.1 Compliance with Clause 602.6.5. for the position and alignment of dowel bars at contraction and expansion joints shall be checked by measurements relative to the side forms or guide wires.

602.11.7.2 When the slab has been constructed, the position and alignment of dowel bars and any filler board shall be measured after carefully exposing them in the plastic

concrete across the whole width of the slab. When the joint is an expansion joint, the top of the filler board shall be exposed sufficiently in the plastic concrete to permit measurement of any lateral or vertical displacement of the board. During the course of normal working, these measurements shall be carried out in the pavement section at the end of days work by extending slab length by 2 m. After sawing the transverse joint groove, the extended 2 m slab shall be removed carefully soon after concrete has set to expose dowels over half the length. These dowels can be tested for tolerances. This joint shall be treated as construction joint. The position of dowel bars in any type of transverse joint ie, contraction, construction or expansion can alternatively be tested by suitable device like MIT SCAN with the permission of the Engineer.

602.11.7.3 If the position and alignment of the bars in a single joint in the slab is unsatisfactory then the next two joints shall be inspected. If only one joint of the three is defective, the rate of checking shall be increased to one joint per day until the Engineer is satisfied that compliance is being achieved.

602.11.7.4 After the dowel bars have been examined, the remainder of the concrete shall be removed over a width of 500 mm on each side of the line of the joint and reinstated to the satisfaction of the Engineer. The dowels shall be inserted on both sides of the 1 m wide slab by drilling holes and grouting with epoxy mortar. Plastic sheath as per Clause 602.6.5.5 shall be provided on dowels on one of the joints. The joint groove shall be widened and sealed as per Clause 602.10.

602.11.8 Inspection of Tie Bars

To check the position of the tie bars, one metre length 0.5 m on either side of the longitudinal joint shall be opened when the concrete is green (within 20 to 30 minutes of its laying). The pit shall be refilled with the fresh concrete of same mix after checking.

602.12 Measurement of Texture Depth – Sand Patch Method

602.12.1 The following Apparatus shall be used:

- i) A cylindrical container of 25 ml internal capacity;
- ii) A flat wooden disc 64 mm diameter with a hard rubber disc, 1.5 mm thick, next to one face, the reverse face being provided with a handle;
- iii) Dry natural sand with a rounded particle shape passing a 300 micron IS sieve and retained on a 150 micron IS sieve.

602.12.2 Method

The surface to be measured shall be dried, any extraneous mortar and loose material removed and the surface swept clean using a wire brush both at right angles and parallel to the carriageway. The cylindrical container shall be filled with the sand, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The sand shall be poured into a heap on the surface to be treated. The sand shall

be spread over the surface, working the disc with its face kept flat in a circular motion so that the sand is spread into a circular patch with the surface depressions filled with sand to the level of peaks.

602.12.3 The diameter of the patch shall be measured to the nearest 5 mm. The texture depth of concrete surface shall be calculated from $31000/(D \times D)$ mm where D is the diameter of the patch in mm.

602.12.4 Measurement of Texture Depth - Tining

602.12.4.1 The following apparatus shall be used :

- i) Tire Tread Depth Gauge
A stainless steel tire tread depth gauge with graduations with least count of 1.0 mm. The gauge end may be modified to measure depth of tine texture.
- ii) A stainless steel caliper to measure spacing of tines. If necessary the caliper may be modified to measure the spacing and width of tine texture. The gauge shall be used after making necessary calibration.
- iii) Wire brush
- iv) Corborundum stone
- v) Steel straight edge to remove snots etc. sticking to the surface. The straight edge may be of 6 x 25 x 300 mm size.

602.12.4.2 Test Section

A unit of testing shall be 75 m per lane. If the length of construction is less than 75 m it shall be taken as one unit.

602.12.4.3 Test Procedure

In each 75 m section, along the diagonal line, 10 points shall be selected for making checks of depth, width and spacing of tine grooves. The surface where tests are to be conducted shall be cleared carefully with a wire brush or a steel straight edge or using a corborundum plate to remove any upward projection of concrete. When the base plate of the gauge is in contact with the concrete surface, the gauge shall be pressed to the bottom of groove and the depth shall be measured and recorded at this location. At the same location, the spacing of tines shall be measured to verify whether the pattern recommended in Clause 602.9.11.1 is complied or not.

The average of depth and width at 10 locations shall be calculated and recorded to the nearest 1 mm. The spacing of spectrum measured at 10 locations shall be recorded separately.

602.12.5 The average depth shall be 3 to 4 mm. When the depth is less than 2.5 mm and in excess of 4.5 mm, the Contractor shall stop concreting till he corrects his tine

brush or replaces it. The sensors associated with work shall be again calibrated to achieve the required texture. The textured groove less than 2.5 mm shall be re-grooved using concrete saw at the cost of Contractor. Variation in texture width in the range of 3+1 mm and 3 - 0.5 mm will be acceptable. If the variation of width is in excess of this range, the Contractor shall stop work and correct the brush and technique. When the spacing of spectrum is not satisfactory, the Contractor shall replace the entire brush.

602.13 Opening to Traffic

No vehicular traffic shall be allowed to ply on the finished surface of a concrete pavement within a period of 28 days of its construction and until the joints are permanently sealed and cured. The road may be opened to regular traffic after completion of the curing period of 28 days and after sealing of joints is completed including the construction of shoulder, with the written permission of the Engineer.

602.14 Acceptance Criteria in Quality and Distress

- i) **Tolerances for Surface Regularity, Level, Thickness and Strength:**
The tolerances for surface regularity, level, thickness and strength shall conform to the requirements given in Clause 903.5. Control of quality of materials and works shall be exercised by the Engineer in accordance with Section 900.
- ii) **Tolerances in Distress :** The acceptance criteria with regard to the types of distresses in rigid pavement shall be as per IRC:SP-83. "Guidelines for Maintenance, Repair and Rehabilitation of Cement Concrete Pavements". The cracks (of severity rating not more than 2) which may appear during construction or before completion of Defect Liability Period shall be acceptable with suggested treatments as given in IRC:SP-83.

Cement Concrete Pavement slabs having cracks of severity rating more than 2 i.e. cracks of width more than 0.5 mm for single discrete cracks, multiple and transverse cracks and cracks of width more than 3 mm in case of longitudinal cracks and of depth more than half of the concrete pavement slabs, shall be removed and replaced as per IRC:SP-83.

602.15 Measurements for Payment

602.15.1 Cement Concrete pavement shall be measured as a finished work in cubic metres of concrete placed based on the net plan area and thickness as measured in accordance with Clause 602.15.2.

602.15.2 The finished thickness of concrete for payment on volume basis shall be computed in the manner described in Clause 113.3 with the following modifications:

- i) The levels shall be taken before and after construction at grid points 5 m centre to centre longitudinally in straight as well as at curves.

- ii) A day's work is considered as a 'lot' for calculating the average thickness of the slab. In calculating the average thickness, individual measurements which are in excess of the specified thickness by more than 10 mm shall be considered as the specified thickness plus 10 mm.

602.15.3 Individual areas deficient by more than 10 mm shall be verified by the Engineer by ordering core cutting and if in his opinion the deficient areas warrant removal, they shall be removed and replaced with concrete of the thickness shown on the plans.

602.16 Rate

602.16.1 The Contract unit rate for the construction of the cement concrete pavement shall be payment in full for carrying out the operations required for the different items of the work as per these Specifications including full compensation for all labour, tools, plant, equipment, providing all materials i.e. aggregates, dowel bars, tie bars, PVC membrane, cement, stabilizers (lime, cements or any other stabilizers approved by the Engineer), storing, mixing, transportation, placing, compacting, finishing, curing, testing, all royalties, fees, rents where necessary, all leads and lifts and incidentals to complete the work as per Specifications.

The unit rate shall all include the full costs of construction, expansion, contraction and longitudinal joints including joint filler, sealant, primer, debonding strip and all other operations for completing the work. The construction and testing of trial length shall be included in the contract unit rate for the pavement and shall not be paid separately.

602.16.2 Where the average thickness for the lot is deficient by the extent shown in Table 600-6, payment for cement concrete pavement shall be made at a price determined by adjusting the contract unit price as per Table 600-6.

Table 600-6 : Payment Adjustment for Deficiency in Thickness

Deficiency in the Average Thickness of Day's Work	Percent of Contract Unit Price Payable
Up to 5 mm	100
6-10 mm	87

602.16.3 No additional payment shall be made for the extra thickness of the slab than shown on the drawings.

700

GEOSYNTHETICS

701 GEOSYNTHETICS FOR ROAD AND BRIDGE WORKS**701.1 Application and General Requirements**

The specification covers the various applications of geosynthetic materials for use in road and bridge works including supplying and laying as per contract specifications.

Geosynthetic is a general classification for all synthetic materials used in geotechnical engineering application. It includes geotextiles, geogrids, geostrips, geomembranes, geonets, geocomposites, geocells, geosynthetic mats, paving fabric and glass grid etc. Geo fabrics made from natural fibres such as jute, and coir referred to herein under natural geotextiles may also be used in different geotechnical engineering applications.

- i) **Geotextiles** : Any permeable synthetic textile used with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project, structure, or system.

The geotextile fabric shall be a woven, non-woven or knitted fabric consisting of long-chain polymeric filaments or yarns such as polypropylene, polyethylene or polyester or any combination thereof, formed into a stable network such that the filaments or yarns retain their relative position to each other.

There are several application areas for geotextiles requiring specific functions namely separation, filtration, drainage, reinforcement or a combination thereof.

- ii) **Geogrids** : A deformed or non-deformed netlike polymeric material used with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of human-made project, structure, or system.

Geogrids have relatively high strength, high modulus, and low-creep-sensitive polymers with apertures varying from 10 to 100 mm in size or more. The openings/holes in geogrids are either elongated ellipse, near squares with rounded corners, squares or rectangles. Geogrids can be of uni-axial grid, bi-axial grid or three dimensional grids. Geostrip is another form of geogrid, which is used in reinforced soil structures. It is primarily made of synthetic material in strips and is made from high tenacity polyester yarn and contained in a suitable polymer sheath.

These are used as reinforcement in pavements and reinforced soil slopes.

- iii) **Geomembranes** : An essentially impermeable membrane (liner or barrier) used with foundation, soil, rock, earth, or in any other geotechnical application as an integral part of human-made project, structure, or system, used to control fluid migration.

Geomembranes are made from PVC or polyethylene sheets, which are duly protected from ultraviolet exposure by carbon black or any antioxidants and thermal stabilizers.

These are used as capillary cut off in roads in water logged areas.

- iv) **Geonets** : Geonets are used in combination with other types of geosynthetics. These are usually formed by continuous polymeric ribs at acute angle to one another. When the ribs are opened relatively large size apertures are formed in a net like configuration.

These are used in combination with other geosynthetic materials to form a composite material.

- v) **Geocomposite** : A manufactured material, which could be a combination of any two or more synthetic materials like geotextiles, geogrids, geonets and geomembranes etc., in laminated or composite form. One of the popular form of geocomposite is Drainage Composite. Drainage Composites are formed by combining geotextile or geomembrane with a core of geonet or serrated/corrugated polymeric materials.

Prefabricated Vertical Drains (PVD)/Band Drains and Fin Drains come under the category of geocomposites.

- vi) **Geocell** : It is a three dimensional structure with interconnected cells. The geocells are made of polyester/polypropylene/high density polyethylene stabilized with carbon black.

Geocells may be used in erosion control of slopes.

- vii) **Geosynthetic Mats** : These are two dimensional or three dimensional mats with specified thickness, made of multi-filaments, with apertures to allow vegetation growth for erosion control application. Geosynthetic mat consists of UV stabilized non-degradable polypropylene/polyethylene or similar polymer fibres that are extruded or heat bonded to provide a dimensionally stable matrix. A tension element like steel wire mesh or geogrid shall be included in these mats as reinforcement, where these mats are required to possess more strength against erosive forces, like in steep slopes or in heavy rainfall areas.

These are used for erosion protection of slopes.

- viii) **Natural Geotextiles** : These geotextiles are made of natural fibres like jute or coir. The blankets/mats/mesh made of these fibres are sometimes further reinforced with polymeric nettings to enhance its tensile strength and for holding the fibres intact. The polymer netting is securely stitched on both sides of the fabric to form a strong quilted mat. These fabrics have excellent drapability and aid in quick growth of vegetation and are used for erosion control applications.

- ix) **Paving Fabric and Glass Grids** : The paving fabrics are non woven heat set material, consisting of atleast 85% by weight of polyolefins, polyester or polyamides. They are heat bonded only on one side.

Glass grids are either a composite glass fibre reinforced geogrid with continuous filament nonwoven geotextile chemically /mechanically bonded to the grid, or bituminous coated glass fibre geogrids with or without adhesive on one side of the grid.

The paving fabric, glass grids and composite of fabric and glass grids are used in bituminous pavements to act as stress relieving membrane and crack retarding layer within the pavement structure. The paving fabric also serves the function of water barrier.

701.2 Testing, Certification and Acceptance

701.2.1 Geosynthetic Materials Shall be Tested and Certified in the Following Manner.

- a) The manufacturer shall have ISO or CE certification for manufacturing process and quality control.
- b) The manufacturer shall provide manufacturer's test certificate for every lot supplied from the factory.
- c) The supplier shall provide third party test reports from an independent laboratory with valid accreditation for all the test values in Manufacturer's test certificate.

701.2.2 Geosynthetics shall be tested in accordance with tests prescribed by BIS. In absence of IS codes, tests prescribed either by ASTM, EN, BS or ISO shall be conducted.

701.2.3 The material shall meet the requirements as specified in the contract.

701.3 Marking

Geosynthetic rolls shall be marked with the following information:

- a) Manufacturer's name
- b) Roll number
- c) Grade
- d) Length
- e) Date of manufacture; and
- f) Product identification details

701.4 Packing, Storage and Handling

701.4.1 Each geosynthetic roll shall be wrapped with a material that will protect the geosynthetic from damage due to shipment, water, sunlight and contaminants. The protective wrapping with a tarpaulin or opaque plastic sheet shall be maintained during periods of shipment and storage.

During storage, geosynthetic rolls shall be elevated off the ground and adequately covered to protect from site construction damage, precipitation, prolonged ultra-violet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 71°C, and any other environmental condition that may damage the physical properties of the geosynthetics.

701.4.2 If the outer layer of the geosynthetic is damaged, or exposed to sunlight for a period beyond that is permitted the outermost wrap of the rolls shall be discarded, and only the remaining undamaged/unexposed material shall be used. If the geosynthetic rolls become wet, the water proof cover shall be removed, the rolls shall be elevated off the ground and exposed to wind in order to dry the fabric. The paving fabric used with bitumen overlays shall be completely dry prior to installation.

702 GEOTEXTILES FOR DRAINAGE, SEPARATION AND EROSION CONTROL**702.1 Scope**

The work covers the use of geotextile materials for drainage, separation/filtration and erosion control works including supplying and laying as per design, drawing and these specifications.

For drainage/filtration function, geotextile shall be able to convey water across the plane of the fabric throughout its design life.

For separation function the geotextile shall prevent intermixing of two layers of dissimilar materials, throughout the design life of the structure.

The geotextile as a filter material below erosion control measures like stone pitching or stone filled mattresses over the slopes, shall allow the water to flow out and at the same time prevent the loss of soil under the protective measures.

702.2 Material**702.2.1 Strength Requirement**

The minimum strength of geotextile in terms of MARV under different installation conditions shall be as specified in Table 700-1.

Table 700-1 : Minimum Geotextile Strength Property Requirements

Installation Condition	Type	Strength Property Requirement (MARV)							
		Grab Strength in Newton (N) as per ASTM D 4632/ IS:13162 Part 5		Tear Strength in Newton (N) as per ASTM D 4533/ IS:14293		Puncture Strength in Newton (N) as per IS:13162 Part 4		Burst Strength in Newton (N) as per ASTM D 3786/ IS:1966	
		Elongation at Failure							
		<50 %	>50 %	<50 %	>50 %	<50 %	>50 %	<50 %	>50 %
Harsh installation condition	Type 1	1400	900	500	350	500	350	3500	1700
Moderate Installation condition	Type II	1100	700	400	250	400	250	2700	1300
Less Severe Installation condition	Type III	800	500	300	180	300	180	2100	950

Note:

- 1) All numeric values in the above table represent Minimum Average Roll Value (MARV) in weaker principal direction. The MARV is derived statistically as the average value minus two standard deviations.
- 2) When the geotextiles are joined together by field sewing, the seam strength shall be at least 60 percent of the material's tensile strength. All field seams shall be sewn with thread as strong as the material in the fabric.
- 3) The puncture strength if determined in accordance with ASTM D 6241, the minimum requirement in terms of "Newton (N)" shall be as follows:

Installation condition	Strength property requirement (MARV)		
	Puncture Strength in Newton (N) as per ASTM D 6241.		
	Elongation at Failure		
		< 50 %	> 50 %
Harsh installation condition	2800	2000	
Moderate Installation condition	2250	1400	
Less Severe Installation condition	1700	1000	

702.2.2 Ultraviolet Stability Requirements

The material shall satisfy the ultraviolet stability requirements specified in Table: 700-2.

Table 700-2 : Requirements for Ultra Violet Stability

S.No	Properties of Fabric	Requirements (Retained Strength)
1)	Grab Strength	Not less than 70% after 500 hours of exposure
2)	Tear Strength	
3)	Puncture Strength	
4)	Burst Strength	

702.2.3 Hydraulic Requirements for Various Applications**702.2.3.1 Subsurface Drainage**

The geotextile shall conform to the physical requirements specified in Table 700-3.

Table 700-3 : Geotextile Requirements for Subsurface Drainage

In-situ Passing 0.075 mm Sieve (%)	Permittivity, per sec, as per ASTM D 4491/IS:14324-1995	Maximum Apparent Opening Size, mm ASTM D 4751/IS:14294-1995
< 15	0.5	0.43
15 to 50	0.2	0.25
> 50	0.1	0.22

The type of geotextile shall be decided by the Engineer depending upon the installation conditions.

702.2.3.2 Separation

The geotextile for different subgrade soil conditions shall conform to the requirements given in Tables 700-4 and 700-5.

Table 700-4 : Geotextile Requirements for Separation (Subgrades Soaked CBR >3)

S. No.	Geotextile Property	Requirement
1)	Permittivity as per ASTM D 4491	0.02 sec ⁻¹ (per sec)
2)	Maximum Apparent Opening Size as per ASTM D 4751	0.60 mm

Table 700-5 : Geotextile Requirements for Separation (Subgrades Soaked CBR ≤3)

S. No.	Geotextile Property	Requirement
1)	Permittivity as per ASTM D 4491	0.05 sec ⁻¹ (per sec)
2)	Maximum Apparent Opening Size as per ASTM D 4751	0.43

702.2.3.3 Erosion Control

The geotextile for erosion control shall conform to requirements given in Table 700-6.

Table 700-6 : Geotextile Requirements for Erosion Control

In-situ Soil Passing 0.075 mm Sieve (%)	Permittivity, per sec ASTM D 4491	Maximum Apparent Opening Size, mm ASTM D 4751
<15	0.7	0.43
15 to 50	0.2	0.25
>50	0.1	0.22

702.3 Construction**702.3.1 General**

Exposure of geotextiles to the elements between lay down and cover shall be a maximum of 14 days to minimize damage potential.

In trenches, after placing the backfill material, the geotextile shall be folded over the top of the filter material to produce a minimum overlap of 300 mm for trenches greater than 300 mm wide. In trenches less than 300 mm wide, the overlap shall be equal to the width of the trench. The geotextile shall then be covered with the subsequent course.

Overlap at roll ends and at adjacent sheets shall be a minimum of 450 mm, except when placed under water. In such instances, the overlap shall be a minimum of 1 m. Where seams are required in the longitudinal trench direction, they shall be joined by either sewing or overlapping. All seams and overlaps shall be subject to the approval of the Engineer.

Care shall be taken during installation so as to avoid any damage to the geotextile. Damages, if any, during installation shall be repaired by placing a geotextile patch over the damaged area and extending it 1m beyond the perimeter of the tear or damage, or as approved by the Engineer.

702.3.2 Subsurface Drainage

Construction shall conform to Clause 309.3 of the specifications.

702.3.3 Separation

After preparation of subgrade as per the specifications along the road alignment, geotextile shall be rolled out as indicated in the drawings. The entire roll shall be placed on the subgrade

and unrolled as smoothly as possible. Wrinkles and folds in the fabric shall be removed by stretching as required.

Adjacent rolls of geotextiles shall be overlapped, sewn, or joined as required. For curves, the geotextile shall be folded or cut and overlapped in the direction of construction. Folds in the geotextile shall be stapled or pinned approximately 0.6 m centre-to-centre. Before covering, the condition of the geotextile shall be checked for damage (i.e., holes, nips, tears, etc) by the Engineer.

Before placing the first lift of granular sub-base on the geotextile, a trial stretch of 100 m shall be laid as per roll width to establish a proper construction methodology of placing and compacting the sub-base in a manner that no damages are caused to the separation layer of geotextile.

702.3.4 Filter Layer Under Stone Pitching for Erosion Control

The geotextile shall be placed in intimate contact of soil ensuring slight tension, to avoid wrinkles or folds and shall be anchored on a properly shaped surface as indicated in drawings and approved by the Engineer. It shall be ensured that the placement of the overlying material be placed in such a manner that it does not tear/puncture the geotextile. Anchoring of the terminal ends of the geotextile shall be accomplished as per drawings through the use of key trenches or aprons at the crest and toe of slope.

The geotextile shall be placed with the machine direction parallel to the direction of water flow. Adjacent geotextile sheets shall be joined by either sewing or overlapping.

The pitching shall begin at the toe and proceed up the slope. Big sized boulders shall not be allowed to roll down the slope.

Any geotextile damaged shall be either replaced or repaired with a patch, as directed by the Engineer, at the cost of the contractor.

702.4 Measurement for Payment

The measurement for payment for sub surface drains shall be as per Clause 309.

The geotextile for separation and for filter layer shall be measured in square metres as per planned dimensions with no allowance for overlapping at transverse and longitudinal joints. Excavation, back fill, bedding and cover material shall be measured separately as per relevant clauses of the Contract.

702.5 Rate

The contract unit rate for subsurface drains using geotextile shall be as per Clause 309.5.

The contract unit rate for the accepted quantities of geotextile for separation and filter layer in place shall be full compensation for furnishing, preparing, hauling, and placing geotextile including all labour, freight, tools, equipment, and incidentals to complete the work as per specifications.

703 GEOGRID

703.1 Scope

The work covers the use of geogrids in sub-base of pavement, erosion control of slopes, reinforced soil slopes and reinforced soil walls including supplying and laying as per design, drawing and these specifications.

The use of geogrids as a component for reinforced soil slopes and walls shall be as per Section 3100.

703.2 Materials

703.2.1 General

Geogrids shall be either made from high tenacity polyester yarn jointed at cross points by weaving, knitting or bonding process with appropriate coating or from polypropylene or polyethylene or any other suitable polymeric material by an appropriate process. Geogrids manufactured by extrusion process are integrally jointed, mono or bi-directionally oriented or stretched meshes, in square, rectangular, hexagonal or oval mesh form. The geogrids manufactured by weaving/knitting/bonding process shall be formed into a stable network such that ribs, filaments or yarns retain their dimensional stability relative to each other including selvages.

703.2.2 Sub-base Reinforcement

Geogrid for use as reinforcement of sub-base layers of flexible pavements shall meet the requirement as per the design subject to the minimum requirements as given in Table 700-7.

703.2.3 Erosion Control

The geogrid for erosion control application shall have the minimum tensile strength of 4 kN/m, when tested as per ASTM D5035 (Minimum Average Roll Value in Machine Direction). The aperture opening size shall be minimum 20 mm x 20 mm and average grid thickness shall be minimum 1.0 mm. Geogrid for erosion control application shall be UV stabilized. The geogrid shall have ultraviolet stability of 70 percent after 500 hrs exposure as per ASTM D 4355.

Table 700-7 : Minimum Requirements for Geogrid for Sub-Base of Flexible Pavement

Property	Test Method	Unit	Requirement
Stiffness at 0.5% strain	ISO-10319	kN/m	≥350; both in machine and cross-machine direction
Tensile strength @2% strain	ASTM D6637	kN/m	≥15% of T_{ult} ; both in machine and cross-machine direction
Tensile strength @5% strain	ASTM D6637	kN/m	≥20% of T_{ult} ; both in machine and cross-machine direction
Junction Efficiency for extruded geogrids	GRI-GG2-87 or ASTM-WK 14256	-	90% of rib ultimate tensile strength
Ultraviolet stability	ASTM D4355	-	70% after 500 hrs exposure

Note :

- 1) All numerical values in the Table represent MARV in the specified direction.
- 2) All geogrids shall be placed along machine direction parallel to the centre line of roadway alignment.

703.2.4 Reinforced Soil Slopes and Walls

The strength and other requirements shall be as per Section 3100.

703.3 Installation and Construction Operations**703.3.1 Sub-base Reinforcement**

Prior to laying of geogrid, the surface shall be properly prepared, cleaned and dressed to the specified lines and levels as shown on the drawings.

The geogrid shall be laid within the pavement structure as shown on the drawings.

Geogrid reinforcement shall be placed flat, pulled tight and held in position by pins or suitable means until the subsequent pavement layer is placed.

No vehicle shall be allowed on geogrid unless it is covered by at least 150 mm thick sub-base material.

703.3.2 Erosion Control

The geogrid for erosion control applications shall be installed in accordance with the manufacturer's recommendation and as per Clause 706.3.

703.3.3 Reinforced Slopes and Walls

The geogrid for reinforced slopes and walls shall be installed in accordance with the manufacturer's recommendation and as per Section 3100.

703.4 Measurement for Payment

The geogrid shall be measured in square metres as per planned dimensions with no allowance for overlapping at joints, anchoring at toe and crest of the slope. Excavation, back fill, bedding and cover material shall be measured separately as per relevant clauses of the Specifications. Reinforced soil slopes and walls shall be measured as per Section 3100.

703.5 Rate

The contract unit rate for the accepted quantities of geogrid in place shall be in full compensation for furnishing, preparing, hauling, and placing geogrid including all labour, freight, tools, equipment, and incidentals to complete the work as per specifications.

For reinforced soil slopes and walls, Section 3100 shall govern.

704 GEOCOMPOSITE DRAINS**704.1 Scope**

The work covers the use of geocomposite drainage system: (i) Fin drains and (ii) Prefabricated Vertical Drains. The work for fin drains shall be carried out in accordance with the requirements of these specifications and to the lines, grades, dimensions and other particulars shown on the drawings or as directed by the Engineer. The work for prefabricated vertical drain shall be carried out as per Clause 314.

Fin drains with plastic core shall be installed for affecting vertical and/or horizontal drainage.

Prefabricated vertical drains shall be installed in soft saturated subsoils at designed spacing so as to accelerate the rate of consolidation.

704.2 Materials**704.2.1 Fin Drains**

Fin drains shall be made of light weight, three dimensional high compressive strength polyethylene core; and heat bonded or needle punched polypropylene/polyester geotextile provided on one side or both sides of the core as per the requirements. Geotextile used in a

drainage composite shall meet the requirements as specified in Table 700-9. The properties of the core material shall meet the requirements as indicated in Table 700-10.

Table 700-9 : Geotextile Requirements for Fin Drains

In-situ Soil Passing 0.075 mm Sieve (%)	Permittivity, per sec ASTM D 4491/IS:14324-1995	Maximum Apparent Opening Size, mm as per ASTM D 4751/IS:14294-1995
< 15	0.5	0.43
15 to 50	0.2	0.25
> 50	0.1	0.22

Table 700-10 : Properties for Fin Drain Core

Property		Test Method	Units	Minimum Average Roll Value
Tensile strength		EN ISO-10319	kN/m	16
CBR Puncture Resistance		EN ISO-12236	N	3000
Mass per unit area		EN ISO-9864	g/m ²	710
Thickness of Composite		EN ISO-9863	mm	4.5
In-plane permeability	Hydraulic Gradient, i=1 at 100 kPa pressure	EN ISO-12958	l/m	0.55
	Hydraulic Gradient, i=1 at 200 kPa pressure			0.45

704.2.2 Prefabricated Vertical Drains (PVDs)/Band Drains

The PVDs/Band Drains shall meet the requirements as specified in Table 700-11.

Table 700-11 : Properties for Prefabricated Vertical Drains/Band Drains

S. No	Property	Test Method	Value
A	Composite Drain		
1)	Width		≥100 mm
2)	Thickness	ASTM D5199	≥4 mm
3)	Tensile strength	ASTM D4595	>2.00 kN
4)	Elongation at break		>35%
5)	Discharge capacity	i = 1.0 at, 300 kPa pressure	ASTM D4716 >1.5 x 10 ⁻⁵ m ³ /s

S. No	Property	Test Method	Value
B	Core		
1)	Material		Polypropylene/Polyethylene
2)	Configuration/structure		Corrugated, filament, dimpled, studded etc.
C	Filter		
1)	Material		Polyester/polypropylene
2)	Structure		Nonwoven
3)	Mass per unit area	ASTM D5261	>120 g/m ²
4)	Tensile strength	ASTM D4632	>500 N
5)	Elongation at break		>45%
6)	Trapezoid tear strength	ASTM D4533	>150 N
7)	Permeability	ASTM D4491	>5 x 10 ⁻⁶ m/s
8)	Apparent opening size	ASTM D4751	

704.3 Installation

704.3.1 Fin Drains

The installation of fin drains shall be as per drawings. Where fin drains are assembled on site, the assembly area shall be clean and dry. No geotextile or core material shall be exposed to daylight (or any source of ultraviolet radiation) for a period exceeding 50 hours. Where fin drains are laid in a trench, the bottom of the trench shall be free of irregularities and shall be brought to the required level. Rock and other hard protrusions shall be removed and any excess cut in the trench bottom shall be filled and compacted back to the required grade with suitable excavated or imported material as directed by the Engineer. Fin drains shall be capable of being connected longitudinal or laterally into pipe systems or chambers for inflow and outflow purposes. Joints parallel to the direction of flow and any exposed edge shall be protected from the ingress of soil by a geotextile wrapping with a minimum overlap of 150 mm or other measures as approved by the Engineer. The splicing of lengths of geotextile and minimum overlap shall be as per the drawing or as approved by the Engineer.

704.3.2 Prefabricated Vertical Drains (PVD)

The installations for PVD shall be as per relevant Clauses of Section 314.

704.4 Measurement for Payment

Measurement for Fin drain shall be in running metre of its length.

Measurement for payment for PVDs shall be as per Clause 314.2.3.

704.5 Rate

The Contract unit rate for fin drains shall be payment in full for all items such as excavation, dressing the sides and bottom, providing fin drains and installation etc., including full compensation for all materials, labour, tools, equipment incidental to complete the work as shown on drawings with all leads and lifts including removal and disposal with all leads of unsuitable material. Provision of inlets, outlet pipes, bedding, etc., wherever required shall be incidental to construction of drain.

Unit rate for installation of vertical drains shall be as per Clause 314.2.4.

705 GEOCELL FOR SLOPE PROTECTION**705.1 Scope**

The work covers the use of geocells for erosion control of soil slope including supplying and laying as per design, drawings and these specifications.

Geocells filled with local soil or with granular material shall be placed on cut or fill slope to hold top cover soil and allow vegetation to grow.

705.2 Materials

The geocell is a three dimensional structure consisting of series of cells and resembles a honey combed structure. The geocell shall be made of a suitable polymeric material such as high density polyethylene stabilised with carbon black.

705.2.1 Strength and Other Requirements of Geocell

Geocell shall meet the minimum specifications and properties specified in Table 700-12.

The geocells for erosion control measures shall have cells with nominal opening of 450 cm² to 1250 cm² and perforations in the cell wall shall be between 11% to 16%. The cell depth for erosion control shall vary from 75 mm to 100 mm.

For anchoring the cells on steep slopes suitable arrangements shall be made as shown on the drawings.

705.3 Installation and Construction Operations

Prior to laying of geocell on the slope, the surface shall be properly prepared, clean and dressed to the specified lines and levels as shown on the drawings.

Table 700-12 : Requirements of Geocell for Slope Protection

Property	Test method	Unit	Min. Required Value
Density	ASTM D1505	gm/cm ³	0.900
Environmental Stress crack resistance (ESCR)	ASTM D1693	Hrs	3000
Carbon Black Content		% by Weight	1.5 to 2
Strip/Cell Wall thickness	ASTM D5199	mm	1.20
Seam Peel-Strength Test		N per 25 mm of cell depth.	350
Creep Rupture Strength	ASTM D2990		Creep Rupture Load at 10,000 hours shall be 1 kN minimum obtained from the 95% prediction interval at 10,000 hours considering a logarithmic time/creep rupture model.

Trench keys along the crest and at the bottom of slope area shall be dug to fix the cellular system in the ground.

Cellular section shall be expanded to the predesigned shape and size, and placed over prepared slope. Geocell sections shall be fastened together using accessories as per manufacturer's installation guide and the drawings.

After cellular sections are secured to the slope, the cells shall be filled with the specified materials ensuring that no damage is caused to the cells. Filling of cells shall be done from the toe of slope to crest of slope.

The fill shall be overfilled between 25 mm to 50 mm and material shall be suitably tamped to leave soil flush with top edge of cell walls.

Once the soil filling is completed, turfing/seeding shall be done as recommended.

705.4 Measurement for Payment

The geocell protection work shall be measured as finished work in square meters as per planned dimensions with no allowance for overlapping at joints, anchoring at toe and crest of the slope. It shall also include the fixing and anchoring of cells in the ground with accessories as per manufacturer's recommendation or as specified in the design and drawings.

The above also includes turfing, seeding and all other incidental items to cover the work of vegetation on slopes, unless otherwise specified in the contract. The quantities of cellular

system for erosion control as shown on the drawings may be increased or decreased at the direction of the Engineer based on construction procedure and actual site conditions that occur during construction of the project. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

705.5 Rate

The contract unit rate for goecell protection system shall payment in full be in full for furnishing and installing the specified materials in accordance with the contract documents including fixing and anchoring of cells in the ground as per manufacturer's recommendations, filling of cells with specified materials, seeding and all other incidentals including all other items to complete the work as per these specifications.

706 GEOSYNTHETIC MAT

706.1 Scope

The work covers the use of geosynthetic mats for control of erosion of slopes including supplying and laying the mat, spreading soil and seeding to promote the design of vegetation, as per design, drawing and these specifications.

706.2 Material and Strength Requirements

Geosynthetic mat shall be a three-dimensional structure consisting of UV stabilized non-degradable polypropylene, polyethylene, nylon or similar polymer fibres that are extruded or heat bonded at the contact points to provide a dimensionally stable matrix for soil erosion protection. A tension element, i.e., a reinforcing element like geogrid or steel wire mesh shall be included along with the three dimensional polymeric mats to provide strength against erosive forces, if specified in the contract

The tensile strength requirements for non reinforced and reinforced three dimension geosynthetics mat shall meet the minimum requirement as specified in Table 700-13 and Table 700-14 respectively.

706.3 Installation

Prior to laying of geosynthetics mat on the slope, the surface shall be properly prepared, cleaned and dressed to the specified lines and levels as shown on the drawings. Specified trench keys along the crest and at the bottom of slope area shall be provided to fix the geosynthetics mat in the ground. In case the soil is not fertile, it shall be mixed with suitable amount of fertilizer or seeds.

**Table 700-13 : Tensile Strength Requirement for Normal (Non-Reinforced)
Three Dimensional Geosynthetic Mat for Erosion Control Application
(Less Severe Environmental Condition)**

Property	Test Method	Units	Minimum Average Roll Value
Tensile strength requirement (For slopes less than 60°)	ASTM D 5035	kN/m	2
Ultraviolet stability at 500h, Retained strength percentage with respect to original strength	ASTM D 4355	%	80
Thickness	ASTM D 6525	mm	6.5
Mass per unit area	ASTM D 3776	gm/m ²	250

**Table 700-14 : Tensile Strength Requirement for Reinforced Three Dimensional
Geosynthetic Mat for Erosion Control Application
(Severe Environmental Conditions)**

Property	Test Method	Units	Minimum Average Roll Value
Tensile strength requirement	ASTM D 5035	kN/m	For Slopes up to 60°
			For Slopes up to 80°
Ultraviolet stability at 500h, Retained strength percentage with respect to original strength	ASTM D 4355	%	80
Thickness	ASTM D 6525	mm	12
Mass per unit area of the composite	ASTM D 3776	gm/m ²	500

The work of laying the mat shall begin at the top of the slope providing anchor blankets in a 300 mm deep and 300 mm wide trench and anchoring with staples/pins. The mat shall then be unrolled down the slope in the machine direction. The blanket shall not be stretched but shall have full contact with the soil. The blanket shall be anchored using staples or stakes.

Edges of adjacent parallel rolls shall be overlapped by approximately 100 mm to 120 mm and anchored with staples at 600 mm to 800 mm spacing depending on the slope. When blankets have to be spliced, the upper blanket end shall be placed over lower blanket end (shingle style) with 300 mm overlap and anchoring with two staggered rows of staples at 300 mm spacing.

A minimum cover of soil shall be spread followed by spreading the seeds and fertiliser.

In the absence of rain, blankets shall be regularly watered for viable growth till vegetation sustains on its own.

If any damage due to heavy downpour is noticed, suitable corrective measures shall be taken immediately.

Gully formations, if any, shall be suitably corrected depending upon the site condition.

The treated area shall be protected from the movement of cattle (goat, sheep & cow). Grazing shall be avoided till the vegetation sustains on its own

706.4 Measurement for Payment

The geosynthetic mat shall be measured in square metre as per planned dimensions with no allowance for overlapping at joints, anchoring at toe and crest of the slope.

706.5 Rate

The contract unit rate for geosynthetic mat for erosion control shall be in full compensation for furnishing and installing the specified materials and growth of vegetative cover in accordance with the contract documents including site preparation, and for furnishing all labour, tools, equipment and incidentals to complete the work as per these Specifications.

707 NATURAL GEOTEXTILE

707.1 Scope

The work covers the use of natural geotextiles for control of erosion of slopes including supplying and laying the mat spreading soil and seeding to promote the growth of vegetation, as per design, drawing and these specifications.

Natural Geotextile shall be used to control surface erosion of top cover soil on cut or fill slopes and to facilitate vegetation to grow.

707.2 Strength Requirements

The natural fibre geotextiles made of Jute shall meet the minimum requirement as stated in IS:14715 - Woven Jute Geotextiles – Specification. However for coir fibre geotextile, it shall meet the requirements as specified in Table 700-15, when used for erosion control measures.

Table 700-15 : Typical Specifications of Natural Geotextile (MARV*) using Coir

Type of Price	Weight (gsm)	Width (cm)	Thickness (mm)	Tensile Strength (KN/m)		Elongation at Break (%)	Water Holding Capacity (%)	Porometry (°95), Micron
				MD	CD			
Open Mesh fabric	300	120	4.0	5	2.5	20	-	-
Nonwoven Fabric	450	150	4.0	7.5	2.5	30	80	75

* Minimum average roll value

707.3 Installation

Prior to laying of natural geotextiles on the slope, the surface shall be properly prepared, cleaned and dressed to the specified lines and levels as shown on the drawings. Specified trench keys along the crest and at the bottom of slope area shall be provided to fix the natural geotextile in the ground. In case the soil is not fertile, it shall be mixed with suitable amount of fertilizer or seeds.

The work of laying the mat shall begin at the top of the slope providing anchor blankets in a 300 mm deep and 300 mm wide trench and anchoring with staples/pins. The mat shall then be unrolled down slope in the machine direction. The blanket shall not be stretched but shall have full contact with the soil. The blanket shall be anchored using staples or stakes. Edges of adjacent parallel rolls shall be overlapped by approximately 100-120 mm and anchored with staples at 600-800 mm spacing depending on the slope. When blankets have to be spliced, the upper blanket end shall be placed over lower blanket end (shingle style) with 300 mm overlap and anchoring with two staggered rows of staples at 300 mm spacing.

A minimum cover of soil shall be spread followed by spreading the seeds and fertilizer. A slow release supplementary fertilizer may be applied to speed up the growth of the vegetation.

In the absence of rain, blankets shall be regularly watered for viable growth till vegetation sustains on its own.

If any damage due to heavy downpour is noticed, suitable corrective measures shall be taken immediately.

Gully formations, if any, shall be suitably corrected depending upon the site conditions.

The treated area shall be protected from the movement of cattle (goat, sheep & cow). Grazing shall be avoided till the vegetation sustains on its own.

707.4 Measurement for Payment

The natural geotextile shall be measured in square metres as per planned dimensions with no allowance for overlapping at joints, anchoring at toe and crest of the slope.

707.5 Rate

The contract unit rate for natural geotextile mat for erosion control shall be in full compensation for furnishing and installing the specified materials and growth of vegetative cover in accordance with the contract documents including site preparation, and for furnishing all labour, tools, equipment and incidentals to complete the work as per these Specifications.

708 PAVING FABRICS/GLASS GRIDS**708.1 Scope**

This work shall consist of laying geosynthetic materials either non-woven paving fabric or fibre glass coated grid over existing bituminous surface, including preparation of surface and joining, stitching or overlapping of geosynthetic fabric etc., as part of highway pavement strengthening in layers as shown on drawings or as directed by the Engineer.

708.2 Material Requirements**708.2.1 Paving Fabrics**

The paving fabric will be a non-woven heat set material consisting of at least 85 percent by weight of polyolefins, polyesters or polyamides. The paving fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects which will adversely alter its physical properties. The fabric shall be specifically designed for pavement applications and be heat bonded only on one side to reduce bleed-through of tack coat during installation. The fabric shall meet the physical requirements given in Table 700-16.

Table 700-16 : Physical requirements for Paving Fabrics (Minimum Average Roll Value)

Property	Units	Standard Requirements	Test Method
Grab Tensile Strength	N	450	ASTM D 4632
Elongation	%	≥ 50	ASTM D 4632
Mass Per Unit Area	gm/m ²	140	ASTM D 3776
Asphalt Retention	Kg/10 sq.m	10*	ASTM D 6140
Melting Point	°C	150	ASTM D 276
Surface Texture	-	Heat bonded on One side only	Visual Inspection only

Note : * the product asphalt retention property must meet MARV provided by the manufacturer.

708.2.2 Glass Grids

These will be either a composite glass fibre reinforced geogrid with continuous filament non-woven Geotextile chemically or mechanically bonded to the grid; or bituminous coated glass fiber geogrid with or without adhesive on one side of the grid. The physical and mechanical properties of glass grid fabric shall conform to the requirements given in Table 700-17.

Table 700-17 : Properties of Glass Fibre Grids

Property	Units	Requirement			
		Tensile Strength in Both Median and Cross-Machine Direction			
Tensile Strength	kN/m	ASTM D 6637	50	1000	200
% Elongation at break	%		> 4	> 4	> 4
Minimum Mesh Size	mm		25 x 25	12.5 x 12.5	12.5 x 12.5
Melting Point	°C	ASTM D 276	> 250	> 250	> 250

708.2.3 Asphalt Reinforcing Geogrids

These shall be made of high modulus polyester yarns with low creep properties. The grid shall be connected to low weight non-woven polypropylene fabric. The composite shall have a bitumen finish. The properties shall conform to the requirements given in Table 700-18.

Table 700-18 : Properties of Asphalt Reinforcement Geogrids

Property	Units	Test Method	Requirement		
			Tensile strength in both MD and CD, Not less than		
Tensile strength	kN/m	ISO-10319	25	50	100
% Elongation at break	%	ISO-10319	12.5%	12.5%	12.5%
Mesh Size			35 x 35 20 x 20	35 x 35 20 x 20	35 x 35 20 x 20
Melting Point	°C		> 190	> 190	> 190

708.3 Installation

708.3.1 Weather Limitations

The air and pavement temperatures shall be at least 10°C for placement of hot bitumen and at least 16°C for placement of asphalt emulsion. The asphalt tack coat or Glass grid shall not be placed when weather conditions are not suitable.

708.3.2 Surface Preparation

The pavement surface shall be dry and cleaned of all dirt and oil to the satisfaction of the Engineer. Cracks wider than 3 mm shall be cleaned and filled with suitable bituminous material

approved by the Engineer. Potholes and locally failed and cracked pavement sections shall be repaired as directed by the Engineer. If the existing pavement is rough or has been milled, a levelling course shall be provided prior to installation of the Glass grid.

708.3.3 Tack Coat

The tack coat used to impregnate the fabric and bond the fabric to the pavement shall be paving grade Bitumen of VG-10. Glass fiber grids with adhesive on one side may not require a tack coat.

The tack coat shall be applied using a calibrated distributor spray bar. Hand spraying, squeegee and brush application may be used only in locations where the distributor truck cannot reach. The tack coat shall be uniformly applied at a rate to bond the nonwoven scrim to the existing pavement surface. The tack coat application rate shall be 1 Kg per square metre or as specified in the contract. When using emulsions, the application rate must be increased as directed by the Engineer to take into account the water content in the emulsion. The temperature of the tack coat shall be sufficiently high to permit a uniform spray. Bitumen shall be sprayed at temperatures between 143°C and 163°C. For emulsions, the distributor tank temperatures shall be maintained between 55°C and 71°C. The target width of the tack coat application shall be equal to the Glass grid width plus 100-150 mm. The tack coat shall be applied only as far in advance of Glass grid installation as is appropriate to ensure a tacky surface at the time of Glass grid placement. Traffic shall not be allowed on the tack coat. Excess tack coat shall be cleaned from the pavement.

708.3.4 Paving Fabric Placement

The paving fabric shall be placed onto the tack coat using mechanical or manual lay down equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding. The paving fabric shall be placed before to the tack coat cools and loses tackiness. After laying the paving fabric, some loose bituminous premix material shall be sprinkled on it in the wheel path of the paver and the tipper to ensure that the fabric is not picked up between the wheels. Paving fabric shall not be installed in areas where the bituminous overlay tapers to a thickness of less than 40 mm. Excess paving fabric which extends beyond the edge of existing pavement or areas of tack coat application shall be trimmed and removed. When bitumen emulsions are used, the emulsion shall be allowed to cure properly such that no water/moisture remains prior to placing the paving fabric. Wrinkles or folds in excess of 25 mm shall be single-lapped in the direction of the paving operation. Brooming and/or pneumatic rolling will be required to maximize paving fabric contact with the pavement surface. Additional hand-placed tack coat may be required at laps and repairs as determined by the Engineer to satisfy bitumen retention of the lapped paving fabric. All areas where paving fabrics have been placed shall be paved the same day. No traffic except necessary construction equipment will be allowed to drive on the paving fabric. Turning of the paver and other vehicles shall be done gradually and kept to a minimum to avoid movement and

damage to the paving fabric. Abrupt starts and stops shall also be avoided. Damaged fabric shall be removed and replaced with the same type of fabric. Overlaps shall be shingle-lapped in the direction of paving. Additional tack coat shall be placed between the overlap to satisfy saturation requirements of the fabric. Overlap shall be sufficient to ensure full closure of the joint but not exceed 150 mm. Transverse joints shall be overlapped in the direction of the pavement by 100 to 150 mm or as per the manufacturer's recommendations or as directed by the Engineer. Longitudinal joints shall be overlapped by 20-30 mm or as per the manufacturer's recommendations or as directed by the engineer. The overlay operations shall be completed at the earliest after laying the fabric.

708.3.5 Glass Grid Placement

The glass grid shall be placed on the surface provided by the tack coat using mechanical or manual lay down equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding. On curves, the Glass grid must be cut and realigned to match the curvature.

Glass grid shall not be installed in areas where the bituminous overlay tapers to a compacted thickness of less than 40 mm. When emulsions are used, the emulsion shall be allowed to cure properly such that no water/moisture remains prior to placing the glass grid. Wrinkles severe enough to cause folds shall be slit and laid flat. Brooming and/or rubber-tire rolling will be required to maximize glass grid contact with the pavement surface. Additional hand-placed tack coat may be required at overlaps and repairs as required by the Engineer. Turning and braking of the paver and other vehicles shall be done gradually and kept to a minimum to avoid movement and damage to the glass grid. Damaged composite shall be removed and replaced with the same type of composite and a tack coat.

All areas where glass grid has been placed shall be paved the same day. No traffic except necessary construction traffic shall be allowed to drive on the glass grid.

Overlaps shall be shingle - lapped in the direction of paving. Additional tack coat shall be placed between the overlap to satisfy saturation requirements of the fabric. Overlap shall be sufficient to ensure full closure of the joint but not exceeding 150 mm.

708.3.6 Overlay Placement

Bituminous overlay construction shall closely follow the placement of paving fabric or glass-grid. Excess tack coat that bleeds through the paving fabric or glass grid shall be removed by broadcasting hot mix or sand on the glass grid. Excess sand or hot mix shall be removed before beginning the paving operation. In the event of rainfall prior to the placement of the asphalt overlay, the fabric must be allowed to dry completely before the overlay is placed. Overlay asphalt thickness shall meet the requirements of the contract drawings and documents. The minimum compacted thickness of the first lift of overlay asphalt concrete shall not be less than 40 mm.

708.4 Measurement

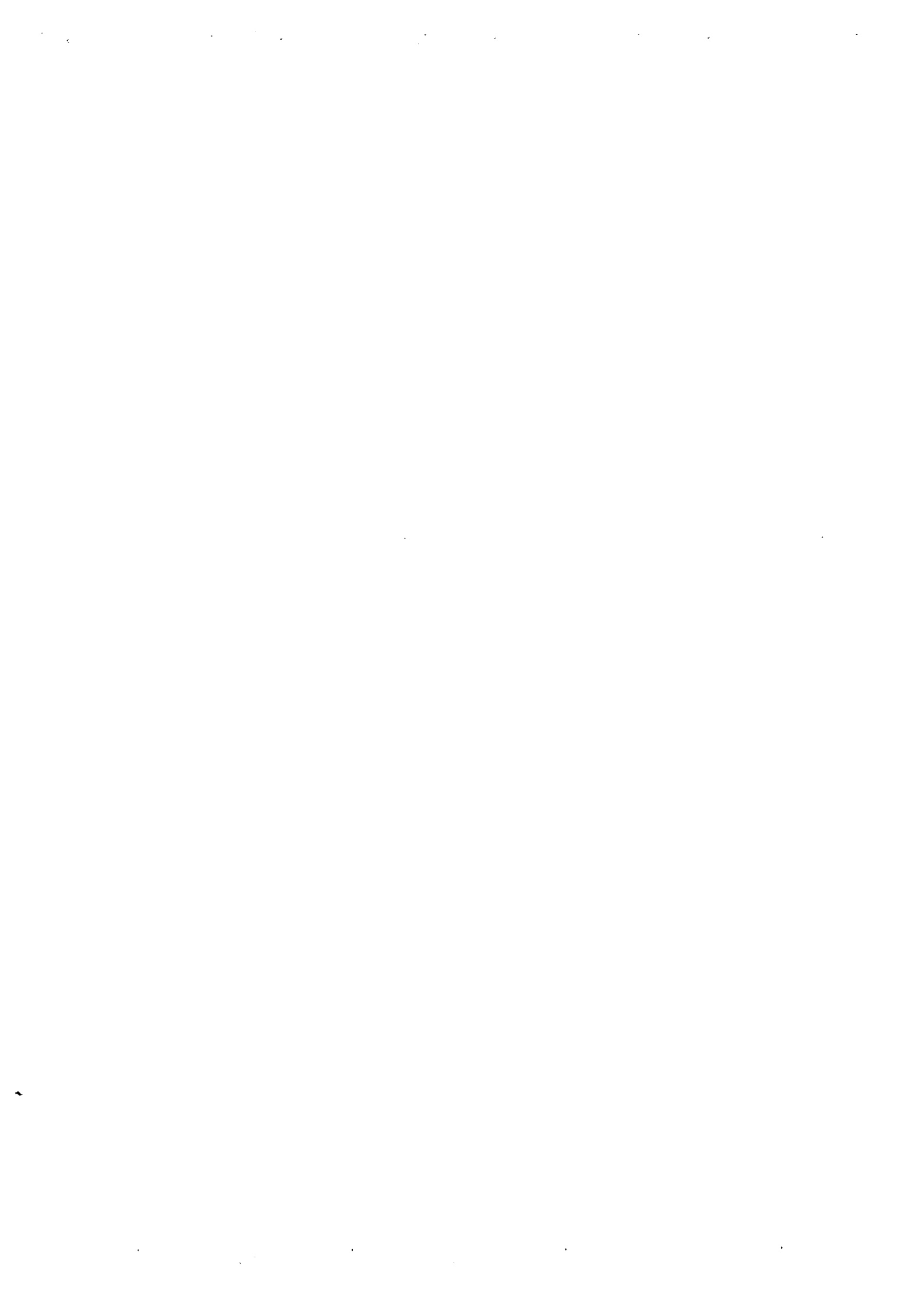
The paving fabric/ glass fibre geogrid shall be measured in Square metres of paved area covered by the fabric/ glass fibre geogrid.

708.5 Rate

The contract unit rate shall be for the accepted quantities of paving fabric. The rate shall be full compensation for the work performed and furnishing, preparing, hauling and placing materials including all labour, material, freight, tools, equipment and incidentals to complete the work as per contract.

800

**TRAFFIC SIGNS,
MARKINGS AND
OTHER ROAD
APPURTENANCES**



801 TRAFFIC SIGNS**801.1 Scope**

The work shall consist of the fabrication, supply and installation of ground mounted traffic signs on roads. The details of the signs shall be as shown in the drawings and in conformity with the Code of Practice for Road Signs, IRC:67-2010.

801.2 Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements:

801.2.1 Concrete

Concrete for foundation shall be of M 15 Grade as per Section 1700 or the grade shown on the drawings or otherwise as directed by the Engineer.

801.2.2 Reinforcing Steel

Reinforcing steel shall conform to the requirement of IS:1786 unless otherwise shown on the drawing.

801.2.3 Bolts, Nuts, Washers

High strength bolts shall conform to IS:1367 whereas precision bolts, nuts, etc., shall conform to IS:1364.

801.2.4 Plates and Supports

Plates and support sections for the sign posts shall conform to IS:226 and IS:2062 or any other relevant IS Specifications.

801.2.5 Substrate

Sign panels shall be fabricated on aluminium sheet, aluminium composite panel, fibre glass sheeting, or sheet moulding compound. Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS:736-Material Designation 24345 or 1900. Aluminium Composite Material (ACM) sheets shall be sandwiched construction with a thermoplastic core of Low Density Polyethylene (LDPE) between two thick skins/sheets of aluminium with overall thickness and 3 mm or 4 mm (as specified in the Contract), and aluminium skin of thickness 0.5 mm and 0.3 mm respectively on both sides.

The mechanical proportion of ACM and that of aluminium skin shall conform to the requirements given in Table 800-1, when tested in accordance with the test methods mentioned against each of them.

Table 800-1 : Specifications for Aluminium Composite Material (ACM)

S. No.	Description	Specification	
		Standard Test	Acceptable Value
A	Mechanical Properties of ACM		
1)	Peel off strength with retro reflective sheeting (Drum Peel Test)	ASTM D903	Min. 4 N/mm
2)	Tensile strength	ASTM E8	Min. 40 N/mm ²
3)	0.2% Proof Stress	ASTM E8	Min. 34 N/mm ²
4)	Elongation	ASTM E8	Min. 6%
5)	Flexural strength	ASTM 393	Min. 130 N/mm ²
6)	Flexural modulus	ASTM 393	Min. 44.00 N/mm ²
7)	Shear strength with Punch shear test	ASTM 732	Min. 30 N/mm ²
B	Properties of Aluminium Skin		
1)	Tensile strength (Rm)	ASTM E8	Min. 65 N/mm ²
2)	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm ²
3)	Elongation	ASTM E8	A50 Min. 2%
4)	0.2% Proof Stress	ASTM E8	Min. 10 N/mm ²

801.2.6 Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick with Aluminium and 3 mm thick with Aluminium Composite Material. All other signs be at least 2 mm thick with Aluminium and 4 mm thick with Aluminium Composite Material. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under prevailing wind and other loads.

801.2.7 In respect of sign sizes not covered by IRC:67, the structural details (thickness, etc.) shall be as per the approved drawings or as directed by the Engineer.

801.3 Traffic Signs having Retro-Reflective Sheeting

801.3.1 General Requirements

The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface.

It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for co-efficient of retro-reflection, day/night time colour luminous, shrinkage, flexibility, linear removal, adhesion, impact resistance, specular gloss and fungus resistance and its having passed these tests shall be obtained from a Government Laboratory/Institute, by the manufacturer of the sheeting. The retro-reflective sheeting shall be either of Engineering Grade material with enclosed lens, High Intensity Grade with encapsulated lens or Micro-prismatic Grade retro-reflective element material as given in Clauses 801.3.2 to 801.3.7. Guidance on the recommended application of each class of sheeting may be taken from IRC:67.

801.3.2 High Intensity Grade Sheeting

801.3.2.1 High Intensity Grade (Type III)

This high intensity retro reflective sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface or as an unmetallised micro prismatic reflective material element. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D:4956-09) as indicated in **Table 800-2**.

Table 800-2 : Acceptable Minimum Co-efficient of Retro-Reflection for High Intensity Grade Sheeting (Type III) (Encapsulated Lens Type) (Candelas Per Lux Per Square Metre)

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 ⁰ ^B	-4 ⁰	300	200	120	54	54	24	14
0.1 ⁰ ^B	+30 ⁰	180	120	72	32	32	14	10
0.2 ⁰	-4 ⁰	250	170	100	45	45	20	12
0.2 ⁰	+30 ⁰	150	100	60	25	25	11	8.5
0.5 ⁰	-4 ⁰	95	62	30	15	15	7.5	5.0
0.5 ⁰	+30 ⁰	65	45	25	10	10	5.0	3.5

A minimum of Coefficient of Retro-reflection (RA) cd/lx/ft² (cd-lx-1m²).

B Values for 0.1⁰ observation angles are supplementary requirements that shall apply only when specified by the purchaser in the Contract or order. When totally wet, the sheeting shall show not less than 90 percent, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.3 High Intensity Micro-Prismatic Grade Sheeting (HIP) (Type IV)

This sheeting shall be of high intensity retro-reflective sheeting made of micro-prismatic retro-reflective element material coated with pressure sensitive adhesive. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D:4956-09) as indicated in **Table 800-3**.

**Table 800-3 : Acceptable Minimum Co-efficient of Retro-Reflection for High Intensity Micro-Prismatic Grade Sheeting (Type IV)
(Candelas Per Lux Per Square Metre)**

Observation	Entrance	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 ^{0B}	-4 ⁰	500	380	200	70	90	42	25
0.1 ^{0B}	+30 ⁰	240	175	94	32	42	20	12
0.2 ⁰	-4 ⁰	360	270	145	50	65	30	18
0.2 ⁰	+30 ⁰	170	135	68	25	30	14	8.5
0.5 ⁰	-4 ⁰	150	110	60	21	27	13	7.5
0.5 ⁰	+30 ⁰	72	54	28	10	13	6	3.5

A Minimum Coefficient of Retro reflection (RA) cd/fc/ft² (cd-lx-1m²).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table . At the end of 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.4 Prismatic Grade Sheeting

801.3.4.1 Prismatic Grade Sheeting (Type VIII)

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM E 810) as indicated in Table 800-4.

801.3.4.2 Prismatic Grade Sheeting (Type IX)

The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM E 810) as indicated in Table 800-5.

Table 800-4 : Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade Sheeting (Type VIII) (Candelas Per Lux per Square Metre)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluor- escent Yellow/ Green	Fluor- escent Yellow	Fluor- escent Orange
0.1 ^{0B}	-4 ⁰	1000	750	375	100	150	45	30	800	600	300
0.1 ^{0B}	+30 ⁰	460	345	175	46	69	21	14	370	280	135
0.2 ⁰	-4 ⁰	700	525	265	70	105	32	21	560	420	210
0.2 ⁰	+30 ⁰	325	245	120	33	49	15	10	260	200	95
0.5 ⁰	-4 ⁰	250	190	94	25	38	11	7.5	200	150	75
0.5 ⁰	+30 ⁰	115	86	43	12	17	5	3.5	92	69	35

A Minimum Coefficient of Retro reflection (R^A) cd/fc/ft² (cd-lx-1m²).

B Values for 0.1⁰ observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

Table 800-5 : Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade Sheeting (Type IX) (Candelas Per Lux per Square Metre)

Observation	Entrance	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow/ Green	Fluore- scent Yellow	Fluore- scent Orange
0.1 ^{0B}	-4 ⁰	600	500	250	66	130	130	530	400	200
0.1 ^{0B}	+30 ⁰	370	280	140	37	74	17	300	220	110
0.2 ⁰	-4 ⁰	380	285	145	38	76	17	300	230	115
0.2 ⁰	+30 ⁰	215	162	82	22	43	10	170	130	65
0.5 ⁰	-4 ⁰	240	180	90	24	48	11	190	145	72
0.5 ⁰	+30 ⁰	135	100	50	14	27	6.0	110	81	41
1.0 ⁰	-4 ⁰	80	60	30	8.0	16	3.6	64	48	24
1.0 ⁰	+30 ⁰	45	34	17	4.5	9.0	2.0	36	27	14

A Minimum Coefficient of Retro reflection (R^A) cd/fc/ft² (cd-lx-1m²).

B Values for 0.1⁰ observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.4.3 Prismatic Grade Sheeting (Type XI)

A Retro-reflective sheeting typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-

reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM E 810) as indicated in Table 800-6.

Table 800-6 : Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade Sheeting Type A (Type XI) (Candelas Per Lux per Square Metre)

Observation	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow/Green	Fluorescent Yellow	Fluorescent Orange
0.1 ^{0B}	-4 ⁰	830	620	290	83	125	37	25	660	500	250
0.1 ^{0B}	+30 ⁰	325	245	115	33	50	15	10	260	200	100
0.2 ⁰	-4 ⁰	580	435	200	58	87	26	17	460	350	175
0.2 ⁰	+30 ⁰	220	165	77	22	33	10	7.0	180	130	66
0.5 ⁰	-4 ⁰	420	315	150	42	63	19	13	340	250	125
0.5 ⁰	+30 ⁰	150	110	53	15	23	7.0	5.0	120	90	45
1.0 ⁰	-4 ⁰	120	90	42	12	18	5.0	4.0	96	72	36
1.0 ⁰	+30 ⁰	45	34	16	5.0	7.0	2.0	1.0	36	27	14

A Minimum Coefficient of Retro-reflection (RA) cd/lx/ft² (cd-lx-1m²).

B Values for 0.1⁰ observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.5 Adhesives

The sheeting shall have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent other preparation for adhesion to a smooth clean surface, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The sheeting shall be applied in accordance with the manufacturer's specifications.

801.3.6 Fabrication

Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased either by acid or hot alkaline etching and all

scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm. Where screen printing with transparent colours is proposed, only butt joint shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.7 Messages/Borders

The messages (legends, letters, numerals etc.) and borders shall either be screen-printed or of cut out from durable transparent overlay or cut out from the same type of reflective sheeting for the cautionary/mandatory sign boards. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. For the informatory and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cut out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. For screen-printed transparent coloured areas on white sheeting, the coefficient of retro-reflection shall not be less than 50 percent of the values of corresponding colour in Tables 800-2 to 800-8 as applicable. Cut-out messages and borders, wherever used, shall be either made out of retro-reflective sheeting or made out of durable transparent overlay except those in black which shall be of non-reflective sheeting or opaque in case of durable transparent overlay.

801.3.8 Colour for Signs

801.3.8.1 Signs shall be provided with retro-reflective sheeting and/or overlay film/screening ink. The reverse side of all signs shall be painted grey.

801.3.8.2 Except in the case of railway level crossing signs the sign posts shall be painted in 250 mm side bands, alternately black and white. The lowest band next to be ground shall be in black.

801.3.8.3 The colour of the material shall be located within the area defined by the chromaticity coordinates in Table 800-7 and comply with the luminance factor when measured as per ASTM D-4956.

Table 800-7 : Colour Specified Limits (Daytime)

Colour	1		2		3		4		Daytime Luminance Factor (Y%)	
	x	y	x	y	x	y	x	y	Min.	Max.
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	15	--
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	24	45
Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	2.5	11
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	2.5	11
Blue	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216	1	10
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404	12	30
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390	1	6
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540	60	--
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	45	--
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	25	--

The colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

801.3.8.4 The Regulatory/Prohibitory and warning signs shall be provided with white background and red border. The legend/ symbol for these signs shall be in black colour. The Mandatory sign shall be provided with Blue background and white Symbol/letter.

801.3.8.5 The colours chosen for informatory or guide signs shall be distinct for different classes of roads. For National Highways and State Highways, these signs shall be of green background and for Expressways these signs shall be of blue background with white border, legends and word messages.

801.3.9 Refurbishment

Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing or materials as per Clause 801.2.5, pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

801.3.10 Sizes of Letters

801.3.10.1 Letter size should be chosen with due regard to the speed, classification and location of the road, so that the sign is of adequate size for legibility but without being too large or obtrusive. The size of the letter, in terms of x-height, to be chosen as per the design speed is given in Table 800-8.

Table 800-8 : Acceptable Limits for Sizes of Letters

Design Speed (Km./hr.)	Minimum 'x' Height of the Letters (mm)	Minimum Sight Distance/ Clear Visibility Distance (m)	Maximum Distance from Centre Line (m)
40	100	45	12
50	125	50	14
65	150	60	16
80	250	80	21
100	300	90	24
120	400	115	32

The thickness of the letters and their relation to the x-height, the width, the heights are indicated in Table IV (a) of the Annexure-4 of IRC:67 to facilitate the design of the informative signs and definition plates.

801.3.10.2 For advance direction signs on non-urban roads, the letter size ('x' height) should be minimum of 150 mm for Expressway, National and State Highways and 100 mm for other roads. In case of overhead signs, the size ('X' height) of letters may be minimum 300 mm. Thickness of the letter could be varied from 1/6 to 1/5 of the letter 'x' size. The size of the initial uppercase letter shall be 1-1/3 times x-height. In urban areas, letter size shall be 100 mm on all directional signs. For easy and better comprehension, the word messages shall be written in upper case letters only.

801.3.10.3 Letter size on definition plates attached with normal sized signs should be 100 mm or 150 mm. In the case of small signs, it should be 100 mm. Where the message is long, as for instance in "NO PARKING" and "NO STOPPING" signs, the message may be broken into two lines and size of letters may be varied in the lines so that the definition plate is not too large. The lettering on definition plates will be all in upper case letters.

801.3.11 Warranty and Durability

The Contractor shall obtain from the manufacturer a ten year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of micro-

prismatic sheeting and a seven-year warranty for high intensity grade and submit the same to the Engineer. The warranty shall be inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting. The Contractor/supplier shall also furnish the LOT numbers and certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty and that the contractor/supplier is the authorized converter of the particular sheeting.

All signs shall be dated during fabrication with indelible markings to indicate the start of warranty. The warranty shall also cover the replacement obligation by the sheeting manufacturer as well as contractor for replacement/repair/restoration of the retro-reflective efficiency.

A certificate in original shall be given by the sheeting manufacturer that its offered retro-reflective sheeting has been tested for various parameters such as co-efficient of retro-reflection, day/night time colour and luminance, shrinkage, flexibility, linear removal, adhesion, impact resistance, specular gloss and fungus resistance; the tests shall be carried out by a Government Laboratory in accordance with various ASTM procedures and the results must show that the sheeting has passed the requirements for all the above mentioned parameters. A copy of the test reports shall be attached with the certificate.

801.4 Installation

801.4.1 The traffic signs shall be mounted on support posts, which may be of GI pipes conforming to IS:1239, Rectangular Hollow Section conforming to IS:4923 or Square Hollow Section conforming to IS:3589. Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area up to 0.9 sq.m shall be mounted on a single post, and for greater area two or more supports shall be provided. Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.

801.4.2 All components of signs (including its back side) and supports, other than the reflective portion and G.I. posts shall be thoroughly de-scaled, cleaned, primed and painted with two coats of epoxy/ fibre glass/ powder coated paint. Any part of support post below ground shall be painted with protective paint.

801.4.3 The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

801.5 Measurement for Payment

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square metres.

801.6 Rate

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site furnishing of necessary test certificates, warranty and incidentals to complete the work in accordance with these Specifications.

802 OVERHEAD SIGNS**802.1 Scope**

The work shall consist of fabrication, supply and installation of overhead traffic signs on roads. The details of the signs shall be as shown in the drawings and in conformity with the Code of Practice for Road Signs, IRC:67-2010.

802.2 Height

Overhead signs shall provide a vertical clearance of not less than 5.5 m over the entire width of the pavement and shoulders except where a lesser vertical clearance is used for the design of other structures. The vertical clearance to overhead sign structures or supports need not be greater than 300 mm in excess of the minimum clearance of other structures.

802.3 Lateral Clearance

802.3.1 The minimum clearance outside the usable roadway shoulder for signs mounted at the road side or for overhead sign supports either to the right or left side of the roadway shall be 1.80 m. This minimum clearance of 1.80 m shall also apply outside of an unmountable kerb. Where practicable, a sign should not be less than 3 m from the edge of the nearest traffic lane. Large guide signs should be farther removed preferably 9 m or more from the nearest traffic lane, unless otherwise specified. Lesser clearances, but not generally less than 1.80 m, may be used on connecting roadways or ramps at inter-changes.

802.3.2 Where a median is 3.6 m or less in width, consideration should be given to spanning over both roadways without a central support. Where overhead sign supports cannot be placed at a safe distance away from the line of traffic or in an otherwise protected site, they should either be so designed as to minimize the impact forces or protect motorists adequately by a physical barrier or guard rail of suitable design.

802.4 Materials for Overhead Sign and Support Structures

802.4.1 Aluminium alloy or galvanized steel to be used as truss design supports shall conform to relevant IS. These shall be of sections and type as per structural design requirements as shown on the plans.

802.4.2 After steel trusses have been fabricated and all required holes punched or drilled on both the horizontal truss units and the vertical and support units, they shall be galvanized in accordance with IS Specifications.

802.4.3 Where aluminium sheets are used for road signs, they shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS:736 - Material Designation 24345 or 1900. The thickness of sheet shall be related to the size of the sign with minimum thickness of sheet as 1.5 mm.

802.4.4 High strength bolts shall conform to IS:1367 whereas precision bolts, nuts etc. shall conform to IS:1364.

802.4.5 Plates and support sections for sign posts shall conform to IS:226 and IS:2062.

802.4.6 The overhead signs shall be of micro prismatic retro-reflective sheeting.

802.5 Size and Locations of Signs

802.5.1 The size of the signs, letters and their placement shall be as specified in the Contract drawings and Specifications.

802.5.2 In the absence of details or for any missing details in the Contract documents, the signs shall be provided as directed by the Engineer.

802.6 Installation

802.6.1 From safety and aesthetic considerations, overhead signs shall be mounted on overhead bridge structures. Where these are required to be provided at some other locations, the support system providing pleasing aesthetics, should be properly designed based on sound engineering principles, to safely sustain the dead load, live load and wind load on the completed sign system. For this purpose, the overhead signs shall be designed to withstand a wind loading of 150 kg/m² normal to the face of the sign and 30 kg/m² transverse to the face of the sign. In addition to the dead load of the structure, walkway loading of 250 kg concentrated live load shall also be considered for the design of the overhead sign structure.

802.6.2 The supporting structure and signs shall be fabricated and erected as per details given in the plans and at locations directed by the engineer.

802.6.3 Sign posts, their foundations and sign mountings shall be so constructed as to hold signs in a proper and permanent position to adequately resist swaying in the wind or displacement by vandalism.

802.6.4 The work of construction of foundation for sign supports including excavation and backfill, forms, steel reinforcement, concrete and its placement shall conform to the relevant Specifications given in these Specifications.

802.6.5 The structures shall be erected with the specified camber and in such a manner as to prevent excessive stresses, injury and defacement.

802.6.6 Brackets shall be provided for mounting signs of the type to be supported by the structure. For better visibility, they shall be adjustable to permit mounting the sign faces at any angle between a truly vertical position and three degree from vertical. This angle shall be obtained by rotating the front lower edge of the sign forward. All brackets shall be of a length equal to the heights of the signs being supported.

802.6.7 Before erecting support structures, the bottom of each base plate shall be protected with an approved material which will adequately prevent any harmful reaction between the plate and the concrete.

802.6.8 The end supports shall be plumbed by the use of levelling nuts and the space between the foundation and base plate shall be completely filled with an anti-shrink grout.

802.6.9 Anchor bolts for sign supports shall be set to proper locations and elevation with templates and carefully checked after construction of the sign foundation and before the concrete has set.

802.6.10 All nuts on aluminium trusses, except those used on the flanges shall be tightened only until they are snug. This includes the nuts on the anchor bolts. A thread lubricant shall be used with each aluminium nut.

802.6.11 All nuts on galvanized steel trusses, with the exception of high strength bolt connections, shall be tightened only to a snug condition.

802.6.12 Field welding shall not be permitted.

802.6.13 After installation of signs is complete, the sign shall be inspected by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor to eliminate or minimize this condition.

802.7 Measurements for Payment

802.7.1 Aluminium or steel overhead sign structure shall be measured for payment by the specific unit (each) complete in place as indicated in the Bill of Quantities and the detailed drawings(s).

802.7.2 Flat sheet aluminium signs with retro-reflective sheeting thereon shall be measured for payment by the square metre, complete in place.

802.8 Rate

802.8.1 The Contract unit rate for overhead sign structure shall be payment in full compensation for furnishing all labour, materials, tools, equipment, excavation for foundation, concrete, reinforcement, painting of structural steel and sign back, fabrications and installation, furnishing of necessary test certificates, warranty and all other incidental costs necessary to complete the work to these Specifications.

802.8.2 The Contract unit rate for aluminium sheet signs shall include the cost of making the sign including all materials and fixing the same in position and all other incidental costs necessary to complete the work to these Specifications.

803 ROAD MARKINGS

803.1 Scope

The work shall consist of providing road markings of specified width, layout and design using paint of the required specifications as given in the Contract and as per guidelines contained in from IRC:35-1997.

803.2 Materials

Road markings shall be of ordinary road marking paint hot applied thermoplastic compound, reflectorised paint or cold applied reflective paint as specified in the item and the material shall meet the requirements as specified in these Specifications.

803.3 Ordinary Road Marking Paint

803.3.1 Ordinary paint used for road marking shall conform to Grade I as per IS:164.

803.3.2 The road marking shall preferably be laid with appropriate road marking machinery.

803.4 Hot Applied Thermoplastic Road Marking

803.4.1 Thermoplastic Material

803.4.1.1 General

The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads. The colour of the compound shall be white or yellow (IS colour No. 356) as specified in the drawings or as directed by the Engineer.

803.4.1.2 Requirements :

- i) **Composition:** The pigment, beads, and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800-9.

Table 800-9 : Proportions of Constituents of Marking Material (Percentage by Weight)

Component	White	Yellow
Binder	18.0 min.	18.0 min.
Glass Beads	30-30	30-30
Titanium Dioxide	10.0 min.	--
Calcium Carbonate and Inert Fillers	42.0 max.	See Note below
Yellow Pigments	--	See Note below

Note : Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this Specification are met.

- ii) **Properties:** The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part I), shall be as below:
- a) **Luminance :**
 White: Daylight luminance at 45°-65 percent min. as per AASHTO M 249
 Yellow: Daylight luminance at 45°-45 percent min. as per AASHTO M 249
- b) **Drying time :** When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.
- c) Skid resistance: not less than 45 as per BS:6044.
- d) Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks.
- e) Softening point: 102.5°C ± 9.5°C as per ASTM D 36.
- f) Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTO M 249
- iii) **Storage life :** The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/ Contractor.

- iv) **Reflectorisation** : Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.2.
- v) **Marking** : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:
 - 1) The name, trade mark or other means of identification of manufacturer
 - 2) Batch number
 - 3) Date of manufacture
 - 4) Colour (white or yellow)
 - 5) Maximum application temperature and maximum safe heating temperature.
- vi) **Sampling and Testing** : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.2 Reflectorizing Glass Beads

803.4.2.1 General

This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-9 and Type 2 beads are those which are to be sprayed on the surface vide Clause 803.6.4.

803.4.2.2 The glass beads shall be transparent, colourless and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause 803.4.2.3.

803.4.2.3 Specific Requirements

- a) **Gradation** : The glass beads shall meet the gradation requirements for the two types as given in Table 800-10.

Table 800-10 : Gradation Requirements for Glass Beads

Sieve Size	Percent Retained	
	Type 1	Type 2
1.18 mm	0 to 3	
850 micron	5 to 20	0 to 5
600 micron	--	5 to 20
425 micron	65 to 95	--
300 micron	--	30 to 75
180 micron	0-10	10 to 30
Below 180 micron	--	0 to 15

- b) **Roundness:** The glass beads shall have a minimum of 70 percent true spheres.
- c) **Refractive index:** The glass beads shall have a minimum refractive index of 1.50.
- d) **Free flowing properties:** The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

803.4.2.4 Test Methods

The specific requirements shall be tested with the following methods:

- i) Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter dessicator which is filled within 25 mm of the top of a dessicator plate with sulphuric acid water solution (specific gravity 1.10). Cover the dessicator and let it stand for 4 hours at 20°C to 29°C. Remove sample from dessicator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be free of lumps and clusters and shall flow freely through the funnel.
- ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS:6088 and BS:3262 (Part I).
- iii) The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify

that the material meets all requirements of these Specifications. However, if so required, these tests may be carried out as directed by the Engineer.

803.4.3 Application Properties of Thermoplastic Material

803.4.3.1 The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.3.2 The material upon heating to application temperatures shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

803.4.4 Preparation

- i) The material shall be melted in accordance with the manufacturer's instructions in a heater with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.
- ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

803.5 Reflectorised Paint

Reflectorised paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of Clause 803.4.2.

803.6 Application

803.6.1 Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

803.6.2 Where the compound is to be applied to cement concrete pavement, a sealing primer as recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

803.6.3 The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

803.6.4 The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

803.6.5 The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS:3262 (Part 3).

803.6.6 The markings shall be done to accuracy within the tolerances given below:

- i) Width of lines and other markings shall not deviate from the specified width by more than 5 percent.
- ii) The position of lines, letters, figures, arrows and other markings shall not deviate from the position specified by more than 20 mm
- iii) The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.
- iv) The length of segment of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

In broken lines, the length of segment and the gap between segments shall be as indicated on the drawings; if these lengths are altered by the Engineer, the ratio of the lengths of the painted sections shall remain the same.

803.6.7 Properties of Finished Road Markings

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

- a) The stripe shall not be slippery when wet.
- b) The marking shall not lift from the pavement in freezing weather.
- c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures upto 60°C.
- d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil dripping from traffic.
- e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- f) The colour of yellow marking shall conform to IS Colour No. 356 as given in IS:164

803.6.8 Measurements for Payment

803.6.8.1 The painted markings shall be measured in sq. metres of actual area marked (excluding the gaps, if any).

803.6.8.2 In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

803.6.9 Rate

The Contract unit rate for road markings shall be payment in full compensation for furnishing all labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these Specifications complete as per the approved drawing(s) or as directed by the Engineer and all other incidental costs necessary to complete the work to these Specifications.

803.7 Cold Applied Reflective Paint**803.7.1 General**

The work shall consist of marking traffic stripes using a solvent based cold applied paint, which shall be applied on the asphalt/cement concrete road surface by brush or by Road Marker (Spray equipment capable of spraying the paint on the road). Glass beads shall be

subsequently spread pneumatically on to the paint when it is still wet so that the beads will be firmly held by the paint after drying. Colour of the paint shall be white or yellow (IS Colour No. 356) as specified in the drawings or as directed by the engineer.

803.7.2 Material

803.7.2.1 The cold applied paint material shall be homogeneously composed of binder, pigment, extenders and other additives as required for the formulation.

803.7.2.2 Composition

The pigments and extenders shall be uniformly dispersed in the binder medium dissolved in organic solvents. The material shall be free from skin, dirt and foreign objects and shall comply with requirements indicated in Table 800-11.

Table 800-11 : Proportions of Constituents or Paints (Percentage by Weight)

Component	White	Yellow
Binder	25.0 min.	18.0 min.
Titanium Dioxide	20.0 min.	--
Calcium Carbonate and Inert Fillers	16.0 min.	29.0 min.
Yellow Pigments	--	14.0 min.

803.7.2.3 Properties

Non-Volatile Matter content by weight shall be a minimum of 65 percent as determined in accordance with test method ASTM D1644. The liquid paint shall have a density of 1.3 g/cc minimum as determined in accordance with test method ASTM D1475.

803.7.2.4 Appearance

Drying Time of the paint as determined by the test method ASTM D711 shall be a maximum of 20 minutes at a wet film thickness of 350 micron. The paint shall set to bear traffic after 40 minutes when the ambient temperature is higher than 24°C. The paint shall not be applied when the surface temperature of the road is higher than 40°C.

803.7.2.5 Properties of the Dried Paint Film

When tested using a sand abrasion tester as described in ASTM D968, the quantity of sand required for removal of a 75 micron thick unbeaded dry film shall be greater than 65 litres.

803.7.2.6 Elongation

The unbeaded dry film shall pass the test in accordance with ASTM D 1737 and ASTM D 2205.

803.7.2.7 Water Resistance

The unbeaded dry film shall pass the test in accordance with ASTM D1647 and ASTM D2205.

803.7.2.8 Skid Resistance

Skid resistance for the beaded dry film shall be not less than 45 as per BS 6044.

803.7.2.9 Storage Life

The material shall meet the specifications for a period of one year. During this period, the paint material when stored in an airtight container shall not form skin. The material shall also not form a cake at the bottom of the container.

803.7.2.10 Minimum Thickness of the Unbeaded Cold Applied Paint Coat

The minimum thickness of the wet unbeaded coat of paint shall not be less than 400 micron, and the minimum thickness of the dry unbeaded coat of paint shall not be less than 200 microns.

803.7.2.11 Retro-reflective Properties

The co-efficient of retro-reflection as per British Standards BS EN 1436:1998 shall be as under:

For white paint (Beaded)	-300 mcd/m ² /lux on application
	-100 mcd/m ² /lux after defect liability period of one year
For yellow paint (Beaded)	-200 mcd/m ² /lux on application
	-100 mcd/m ² /lux after defect liability period of one year

The luminous Co-efficient as per British Standards BS EN 1436:1998 shall be as under:

For white paint (Un-beaded)	100 mcd/m ² /lux on application
For yellow paint (Un-beaded)	80 mcd/m ² /lux on application

803.7.3 Marking

Each container of the cold-paint shall be clearly and indelibly marked with the following information:

- i) The name, trade/patent mark

- ii) Batch No.
- iii) Month of Manufacture
- iv) Colour (White or Yellow)

803.7.4 Sampling and Testing

The cold applied reflective road marking paint shall be sampled and tested in accordance with appropriate ASTM/BS test methods.

The contractor shall furnish to the Engineer a copy of certified test methods from the manufacturer of cold applied reflective road marking paint showing the results of:

- a) No pick up time as per ASTM D 711.
- b) Resistance to wear as per ASTM D 4060 or as per ASTM D 968 from approved laboratories.
- c) material safety data sheet shall be obtained from the manufacturer and kept with the paint materials.

803.7.5 Reflectorising Glass Beads

803.7.5.1 General

Reflection shall be achieved by pneumatically spreading glass beads on to the paint when it is still wet. The beads shall be firmly held by the paint after drying.

803.7.5.2 The glass beads shall be transparent, colourless and free from milkiness, dark particles and excessive air inclusions. These shall conform to the requirements spelt out in Clause 803.6.7.3.

803.7.5.3 Specific Requirements

- i) **Gradation:** The glass beads shall meet the gradation requirements as per No. 4 of BS:6088 as given in Table 800-12.

Table 800-12 : Gradation Requirements for Glass Beads

Sieve Size	Percentage Retained
250 micron	0-10
150 micron	80-100
Below 150 micron	0-20

- ii) **Roundness:** The glass beads shall have a minimum of 70 percent true Spheres.

- iii) **Refractive Index:** The glass beads shall have a minimum refractive Index of 1.50.
- iv) **Free Flowing Properties:** The glass beads shall be free of hard lumps, clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test as given in Clause 803.6.5.4.

803.7.5.4 Test Methods

The specific requirements shall be tested with the following methods:

- i) **Free-Flow Test:** Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter dessicator which is filled within 25 mm of the top of a dessicator plate with sulphuric acid water solution (specific gravity 1.10). Cover the dessicator and let it stand for 4 hours at 20°C to 29°C. Remove sample from dessicator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be free of lumps and clusters and shall flow freely through the funnel.
- ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS:6088 and BS:3262(Part-1)
- iii) The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of these Specifications. However, if so required, these tests may be carried out as directed by the Engineer.

803.7.5.5 Preparation

The cold applied reflective road marking paint shall be stirred well to form homogeneously with the thinner recommended/supplied by the manufacturer and put into the machine with the consistency level recommended by the machine manufacturer by using proper viscometers. The thinner shall not be added more than that recommended by the manufacturer to avoid bleeding.

803.7.5.6 Application

803.7.5.6.1 Marking shall be done by machine. For locations where painting can not be done by machine, approved manual methods shall be used with prior approval of the

Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

803.7.5.6.2 The cold applied paint shall be applied on the asphalt/cement concrete road surface by brush or by Road Marker/Spray equipment capable of spraying the paint on the road surface. Glass beads @ 300 gms per sq.m shall be subsequently spread pneumatically on to the paint when it is still wet so that the beads will be firmly held by the paint after drying.

803.7.5.6.3 The pavement temperature shall not be more than 40°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease oils and all other foreign matter before application of paint.

803.7.5.6.4 The material, when formed into traffic stripes, must be readily renewable by placing an overlay of a new material directly over an old line. Such new material shall so bond itself to the old line that no splitting or separation takes place.

803.7.5.6.5 Cold applied paint shall be applied in intermittent or continues lines of uniform thickness of at least 200 micron of unbeaded dry film thickness unless specified otherwise. When arrows or letters are to be provided, cold applied paint may be applied manually. In addition to the beads recommended for, a further quantity of 300 gms of glass beads per sqm. conforming to the specification shall be sprayed uniformly in to a mono-layer on to the cold paint line in quick succession of the cold paint spraying operation.

803.7.5.6.6 The minimum. thickness specified above in Clause 803.7.5.5.5 is exclusive of surface applied glass beads.

803.7.5.6.7 The finished line shall be free from ruggedness on sides and ends and be parallel to general alignment of the carriage way.

The upper surface of the lines shall be of uniform level and free from streaks.

803.7.5.7 Properties of Finished Road Marking

As per Clause 803.6.7.

803.7.6 Measurement for Payments

As per Clause 803.5.2.1.

803.7.7 Rate

As per Clause 803.5.3.

803.8 Audible and Vibratory Pavement Markings**803.8.1 Description**

The work shall involve application of audible and vibratory pavement markings in accordance with the drawings or the direction of the Engineer.

803.8.2 Materials

Thermoplastic: thermoplastic material shall meet the requirements of Clause 803.4.1 of these Specifications.

Glass Spheres: Use glass spheres meeting the requirements of Clause 803.4.2. The Engineer will take random samples of glass spheres in accordance with ASTM D 1214 and the Department's Sampling, Testing and Reporting Guide schedule.

803.8.3 Equipment

The equipment capable of providing continuous, uniform heating of the striping material to temperatures exceeding 200°C, mixing and agitating the material in the reservoir shall be used to provide a homogenous mixture without segregation. Equipment will maintain the striping material in a plastic state, in all mixing and conveying parts, including the line dispensing device until applied. Equipment shall be capable of producing a consistent pattern of transverse bars positioned at regular and predetermined intervals. It shall meet the following requirements:

- a) capable of travelling at a uniform rate of speed, both uphill and downhill, to produce a uniform application of striping material and capable of following straight lines and making normal curves in a true arc.
- b) capable of applying glass spheres to the surface of the completed stripe by automatic sphere dispensers attached to the striping machine such that the glass spheres are dispensed closely behind the installed line. The glass sphere dispensers should be equipped with an automatic cut-off control that is synchronized with the cut-off of the thermoplastic material and applies the glass spheres uniformly on the entire traffic stripe surface with 50 percent to 60 percent embedment equipped with a special kettle for uniformly heating and melting the striping material.
- c) equipped with special kettle for uniformly heating and melting the striping material. The kettle must be equipped with an automatic temperature control device and material thermometer for positive temperature control and to prevent overheating or scorching of the thermoplastic material.
- d) meets the requirements of the fire safety standards.

803.8.4 Application**803.8.4.1 General**

Before applying traffic stripes and markings, any material that would adversely affect the bond of the traffic stripes shall be removed by a method approved by the Engineer.

Before applying traffic stripes to any portland cement surface, a primer, sealer or surface preparation adhesive of the type recommended by the manufacturer shall be applied. Longitudinal lines should be offset by at least 50 mm from construction joints of Portland cement concrete pavement.

Traffic stripes or markings shall be applied only to dry surface, and when the ambient air and surface temperature is at least 10°C and rising for asphalt surfaces and 16°C and rising for concrete surface.

Striping shall be applied to the same tolerances in dimensions and in alignment. When applying traffic stripes and marking over existing markings, ensure that not more than 50 mm on either end and not more than 25 mm on either side of the existing line is visible.

803.8.4.2 Thickness

Base lines shall be applied having a thickness of 2 mm to 2.2 mm exclusive of the transverse audible bars, when measured above the pavement surface at the edge of the base line.

As an alternative to the flat base line, a profiled baseline meeting the following dimensions may be applied. The profiled baseline shall have a minimum height of 4 mm, when measured above the pavement surface at the edge of the inverted rib profile. The thickness in the bottom of the profile marking shall be 0.9 mm to 1.3 mm. The individual profiles shall be located transversely across the full width of the traffic stripe at approximately 25 mm. On center, with a bottom width between 2.5 mm and 8 mm.

803.8.5 Dimensions of Transverse Audible Bars

The raised transverse bars shall be applied with a profile such that the leading and trailing edges are sloped at a sufficient angle to create an audible and vibratory warning,

Transverse bars on shoulder and centerline markings shall have a height of 11 mm to 14 mm, including the base line. The height shall be measured above the pavement surface at the edge of the marking, after application of drop-on glass spheres. The bars shall have an approximate length of 65 mm. The bars may have a drainage channel on each bar, the width of each drainage channel will not exceed 6.5 mm at the bottom of the channel. The longitudinal distance between bars shall be 750 mm.

803.8.6 Retro-reflectivity

White and yellow audible and vibratory markings shall attain an initial retro reflectance of not less than 300 mcd/1xm² and not less than 250 mcd/1x m², respectively.

803.8.7 Glass Spheres

Glass spheres shall be applied to all markings. The manufacturer shall determine if a single or double application of glass spheres is used and the recommended drop rates for each application shall be adopted.

803.8.8 Contractor's Responsibility

The Engineer shall be notified by the contractor, prior to the placement of audible and vibratory markings. The contractor shall furnish the Engineer with the manufacturer's name and LOT numbers of the thermoplastic materials and glass spheres to be used. He will ensure that the LOT numbers appear on the thermoplastic materials and glass spheres packages. The contractor shall furnish a copy of certified test reports to the Engineer, showing results of tests specified in these Specifications or as per appropriate ASTM/BS method. The Engineer would have the right to test the markings within 3 days of receipt of the Contractor's certification. If the retro reflectivity values measure less than the values shown above, it shall be removed and the stripping reapplied.

803.8.9 Protection of Newly Applied Audible and Vibratory Markings

Traffic shall not be allowed onto or vehicles permitted to cross newly applied pavement markings until they are sufficiently dry. Any portion of the pavement markings damaged by passing traffic or from any other cause shall be removed and replaced.

803.8.10 Observation Period

Pavement markings shall be subject to a 180 day observation period under normal traffic. The observation period will begin with the satisfactory completion and acceptance of the pavement marking work. The pavement markings shall show no signs of failure during the observation period. Any pavement markings that do not perform satisfactorily under traffic during the 180 day observation period, shall be replaced by the contractor at his own cost.

803.8.11 Measurement for Payment

Audible and vibratory pavement markings shall be measured in linear metre. Payments will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work.

804 REFLECTIVE PAVEMENT MARKERS (ROAD STUDS) AND SOLAR POWERED ROAD MARKERS (SOLAR STUDS)

804.1 Scope

The work shall cover the providing and fixing of reflective pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time visibility, as specified in the Contract.

804.2 Material

804.2.1 Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Styrene Acrylonitrile) or HIPS (Hi-impact Polystyrene) or Acrylonitrile Butadiene Styrene (ABS) or any other suitable material approved by the Engineer. The markers shall support a load of 13,635 kg tested in accordance with ASTM D 4280.

804.2.2 Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be moulded of methyl methacrylate conforming to ASTM D 788 or equivalent.

804.3 Design

The slope or retro-reflecting surface shall preferably be $35 \pm 5^\circ$ to base and the area of each retro-reflecting surface shall not be less than 13.0 sq.cm.

804.4 Optical Performance

804.4.1 Unidirectional and Bi-directional Studs

Each reflector or combination of reflectors on each face of the stud shall have a Coefficient of Luminous Intensity (C.I.L.) not less than that given in Tables 800-13 or 800-14 as appropriate.

804.4.2 Omni-directional Studs

Each Omni-directional stud shall have a C.I.L. of not less than 2 mcd/lx.

Table 800-13 : Minimum C.I.L. Values for Category 'A' Studs

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 5° L & R	0.3°	220	110	44
0° U 10° L & R	0.5°	120	60	24

Table 800-14 : Minimum C.I.L. Values for Category 'B' Studs

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 6° L&R	0.3°	20	10	4
0° U 10° L&R	0.5°	15	7.5	3

Note :

- 1) The entrance angle of 0° U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.
- 2) The stud incorporating one or more corner cube reflectors shall be included in Category 'A'. The stud incorporating one or more bi-convex reflectors shall be included in Category 'B'.

804.5 Tests

804.5.1 Co-efficient of luminance intensity can be measured by procedure described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS:873-Part 4: 1973.

804.5.2 Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the values specified in Tables 800-13 or 800-14 provided that

- i) the value is not less than 80 percent of the specified minimum, and
- ii) the average of the left and right measurements for the specific angle is greater than the specified minimum.

804.6 Solar Powered Road Markers (Solar Studs)

The solar studs shall be made of Aluminium alloy and poly carbonate material which shall be absolutely weather resistant and strong enough to support a load of 13,635 kg tested in accordance with ASTM D4280. Its colour may be white, red, yellow, green or blue or combination as directed by the Engineer. Its water resistance shall meet the requirements of IP 65 in accordance with IS:12063:1987 Category 2 for protection against water ingress. The dimensions of solar studs shall not be less than 100 mm x 100 mm x 10 mm. It shall have super bright LEDs so as to provide long visibility from a distance of more than 800 m. Its flashing rate shall not be less than 1 Hz. Its should be able to give the prescribed performance in the temperature range of -40°C to +55°C. Its life shall be not less than 3 years.

804.7 Fixing of Reflective Markers**804.7.1 Requirements**

The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portions of the studs shall be free from crevices

or ledges where dirt might accumulate. Marker height shall not be less than 10 mm and shall not exceed 20 mm. and its width shall not exceed 130 mm. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

804.7.2 Placement

The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the of the marker in a quantity sufficient to result in complete coverage of the area of contract of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place. For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

804.7.3 Warranty and Durability

The contractor shall submit a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel, to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer, at his own cost.

804.8 Measurement for Payment

The measurement of reflective road markers/solar powered road studs shall be in numbers of different types of markers supplied and fixed.

804.9 Rate

The contract unit rate for reflective road markers/solar powered road studs shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental

costs necessary for carrying out the work at site conforming to the specification complete as per approved drawings or as directed by the Engineer.

805 DISTANCE INDICATOR POSTS

805.1 Scope

The work shall cover the supply, painting, lettering and fixing of distance indicator stones along the highway to assist the drivers/users in estimating the distance travelled or remains to be travelled to reach destination, to identify incident location and to provide assistance in maintenance and operations. These devices shall show Hectometre, Kilometre and 5th Kilometres as the case may be.

805.2 These posts shall be in accordance with those prescribed in IRC:26 "Type Designs for 200 Metre Stones" and IRC:8 "Type Designs for Highway Kilometre Stones". They may also be provided in the form of sign systems on highways and roads.

805.3 The material may be made of local stones, concrete or any other material available locally and approved by the Engineer for the devices in accordance with the IRC:26 and IRC:8. For the device(s) provided as the sign system, the material shall be same as that for a traffic sign with retro-reflective sheeting; rectangular in shape (longer side vertical), with colour scheme as that for Advance Direction/Destination signs. The signs shall contain 250 mm white numerals on a 300 mm wide blue or green background (as the case may be) with white border. They shall be 600, 900 or 1200 mm in height for one, two or three digits respectively and shall contain the abbreviation km in 100 mm white letters so that they are clearly visible to approaching vehicle driver from a distance of at least 100 m. They shall be mounted at a minimum height and lateral placement as that for delineators. These devices shall be bedded into the ground with adequate foundations as indicated in the drawings or in the relevant IRC Specifications or as directed by the Engineer. The orientation and location of the devices shall be as indicated in the drawings or in the relevant IRC Specifications or as directed by the Engineer.

805.4 Measurements for Payment

The measurement will be in numbers of 200 metre, kilometer and 5th kilometer distance indicator posts fixed at site, complete job as per these Specifications or as directed by the Engineer.

805.5 Rate

The Contract unit rate for hectometer/kilometer/5th kilometer distance measurement posts shall be payment in full compensation for furnishing all labour, materials, tools, equipment

and making, painting and lettering and fixing at site and all other incidental costs necessary to complete the work to these Specifications.

806 ROAD DELINEATORS

806.1 Scope

The work shall cover supplying and fixing roadway indicators, hazard markers and object markers. Roadway indicators shall be properly installed to indicate the horizontal alignment and vertical profile of the roadway so as to outline the vehicle path for safe driving. Hazard markers shall be installed immediately ahead of obstruction of vehicular path such as just before a narrow bridge. Object markers shall be erected where obstruction within the roadway starts such as channelling island in approaches to intersections.

806.2 The design, materials to be used and the location of the road delineators (roadway indicators, hazard markers and object markers) shall conform to Recommended Practice for Road Delineators, IRC:79, and to relevant drawings or as otherwise directed by the Engineer. The steel drums such as empty bitumen drums shall not be used as they could pose safety hazards, The delineators shall be retro-reflectorised as shown on the drawings or as directed by the Engineer. The reflectors on the delineators shall be of retro-reflective sheeting with encapsulated lens and with the visibility of 300 m under clear weather conditions, when illuminated by the upper beam of the car headlights.

806.3 Installation

The delineators shall be so installed that their posts do not change their orientation and the reflectorised faces are always perpendicular to the direction of travel.

806.4 Measurement for Payments

The measurement shall be made in number of delineators supplied and fixed at site.

806.5 Rates

The Contract unit rates of delineators shall be payment in full compensation for furnishing all labour, materials, tools, equipment including incidental costs necessary to complete the work to these Specifications.

807 BOUNDARY STONES

807.1 Scope

The work shall cover supply and fixing boundary stones as per designs and Specifications given in IRC:25 "Type Designs for Boundary Stones" and at locations indicated in the drawings or as directed by the Engineer. The material to be used shall conform to IRC:25.

807.2 Measurements for Payment

The measurement shall be made in numbers of boundary stones supplied and fixed at site.

807.3 Rate

The Contract unit rate for boundary stones shall be full compensation for furnishing all labour, materials, tools, equipment for preparing, supplying and fixing and all other incidental costs necessary to complete the work to these Specifications.

808 FENCING**808.1 Scope**

The work shall cover supply and installation of chain link fencing or barbed wire fencing with its fixing on GI pipe posts or RCC posts and providing necessary stays and entry gates as shown in the drawing(s) and/or as directed by the Engineer.

808.2 The GI posts shall conform to IS:1239. The GI pipe posts shall be embedded in concrete to a sufficient depth below ground as indicated in the drawings. The steel shall be fabricated and painted to conform to Section 1900 of these Specifications.

808.3 The chain link fencing shall conform to ASTM F 1553-06. They shall be firmly secured to the posts such that the whole fencing remains intact.

808.4 Entry gate(s) shall be made of GI pipes or other metal as per the design shown in the drawing(s).

808.5 The concrete in R.C.C. posts shall conform to M 25 grade or as indicated in the drawings. The requirements of Section 1700 shall govern. Steel for reinforcement shall meet the requirements of Section 1600. The barbed wire fencing shall be galvanised steel barbed wire conforming to IS:278-1978.

808.6 Measurement for Payment

The measurement shall be in running metre of fencing including the entry gates.

808.7 Rate

The Contract unit rate for fencing shall be payment in full compensation for furnishing all labour, materials, tools, equipment for fabrication and fixing at site and all other incidental costs necessary to complete the work to these Specifications.

809 TUBULAR STEEL RAILING**809.1 Scope**

The work shall cover supply, fixing and erecting tubular steel railings as shown on the drawings and/or as directed by the Engineer.

809.2 The railing shall be of tubular steel in conformance to IS:1239. the fabrication and painting except for the final coat shall be completed before dispatch to the site. Prior to the painting, all surfaces shall be grit blasted to the satisfaction of the Engineer and pickled. The priming coat of paint shall be applied as soon as the steel has dried.

809.3 The posts shall be vertical and of the type as shown in the drawing with a tolerance not exceeding 6 mm in a length of 3 m. The railing shall be erected true to line and grade.

809.4 Measurement for Payment

The railing shall be measured in linear metre from end to end along the face of the railing, including end and intermediate posts, with no deduction for gaps as shown on the drawings.

809.5 Rate

The Contract unit rate for Tubular Steel Railing shall be payment in full compensation for furnishing all labour, materials, tools, equipment and plant required for fabrication, connection, oiling, painting, temporary erection, inspection, test and final erection at site and all other incidental costs necessary to complete the work to these Specifications.

810 STRUCTURAL STEEL RAILING**810.1 Scope**

The work shall cover supply, fixing and erecting structural steel railings as shown in the drawings and/or as directed by the Engineer.

810.2 Materials

The structural sections such as angles, flats, rectangular hollow sections etc. shall conform to Section 1900. They shall be painted or galvanised as specified in the Contract.

810.3 Measurement for Payment

The railing shall be measured in linear metre including end and intermediate posts.

810.4 Rate

The contract unit rate for railing shall be payment in full compensation for furnishing materials, labour, tools and equipment required for fabrication, connection, oiling, painting, galvanising, erection, test and all other incidentals necessary to complete the work to these Specifications.

811 CRASH BARRIERS**811.1 Scope**

The work shall consist of construction, provision and installation of crash barriers at locations as shown in the drawing or as directed by the Engineer. The type of the crash barrier shall be as specified in the Contract.

811.2 Concrete Crash Barrier**811.2.1 Materials**

811.2.1.1 All materials shall conform to Section 1000 Materials for Structures as applicable, and relevant Clauses in Section 1600 shall govern the steel reinforcement.

811.2.1.2 The minimum grade of concrete shall be M25.

811.2.2 Construction Operations

811.2.2.1 The concrete barriers shall be either (i) precast or (ii) constructed by the "cast-in-place with fixed forms" method or the "extrusion or slip form" method or a combination thereof at the Contractor's option with the approval of the Engineer. Where "extrusion or slip form" method is adopted full details of the method and literature shall be furnished.

811.2.2.2 The concrete barrier may be precast in lengths upto 6 m depending upon the feasibility of transport and lifting arrangements. Longitudinal roadside concrete barrier shall be placed on adequate bedding as detailed in the drawing. The top and exposed faces of the barriers shall conform to the specified tolerances, as defined in Clause 810.2.2.3, when tested with 3 m straight edge, laid on the surface.

An expansion joint with pre-moulded asphalt filler board shall be provided at the junctions of crash barrier on structure and crash barrier on the fill. The crash barrier on the fill shall

be constructed in pieces of length not exceeding 20 m, with pre-moulded asphalt filler board joints.

Backfilling to the concrete barriers shall be compacted in layers to the compaction of the surrounding earthwork.

811.2.2.3 Tolerance

The overall horizontal alignment of rails shall not depart from the road alignment by more than ± 30 mm, nor deviate in any two successive lengths from straight by more than 6 mm and the faces shall not vary more than 12 mm from the edge of a 3 m straight edge. Barriers shall be at the specified height as shown in the plans above the edge of the nearest adjacent carriageway or shoulder, within a tolerance of ± 30 mm.

811.2.3 End Treatment

The road side concrete barrier shall be provided with an end treatment by tapering the height of terminating end within a length of 8 m to 9 m. Median crash barrier shall be terminated sufficiently away from the median opening. It shall be provided with an end treatment, which shall be obtained by tapering the height of terminating end of the median barrier within a length of 8 m to 9 m.

811.2.4 Measurement for Payment

All barriers shall be measured by linear metres of completed and accepted length in place, corresponding end to end along the face of concrete barriers including approach and departure ends.

811.2.5 Rate

The Contract unit rate shall include full compensation for furnishing all labour, materials including steel for reinforcement tools, equipment and incidental costs necessary for doing all the work involved in constructing the concrete barrier complete in place in all respects as per these Specifications.

811.3 Metal Beam Crash Barrier

811.3.1 Materials

811.3.1.1 Metal beam rail shall be corrugated sheet steel beams of the class, type, section and thickness indicated on the drawings. Railing posts shall be made of steel of the section, weight and length as shown on the drawings. All complete steel rail elements,

terminal sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanized. All elements of the railing shall be free from abrasions, rough or sharp edges and shall not be kinked, twisted or bent.

811.3.1.2 The "W" beam type safety barrier shall consist of a steel post and a 3 mm thick "W" beam rail element. The steel post and the blocking out spacer shall both be channel section of 75 mm x150 mm & size 5 mm thick. The rail shall be 70 cm above the ground level and posts shall be spaced 2 m center-to-center. Double "W" beam barrier shall be as indicated in IRC:5-1998.

The thrie beam safety barrier shall have posts and spacers similar to the ones mentioned above for "W" beam type. The rail shall be placed at 85 cm above the ground level.

The "W" beam, the thrie beam, the posts, spacers and fasteners for steel barriers shall be galvanized by hot dip process (zinc coated, 0.55 kg per square metre; minimum single spot) unless otherwise specified. The galvanizing on all other steel parts shall conform to the relevant IS Specifications. All fittings (bolts, nuts, washers) shall conform to the IS:1367 and IS:1364. All galvanizing shall be done after fabrication.

811.3.1.3 Concrete for bedding and anchor assembly shall conform to Section 1700 of these Specifications.

811.3.2 Construction Operations

811.3.2.1 The line and grade of railing shall be true to that shown on the plans. The railing shall be carefully adjusted prior to fixing in place, to ensure proper matching at abutting joints and correct alignment and camber throughout their length. Holes for field connections shall be drilled with the railing in place in the structure at proper grade and alignment.

811.3.2.2 Unless otherwise specified on the drawing, railing steel posts shall be given one shop coat of paint (primer) and three coats of paint on structural steel after erection, if the sections are not galvanized. Any part of assembly below ground shall be painted with three coats of red lead paint.

811.3.2.3 Splices and end connections shall be of the type and designs specified or shown on the plans and shall be of such strength as to develop full design strength of the rail elements.

811.3.3 Installation of Posts

811.3.3.1 Holes shall be dug or drilled to the depth indicated on the plans or posts may be driven by approved methods and equipment, provided these are erected in proper position and are free from distortion and burring or any other damage.

811.3.3.2 All post holes that are dug or drilled shall of such size as will permit proper setting of the posts and allow sufficient room for backfilling and tapping.

811.3.3.3 Holes shall be backfilled with selected earth or stable materials in layers not exceeding 100 mm thickness and each layer shall be thoroughly tamped and rammed. When backfilling and tamping are completed, the posts or anchors shall be held securely in place.

811.3.3.4 Post holes that are drilled in rock and holes for anchor posts shall be backfilled with concrete.

811.3.3.5 Posts for metal beam guardrail on bridges shall be bolted to the structure as detailed on the plans. The anchor bolts shall be set to proper location and elevation with templates and carefully checked.

811.3.4 Erection

811.3.4.1 All guard rail anchors shall be set and attachments made and placed as indicated on the plans or as directed by the Engineer.

811.3.4.2 All bolts or clips used for fastening the guardrail or fittings to the posts shall be drawn up tightly. Each bolt shall have sufficient length to extend at least 6 mm through and beyond the full nut, except where such extensions might interfere with or endanger traffic in which case the bolts shall be cut off flush with the nut.

811.3.4.3 All railings shall be erected, drawn and adjusted so that the longitudinal tension will be uniform throughout the entire length of the rail.

811.3.5 End Treatment for Steel Barrier

811.3.5.1 End treatments shall form an integral part of safety barriers which should not spear, vault or roll a vehicle for head-on or angled impacts. The two end treatments recommended for steel barriers are "Turned-down-guardrail" and "Anchored in back slope", as shown on the drawings or as directed by the Engineer.

811.3.6 Tolerance

The posts shall be vertical with a tolerance not exceeding 6 mm in a length of 3 m. The railing barrier shall be erected true to line and grade.

811.3.7 Measurements for Payment

811.3.7.1 Metal beam railing barriers will be measured by linear metre of completed length as per plans and accepted in place. Terminals/anchors of various types shall be paid for by numbers.

811.3.7.2 Furnishing and placing anchor bolts and/or devices for guard rail posts on bridges shall be considered incidental to the construction and the costs thereof shall be included in the price for other items of construction.

811.3.7.3 No measurement for payment will be made for excavation or backfilling performed in connection with this construction.

811.3.8 Rate

The Contract unit rate shall include full compensation for furnishing of labour, materials, tools, equipments and incidental costs necessary for doing all the work involved in constructing the metal beam railing barrier complete in place in all respects as per these Specifications.

811.4 Wire Rope Crash Barrier

811.4.1 Scope

The work shall consist of providing wire rope safety barriers as per designs provided by the supplier or as shown in the drawings.

811.4.2 Materials and Design

The wire ropes shall be galvanised steel wire, supported by galvanised steel posts at spacing indicated in the drawings. The supplier shall provide calculations in support of the structural details to establish the stability of the barrier against an impact of a heavy commercial vehicle of a gross weight of 36 T, or any weight specified in the Contract.

811.4.3 Measurement for Payment

The wire rope crash barrier shall be measured in linear material including and anchors.

811.4.4 Rate

The Contract unit rate shall include the supply of materials, labour, fittings, installation and anchors for the wire rope barriers.

812 ROAD TRAFFIC SIGNALS

812.1 Scope

The work shall cover supply and installation of Road Traffic Signals.

The traffic signal, its configuration, size and location shall be in accordance with IRC:93 and IS:7537 and as shown in the drawings or as directed by the Engineer. Prior to installation of signals, the Contractor shall submit to the Engineer, for approval, detailed proposals showing the signal type, sizes, paint and structural details of the signal posts including control system.

812.2 The traffic signals shall have a complete electronic mechanism for controlling the operation of traffic with an auxiliary manual controller. The time plan of signals shall be as per drawing and shall be modified as directed by the Engineer.

812.3 Materials

The various materials and fabrication thereof shall conform to the following:

812.3.1 Signal Foundation

The signal foundation shall be constructed as per Specifications given in Clause 13 of IRC:93 or as shown in the drawings.

812.3.2 Construction Requirements

The construction requirements for post, signal head assembly, signal head, optical system, lamp and holder, visor, post, supports for overhead mounted signals, equipment housing, locks, inter-connecting cables, earthing, mains termination, controller electrical components, etc. shall conform to IS:7537 unless otherwise stated in IRC:93. The post shall be painted and protected as per Clause 3.7 of IS:7537.

812.3.3 Optical Requirements

The shape of all signal lenses shall be circular and shall be of specified colour and size and as shown in the drawing. Quality of lenses, arrangements of lenses, illuminations, visibility and shielding of signals shall be as per relevant Clauses of IRC:93 and IS:7537.

812.4 Tests

Tests shall be carried out on all components of traffic signals including tests on complete system for its performance as per relevant Clauses of IRC:93 and IS:7537.

812.5 Maintenance of Traffic Signals

It shall be the responsibility of the Contractor to provide for maintenance of the signal section system throughout the warranty period for at least five (5) years after installation and as per Clause 18 of IRC: 93.

812.6 Measurement for Payment

The measurement for traffic signalization system shall be by unit for complete work as specified and as per drawing for complete road junction.

812.7 Rate

The Contract unit rate for the traffic signalization system as a whole shall be payment in full compensation for furnishing all labour, materials, tools, equipment for preparing, supplying, fixing at site, testing and maintenance throughout warranty period and all other incidental costs necessary to complete and maintain the work to these Specifications.

813 TRAFFIC CONTROL AND SAFETY DEVICES IN CONSTRUCTION ZONE**813.1 Scope**

The work shall cover supply and installation at site. Traffic Control Devices in the construction zone comprising of signs delineators, traffic cones, drums, barricades, longitudinal barriers, warning tapes, flagmen, reflective jackets, headgears.

813.2 Signs

Traffic signs shall be in accordance with IRC:67 and in accordance with IRC:SP:55. Its material and other requirements shall be in accordance with Clause 801 of these Specifications.

813.3 Delineators

Delineators in constructions zone are in form of vertical posts, cones, traffic cylinders, tapes, drums etc. Vertical posts shall be in accordance with the provisions contained in IRC:79.

813.4 Traffic Cones

813.4.1 Traffic cones may be of height 500 mm, 750 mm and 1000 mm, and 300 to 500 mm in diameter or in a square shape. They shall be of brilliant red/orange/yellow, ultraviolet stabilized colour for maximum visibility and fade resistance under all weather conditions and ambient working temperature of -30°C to +140°C. The material shall be Linear Low Density Polyethylene (LLDP), plastic or rubber so that there is no damage to the vehicle when they are stuck. Cone and base are to be of one continuous layer to prevent tearing and base separation They should be non-crushable/flexible/tear resistant and UV stabilized and made from non-fading colours. They should return to their original shape in just 20 seconds after being crushed. The bases of cones shall be loaded with ballast (but they should not present a hazard if the cones are inadvertently struck) or anchored to check their being blown

away. Their base should be designed for easy stacking without sticking. They may have retro-reflective white band and mounted flashing warning light for enhanced night visibility. All traffic cones shall conform to BS:873 (part 8) Catalogue A and the provisional European Standard EN 13422.

813.4.2 The measurement shall be for each piece and payment for each piece.

813.5 Drums

813.5.1 The drums shall be of size 800 mm to 1000 mm in height and 300 mm in diameter. They shall be constructed of lightweight, flexible, and deformable materials of LLDP or plastic so that no damage is caused to the vehicle when stuck. Steel drums shall not be used. They may be of bright red, yellow or white colours. They should be portable enough to be shifted from place to place within a temporary traffic control project to accommodate changing conditions but would remain in place for a prolonged period. The markings on drums shall be horizontal, circumferential, alternative orange and white retro-reflective stripes 100 to 150 mm wide. Each drum shall have a minimum of two orange and two white stripes. Any non-retro reflective spaces between the horizontal orange and white stripes, shall not exceed 50 mm wide. Drums shall have closed tops that will not allow collection of roadwork or other debris. When they are used in regions susceptible to freezing, they should have drainage holes in the bottom so that water will not accumulate and freeze, causing a hazard if struck by a motorist. Ballast shall not be placed on top of drum.

813.5.2 The measurement shall be for each piece and payment for each piece, for providing and maintenance at site as per the direction of the Engineer.

813.6 Barricades

The barricades may be portable or permanent. Barricades may be of wooden, metal or other suitable material panels. They shall be stable under adverse weather conditions and appear significant but not to cause damage to the vehicle if they are stuck. They can be classified in 3 types, namely Type-I, Type-II and Type-III. Type-I and Type-II are portable and Type-III permanent. Because of their vulnerable position and the hazard they could create, they should be constructed of lightweight materials and should have no rigid stay bracing for A-frame designs.

813.6.1 Type-I and Type II Barricade

The rail/panel length shall be 2000 mm to 2500 mm for Type I and 1000 mm to 1200 mm for Type II barricade. The width of rails shall be 200 mm to 300 mm. The rails shall be painted in alternate yellow and white stripes of 150 mm width each, sloping away at an angle of 45° in the direction of traffic. The support shall be on a "A-Configuration" or otherwise at the top to permit convenient folding and staking for transportation. Their stability shall be improved

by ballasting. On highways or in other situations where barricades may be susceptible to overturning in the wind, sandbags shall be used for ballasting. Sandbags may be placed on lower parts of the frame or stays to provide the required ballast but shall not be placed on top of any striped rail. Barricades shall not be ballasted by heavy objects such as rocks or chunks of concrete.

813.6.2 Type-III Barricade

Type-III is the permanent type and may be made of wood, metal or other suitable material. The typical configuration shall include 3 or more panels/rails, of minimum 1000 mm length (maximum length as per site requirement) and 300 mm width each, painted with alternate yellow and white stripe of 150 mm width sloping at an angle of 45°. They shall be supported and secured on 2 or more vertical supports of same material. On highways or in other situations where barricades may be susceptible to overturning in the wind, sandbags should be used for ballasting. Sandbags may be placed on lower parts of the frame or stays to provide the required ballast but shall not be placed on top of any striped rail. Barricades shall not be ballasted by heavy objects such as rocks or chunks of concrete.

813.6.3 Application

813.6.3.1 Type I or Type II barricades shall be used in situations where traffic is maintained through the temporary traffic control zone. They may be used singly or in groups to mark a specific condition, or they may be used in a series for channelizing traffic. Type I barricades normally would be used on conventional roads or urban streets and arterials. Type II barricades have more retro-reflective area and are intended for use on highways and expressways or other high-speed roadways.

813.6.3.2 Type III barricades be used for road closure and may extend completely across a roadway or from kerb to kerb. Where provision is made for access of authorized equipment and vehicles, the responsibility should be assigned to a person to ensure proper closure at the end of each work day.

When a highway is legally closed but access must still be allowed for local traffic, the Type III barricade should not be extended completely across a roadway. A sign with the appropriate legend concerning permissible use by local traffic shall be mounted.

Signs may be erected on barricades, particularly those of the fixed type, that offer a most advantageous facility for this purpose. The ROAD CLOSED and DETOUR or ARROW signs, and the large arrow warning signs, for example, can be mounted effectively on or above the barricade that closes the roadway.

813.7 Longitudinal Safety Barriers

813.7.1 Longitudinal channelising barricades are light weight channelising devices that can be used singly as Type-I, II or III barricades, or connected so that they are highly visible and have good target value. They should be interlocked to delineate or channelise the traffic flow and mark the work zone. The inter-locking barricade wall should not have gaps that allow pedestrians or vehicles to stray from the channelising path. Longitudinal channels barricades are located adjacent to traffic and therefore, are subject to impact by errant vehicles. Because of their vulnerable positions, longitudinal channelising barricades should be constructed of light weight materials and be crash worthy. They shall be of high density polyethylene, non-fading, and high impact and U.V. resistant. They shall be of orange, white or custom colours. Their size should be minimum 1500 mm in length, 1000 mm in height, 600 mm in width. They could be filled with water through an aperture on the top and emptied by removing a plug at the base.

On roads with low speed traffic, GI sheets material could be considered for longitudinal barricades. They shall be firmly secured to vertical support system with no sharp edges to pose any hazard when struck. Their configuration shall be as per the drawing or as directed by the Engineer.

813.7.2 Measurement shall be per running metre of longitudinal barrier and payment for the running metre of complete job of providing, installation and maintenance at site as per the drawing/direction of the Engineer.

813.8 Flagman

813.8.1 The flagmen or flaggers shall be deployed where:

- Workers or equipment intermittently block an unprotected traffic lane,
- One lane is used for two directions of traffic,
- It is considered necessary to guide, warn or control traffic is considered necessary.

The flagman should be alert, intelligent and capable to effectively perform the assigned duties. Flagman shall be provided with hand signalling devices such as flags and sign paddles. Flagmen must be provided with and must wear warning garments, safety headgear, footwear and gloves for their protection and for conspicuity, while flagging. Warning garments worn at night must be of reflective material. Flags for signalling shall be minimum 600 mm x 600 mm and made of good red cloth and securely fastened to a staff of approximately of 1 m. in length. Sign paddles should be at least 600 mm wide provided with a rigid handle. The background colour of STOP should be red and its shape shall be octagonal conforming to IRC:67. The word STOP would be in white colour. Background of SLOW sign should be yellow with black letters and borders.

813.9 Reflective Clothings

813.9.1 In the work zones and construction sites, all the workers, supervisors and inspecting officers shall wear high visibility fluorescent clothings with retro-reflective material, so that their presence is conspicuous from a distance of 300 m. Clothings may be in form of vests, T-shirts, jackets, pants and raincoats etc., depending upon weather conditions and ease of usage. They shall be of bright colours of fluorescent red-orange or fluorescent yellow-green.

813.9.2 The reflective clothing's shall have reflective bands of width appropriate for the garments viz. vests, T-shirts, jackets, pants and raincoats. It shall have 360° visibility with at least one retro-reflective band encircling the torso, There shall be appropriate separation distances of vertical and horizontal bands placed on torso, sleeves and trouser areas. The garment shall be free of roughness and sharp edges so as not to cause excessive irritation and the wearer should get the best possible degree of comfort and protection.

813.9.3 The reflective clothing shall meet the requirements of standards given in IS:15809-2008 or EN 471:2003 The material shall be tested for colour and luminance, colour fastness with cracking, perspiration, laundering and UV light exposure. The material shall meet the requirements of brightness after rainfall performance, temperature variation, abrasion resistance, flexing, cold folding and variation in temperature.

813.9.4 Measurement shall be for the unit piece of clothing and payment for providing and maintaining at site as per direction of the Engineer.

813.10 Personal Protection Equipment for Workers

All the workers, exposed to moving roadway traffic or equipment in road construction zones shall wear high-visibility safety apparel, headgear, boots, gloves and other protective gears for their protection. The safety apparel shall be in accordance with Clause 813.9. The safety headgear or protective helmet shall protect the wearer against falling objects and possible serious injury. It shall address requirements of shock absorption, resistance to penetration, flame resistance, chin strap anchorages, comfortable wearing and shall meet the requirements of IS:2925 or EN 397. The safety shoes or boots shall provide personal protection from any possible hazard posed by the activity being done and provide comfortable wearing without giving any hindrance in the expected tasks. The work gloves shall provide protection against any personal injury that could be caused by the activities to be performed and comfort in wearing without giving any hindrance in the expected tasks. If the worker is to be exposed to dust in the work zone, he shall have respiratory protection by dust mask meeting the requirements of IS:9473-2008. Depending upon the task, workers engaged in welding operations shall have eye protection through passive welding sheet meeting the requirements of EN 175 or auto darkening sheet meeting the requirement of EN 379/EN 169.

813.11 Measurement

The traffic control device of providing traffic signs shall be measured in number. Traffic control devices like barriers and delineators and supply of flagman shall be measured in number and days for which they are used unless specified otherwise in the Contract. Other traffic control devices such as drums, cones, warning tapes, reflective jackets, headgears for workmen shall be considered incidental to the work.

813.12 Rate

Rate for providing traffic signs shall be inclusive of supply of materials, fabrication, installation and maintenance of signs. The rate for provision of barriers and delineators shall be on a rental basis per number-days. The rate for supply of flagmen shall be full wages including their reflective jackets and headgear per man-days of deployment.

814 TRAFFIC IMPACT ATTENUATORS**814.1 Scope**

The work shall cover configuration, furnishing and installing traffic impact attenuation devices at hazardous locations (for example gore areas between diverging roadways) conforming to the details shown in the drawings/plans or as directed by the Engineer; so as to act as energy absorbers. The traffic impact attenuators or crash cushions shall be installed for speeds greater than 50 kph . They may be composed of sand barrels or of 'w'-beam fender panels supported by diaphragm with trigger mechanism.

814.2 Sand Filled Impact Attenuators

814.2.1 The system shall consist of a group or series of free standing plastic barrels configured in increasing weights from the impact point towards the object. The array shall be designed to transfer the vehicle's momentum to the increasing masses of sand in the barrels and to provide a gradual deceleration. Each barrel is to be designed with a specific weight of unbagged sand to absorb the energy of an errant vehicle. The lighter barrels shall be placed near the front of arrays to gradually slow the smaller vehicles. Heavier barrels shall be placed further back in the array to slow the larger vehicles. The standard module weights are 90 kg, 180 kg, 315 kg, 640 kg and 950 kg, as recommended by AASHTO. The axis of symmetry of the arrays should be directed along the most likely direction. Approach for an errant vehicle for gore areas could be back towards the inter-section of the edges of pavement. Obstacles in narrow median should be shielded on both ends and the modules placed on the ends (to shield opposite direction traffic) should be placed flushed with down stream edge of the obstacle to avoid wrong way hits. The modules should be placed on a concrete or asphalt surface with maximum slope of 5 percent in any direction. Each barrel's location and weight

of sand should be carefully spray painted on the surface at the position that will be covered by the barrel to ensure that the array will be correctly reconstructed after an accident.

814.2.2 The total length and width of the array shall be designed depending upon the expected speed of approaching vehicle. The typical lay out for approach speed of 100 kph would have total length of 10 m, width of 2.5 m accommodating 14 barrels arranged in 9 rows with one barrel in first 4 rows and 2 barrels in next 5 rows. The contractor shall furnish a copy of the manufacturer's installation instructions for whatever particular brand of sand-filled impact attenuator is to be used. The sand-filled impact attenuator arrays shall be inspected to ensure that the array is set up as shown in the standard plans and filled in accordance with the manufacturer's recommendations. Sand barrels are essentially one-hit systems requiring complete replacement of impacted barrels. Their use, therefore, is suitable at sites where impact frequency is expected to be low. The arrangement shall be first designed and the layout drawing got approved by the Engineer.

814.3 Proprietary Attenuator System

The Proprietary Attenuator Systems essentially comprise a series of w- beam fender panels supported by diaphragms with a trigger mechanism at nose, which, when hit, releases a 'front assembly' to absorb the energy of impact. When impacted, the system shall telescope rearward to absorb the energy so as to bring the errant vehicle to a controlled stop. The refurbishment shall involve the replacement of damaged unit with repair done, off site. The contractor/supplier of such system shall furnish the certificate that the system to be installed has been tested in accordance with the NCHRP 350 and performs effectively at design speeds up to 100 kmph.

814.4 Measurement and Payment

The traffic impact attenuator system shall be measured and payment made for design and installation of the system as complete job at each location.

815 SEMI AUTOMATIC TOLL COLLECTION SYSTEM

815.1 Scope

The work shall cover supply and installation of Integrated Semi Automatic Toll Collection System having the following main subsystems:

- i) Automatic Vehicle Counter cum Classifier (AVCC)
- ii) Automatic Boom Barrier
- iii) Contactless Smart Card Systems

- iv) Ticket Printer
- v) User Fare Display unit
- vi) Close Circuit Television System (CCTV)
- vii) Lane Controller
- viii) Traffic Light System
- ix) Intercom System
- x) Over Head Lane Signs
- xi) Integrated Toll Management Software

All equipment shall have built - in or external surge protection devices.

815.2 AVCC System

815.2.1 General

The AVCC system shall be able to distinguish between the categories of vehicles using the highway and as defined by the Ministry's Toll Rules. This class information shall be transmitted to the Lane Computer on completion of the post Automatic Vehicle Classification (AVC). The Lane Computer shall check that this information matches the classification entered by the toll collector. If there is a discrepancy between the two classifications, the Lane Camera shall be triggered to capture a digital image of the vehicle together with details of the class discrepancy message, transaction number with its date and time, lane number and toll collector. The digital image and discrepancy information shall be communicated to the supervisory console for further processing by the toll supervision staff. In case of network or Lane computer failure, the AVCC system shall function independently and feed data directly to the Plaza Server and the system shall be able to detect the vehicle moving in wrong direction. The system shall also assist in auditing the toll collection operation. It shall be in modular unit with capability for various modules and functions to perform independently at different levels of toll collection operation. The Central AVCC data base system shall be part of this audit function. It shall be a stand alone device with control access where the data cannot be changed or altered in any way. The reports from this system shall assist in identifying problems with operations, fraud or over/under collection of tolls. This central AVCC database System shall be able to operate independently of the Toll Lane System, even if the Toll Lane Controller is non operational. Any new technology, meeting the requirements specified in these specifications should not be excluded.

815.2.2 Technical Requirements

Each lane shall be equipped with an AVC controller (different from the lane controller)

interface to classification sensors. The classification sensors can be any or combinations of the following types:

- i) Fibre-optic treadles
- ii) Laser classifiers
- iii) Optical height sensors
- iv) Optical axle counters
- v) Infrared Light curtains
- vi) Magnetic Sensors
- vii) Resistive Sensors

AVCC processing unit shall be a real-time processing unit, shall be the trigger source for Lane Camera system and shall have standby power supply capable of operations for a period of at least 4 hours. The AVC controller should be metallic, vandal-proof with IP 65 protection. It shall have System accuracy (calculated on a base of 10,000 vehicles):

- a) For vehicle counting : 99% minimum
- b) For vehicle classification : 98% minimum

815.3 Automatic Boom Barrier

815.3.1 General

The barriers are to be used to control the traffic through the lane. The operation of boom barrier shall be linked to the lane computer and shall allow the vehicle to pass through after a successful financial transaction. The system shall consist of a fixed housing and a movable arm. The boom shall be of 3000 mm length for a normal lane and more than 3500 mm for extra wide lane. The housing shall contain the motor and control units and shall be installed on the left side of the lane. The boom barrier should be electrically operated barrier gate for Toll Lane application. The barriers shall have presence detectors independent to the AVC system to prevent barrier arms coming down on vehicles while passing. This shall be in the form of infrared units, dedicated embedded loops or any other sensors. The finish of its housing may be Powder Coated Orange, RAL 2000 and that of the boom with powder Coated White RAL 9010 with reflective strips. All housing and internal parts shall have rust and corrosion free metals or alloys of high strength with suitable epoxy coating as applicable. The Housing base frame shall be of Stainless Steel so as to protect the housing from rusting from the bottom.

815.3.2 Technical Requirement

The power supply shall be through 230+/-10%V AC, 50Hz with 100 percent duty cycle. Its Logic Control shall be with Technology to ensure that opening and closing timings remain

constant under variation of wind and speed. It shall have smooth landing of boom without swaying at the end positions. The response time shall be 1.5 seconds, for boom length of upto 3000 mm and 2 sec. for boom length more than 3500 mm. The mean time before failure (MTBF) shall be 5 million cycles (1 Cycle = 1 open and close). It should be able to operate between the temperature range of -5°C to 55°C.

815.4 Lane Camera

815.4.1 General

The camera installed at convenient location shall be capable of capturing images of the following vehicles:

- a) In case of class discrepancy between the class detected by the AVC and that entered by the toll collector
- b) Exempt users
- c) Vehicles with Smart card
- d) All transaction of vehicle with special events
- e) Offending vehicles
- f) When the alarm footswitch is activated by the toll collector.

815.4.2 System Configuration

The camera should be installed at convenient location to capture images of the vehicles. It shall produce clear images of the front view along with the number plates of the vehicles even during night. The resolution of the images should be such that the registration number of the vehicles can be easily read. The camera should have waterproof housing with a hood to protect from direct sunlight. The protection shall be in accordance with IP65. The stand for the camera shall be made in steel tube that will not swing or twist under gutter speed of strong wind.

815.5 Smart Card System

815.5.1 Contactless Smart Card Readers/Writers

815.5.1.1 General

The Contactless Smart Card Readers/Writers are used for managing electronic Toll collection in conjunction with a compatible Contactless Smart Card. The Contactless Smart Card Readers/Writer is linked to a micro-controller or a PC which is typically the lane computer. It allows the vehicle to pass through after a successful financial transaction. Card reader/writer shall be "single-package" type, combining electronics and antenna in one package.

815.5.1.2 Installation Requirement

The Contactless Smart Card Readers/Writers shall be installed on the right side of all the lanes of the Toll Plaza. The orientation of the Contactless Smart Card Readers/Writers shall be wall mounting type, to be at a suitable height on the toll booth wall, to accommodate all types of vehicles e.g. separate readers for trucks/buses and cars/jeeps. This is to ensure that a successful 'Readers/Write' is achieved with a Contactless Smart Card. Readers/Writers'.

815.5.2 Technical Requirements

The reader shall have the ability to read the smart card from a distance, ranging from 0 cm to 10 cm with a transaction time of less than 0.5 seconds for read/write. Contactless Smart Card Readers/Writers shall be wall mounting type and all transactions shall be secured with modern and industry standard cryptographic techniques or those based on DES/3DES mechanisms to resist fraud and to deter theft or misuse. The reader/writer shall conform to ISO Standards: 14443A and shall be sealed to a NEMA 4/IP65. It should have transmit frequency of 13.56 MHz. The operating temperature of the Smart Card Readers/Writer should be -5°C to +55°C and operating humidity of up to 95 percent non-condensing.

815.5.3 Contactless Smart Cards**815.5.3.1 General**

The contactless Smart Card is used for storing money value for the purpose of Toll Collection in conjunction with a compatible Contactless Smart Card readers/writers. The Contactless Smart Card allows the Readers/Writers to increment/decrement user fee from the stored money value. It allows the vehicle to pass through after a successful financial transaction. The Contactless Smart Card, the card readers/writers shall be in a single technology configuration. The smart Card shall be able to store the money value in prepaid mode.

815.5.3.2 Technical Requirements

The card shall meet the ISO 14443A standards for contactless smart cards. The memory of the smart card shall be $\geq 1\text{KB}$. It shall be warranted against defects in materials and workmanship for 3 years. The Operating Temperature of the Smart Card should be -10°C to 60°C.

815.6 Close Circuit Television (CCTV) System**815.6.1 General**

The System shall be provided to monitor the activities of toll collection booth operations in the toll plaza. It shall comprise Video Camera and Video Camera Housing at the toll Plaza

and 106 cm LCD Monitor and Digital Video Recorder (DVR) at the control centre. The Video Cameras shall be conveniently mounted so that full view of the Toll Plaza and the booth operations are captured.

815.6.2 Technical Requirements

The Video Camera shall be of dome type to avoid pilferage, be resistant to vandalism and be weather-proof. The mounting and equipment housing shall be able to withstand adverse weather conditions. The camera shall provide a minimum of 520 TV lines horizontal resolution. The camera shall provide a useable picture at a minimum illumination of 0.02 Lux. The weighted signal to noise (SN) ratio shall be greater than 50 dB at 1.0 V p-p, 75 ohms. The Cameras shall have MTBF (Mean time between failure) of at least 50,000 hours of operation.

815.7 Digital Video Recorder (DVR)

The Digital recorder shall be stand alone and have the facility to record images on the hard disk and also on external recording devices such as DVD, Hard Disk etc. The digital video recorder shall have enough data storage capacity to store video of 15 days from all the cameras and shall have interface to archive the data on to the DVD/Tape for back-up. The DVR shall have sufficient video signal inputs to cater for all cameras. It shall have Capability alarm/event based recording and the facility for high speed searching based on inputs such as date, time, etc. The Digital recorder shall have functionality to display multiple video images simultaneously on a single Monitor/Screen.

815.8 Lane Controller

815.8.1 General

The Lane Controller shall be provided to control and monitor all the sub systems of the toll lane. It shall consist of CPU and power supply, Data Communication ports, Digital I/O port, Circuit breakers, Terminal blocks, Relays LAN port, IP 65 enclosure with high security locking mechanism. All the peripheral devices in the lane shall be hardwired to the Lane Controller.

815.8.2 Technical Requirements

The system shall be modular with Input/Output Card having adequate channels catering to interfacing of all the peripherals devices with a provision for adding extra two devices. The system shall be housed in a metallic enclosure and installed inside the toll booth. All the peripheral devices in the lane shall be hardwired to the Lane Controller.

815.9 User's Fare Display Unit**815.9.1 General**

The Fare Display Unit shall be in the form of a variable message sign, controlled automatically by the lane computer, to indicate the category of the vehicle and the amount payable by the road user. The system shall be LED based. It shall be installed outside the booth, near the payment window so that the road user will have clear view of the fare payable.

815.9.2 Technical Requirements

- | | | |
|--------------------------|---|-----------------|
| a) Power Supply | : | 220V/50 Hz AC |
| b) Communication | : | RS232 |
| c) Operating Temperature | : | -10°C to + 55°C |
| d) Protection | : | IP 65 |
| e) LED Reliability | : | 100,000 hrs |

815.10 Traffic Light System**815.10.1 General**

LED based light signal, installed at the toll lane towards the exit side shall be connected to the lane controller. The traffic sign glowing red would indicate that the motorist has to stop and pay the user fee. After successful transactions, the traffic sign would turn green to indicate that the motorist can proceed. Traffic lights shall be installed on a pole of about 2 m above the road surface on the right side of each lane. The contractor shall decide the appropriate height taking into account other equipments to ensure clear/unobstructed visibility and control through lane controller. The system shall work in synchronization with the boom barrier and shall have in-built night dimming function.

815.10.2 Technical Requirements

- | | | |
|-----------------------------|---|---|
| a) Size of the display | : | Approx 200 mm diameter with sun visor |
| b) LED | : | Industry standard, Red and Green |
| c) Housing | : | Corrosion resistant material |
| d) Environmental protection | : | IP 65 |
| e) Intensity | : | Day light visibility > 1000 mcd for Red,
>1600 mcd for Green |
| f) Operating temperature | : | -10°C to + 65°C |

815.11 Lane Communication System

Voice communication installed in the toll booths shall provide "hands free" two-way verbal communication between the supervision staff in the toll control room and the toll collectors. The toll collector shall be able to attract the attention of the Supervisor in the control room by pressing a single button on the intercom slave unit in the toll booth. The equipment shall also have the facility to allow the supervision staff to monitor communication in the toll booth between the toll collector and the user or between any of the tollbooths without alerting the toll collector. The voice communication system shall operate independently of the Lane Computer system. It shall also be implemented in various rooms of the plaza building and at building access points. Two-way communications shall be possible as soon as the Supervisor responds by selecting the appropriate lane button on the Master Communication unit. One-way communication shall be possible from the Control Room intercom to all lanes simultaneously (broadcast).

815.12 Overhead Lane Signs (OHLS)

815.12.1 The overhead lane signs OHLS shall be mounted on the leading edge of the canopy covering the toll lanes above the centre of the lane to indicate to the User whether the toll lane is open or closed for the processing of vehicles. A red cross signal would indicate that the lane is closed, whilst a green arrow would indicate that the lane is open to traffic.

815.12.2 Technical Requirements

The OHLS shall be made of green and red LEDs. Signs shall be sufficiently bright and directed to indicate to a motorist approaching the toll plaza, at a distance of 250 m on a bright cloud free day that lanes are available for use. The cross and arrow aspects shall be larger than 300 mm. The sign shall be fitted with a sun-hood to screen the effect of the sunlight. The enclosure of the OHLS shall be constructed from a corrosion resistant material. The enclosure shall have an IP 65 rating and be ventilated to dissipate internal heat. The system shall have night dimming function.

815.13 UPS System

UPS system shall be supplied for individual lanes and plaza systems separately. Each UPS system shall be designed for 125 percent of the total connected load. The power supply to all electronic equipment (indoor and outdoor) shall be fed from UPS which shall have minimum 2 hours backup. The power budget calculation is to be submitted to the Engineer.

815.14 Violation Alarm

The siren operates in conjunction with a violation and acts as a warning device. The purpose

of the siren is to alert the plaza staff of a run-through through the lane. Visual indication is via a strobe light. It shall meet the following requirements:

- | | | | |
|------|--------------------------|---|---------------|
| i) | Technology | : | Motor driven |
| ii) | Audible rating | : | 112 dB at 1 m |
| iii) | Hearing distance | : | 500 m |
| iv) | Environmental Protection | : | IP 65 |

815.15 Computer Hardware

815.15.1 Plaza Server shall have following minimum Specification:

- 1) Intel Xeon 3.0 GHz or higher with Intel EM64T/1 MB Cache/800 MHz FSB
- 2) 2 GB ECC DDR2 RAM upgradeable to 12 GB
- 3) Dual Channel U320 SCSI Controller
- 4) 6x36 GB (10K rpm) HDD, Hot-pluggable, with RAID-5 Support
- 5) CDRW – DVD Combo Drive
- 6) Dual Gigabit 10/100/1000 Ethernet
- 8) Redundant Power Supplies, Redundant Fans
- 9) Anti-virus pre-loaded
- 10) Server Management Software – with remote management features onboard
- 11) 20/40 GB DAT Drive
- 12) Certifications: ACP V1.0 B Compliant PCI 2.2 Compliant, PXE Support, WOL support, Microsoft Windows 2000/2003, Linux, PCI-X1.0 Compliant
- 13) Operating Conditions: Operating Temperature Range: 0°C-50°C
Relative Humidity: 20 percent - 90 percent, non-condensing
- 14) AC Voltage: 207V AC to 253V AC @ 47-63Hz

815.15.2 Bar Code Reader

The bar code reader shall be used to scan unique identification bar codes imprinted on media such as paper and plastic medium such as smart cards etc. The bar code reader shall be equipped with easily visible LEDs and audible beeps that indicate the scanner's operation status. The barcode reader shall have a rugged protective boot with an adjustable stand and be mounted to a countertop or be left free standing for handheld scanning. The barcode readers shall conform to IS:14700: Part 6: Sec 3; 2002. The bar code reader shall be IP 54 protected.

815.15.3 Receipt Printer

The receipt printer shall be a compact thermal printer able to print, as a minimum, toll payment receipts (text and graphics) and barcodes. The receipt printer shall use thermal fixed head technology. The print speed shall not be less than 150 mm/s for both text and graphic and at a minimum resolution of 203 dpi (8 dots/mm). It shall be able to support paper thickness of 75 - 80 GSM. The receipt printer shall support programmable English and Hindi fonts and graphics, including Barcodes of at least Code 128 format. The receipt printer shall have an automatic cutter with a self sharpening ceramic rotary knife. The receipt printer shall be robust for use in a toll booth environment where there is heavy usage and possible dust and exhaust from vehicles. The auto cutter shall have a reliability of at least 1.5 million cuts. The receipt printer head shall have a Mean Cycle between Failure (MCBF) of at least 50 million print lines. The receipt printer shall have a Mean Time between Failure (MTBF) of at least 360,000 hours. The receipt printer enclosure shall be IP54 rated.

815.15.4 Toll Management System (TMS)

The Toll Management System (TMS) shall be responsible for processing the data into information that will be used to verify toll transactions, provide toll collector control, cash-up and performance facilities, and shall include a host of management tools and reports for the effective administration of the toll operation. The TMS shall also assist in auditing the toll collection operation. It shall be a modular unit with the capability for various modules and functions to perform independently at different levels of the toll collection operation. The TMS shall have various customized reports to assist in managing the toll facility, and to provide management tools to assess toll revenues. The TMS shall have financial management and traffic analysis tools to assist the operator in planning operations. The contractor/supplier shall ensure that security updates and latest service packs, "patches" are loaded. Industry standard operating systems shall be utilized and all user licenses shall be provided. The database shall be an industry standard database and shall be supplied with all the latest service packs and patches, including user licenses.

815.15.5 Rates

The payment shall be made for design, configuration and commissioning of Semi Automatic Toll Collection System as complete job at the location indicated in the Contract, and shall be in stages specified in the Contract.

816 ADVANCED TRAFFIC MANAGEMENT SYSTEMS (ATMS)**816.1 Scope**

The work shall cover design, supply, installation, commissioning and/or operation and maintenance of Advance Traffic Management Systems (which is one of the components of

Intelligent Transport Systems - ITS). The system would include out-door equipment including emergency call boxes, variable message sign systems, meteorological data system, close circuit TV camera (CCTV) system, traffic counting and classification system and transmission system. The indoor equipment would comprise a large display board, central computer (with Network Management System - NMS), CCTV monitor system, call centre system or management of emergency call boxes housed in a control centre with uninterrupted power supply. Any new technology, meeting the requirements specified in these specifications should not be excluded. The systems shall meet following objectives:

- Smooth and uninterrupted traffic flow
- Enhance road safety
- Real time information and guidance to users
- Emergency assistance round the clock
- Alerts for abnormal road and weather conditions
- Reduced journey time and inconvenience

816.2 System Requirement

ATMS shall provide the following facilities to highway users:

- make emergency calls to Control Centre in case of accidents, breakdown, fire and ambulance.
- pre-warn the highway users about unusual condition on the road.

ATMS shall provide the following information/data to traffic managers for efficient and effective handling of traffic.

- information regarding location of any incident, incoming calls, help required and messages to be passed to third parties.
- Information regarding traffic congestion, speed and weather conditions.

ATMS shall provide the following controls to traffic managers:

- change the variable message signs from the Control Centre.
- mobilize the movement of ambulances, cranes & patrolling vehicles.

ATMS shall provide online recording and reviewing of the voice & visual information for record and analysis.

816.3 System Configuration

The ATMS shall have following sub-systems:

- i) Emergency Call Boxes
- ii) Mobile Communication System
- iii) Variable Message Signs system
- iv) Meteorological Data System
- v) Automatic Traffic Counter cum Classifier System
- vi) Video Surveillance System
- vii) Video Incident Detection System (VIDS)

816.4 Availability Requirements

The inability to perform any required function, the occurrence of unexpected action or degradation of performance below the specifications shall be considered as a failure. The Mean-time-between-failure (MTBF) shall be the average operating time accumulated by the total population of identical items between failures. The system supplier/contractor shall submit MTBF and MTTR figures. The ATMS shall have an overall system availability of better than 99 percent. The ATMS shall be considered unavailable if any of its function cannot be properly executed and when any of the following conditions persist for more than 8 hours on the entire stretch.

- i) **Variable Message System Failure:** No display/Improper Display of VMS or failure of their related transmission/control system which would render the VMS inoperative
- ii) **Emergency Call System Failure:** Failure of any three consecutive Call boxes or failure of their related transmission system which would render the call boxes inoperative.
- iii) **ATCC Failure:** Failure of more than one ATCC or failure of their related transmission system which would render the ATCC inoperative.
- iv) **Met Failure:** Failure of more than one Met or failure of their related transmission system which would render the Met inoperative.
- v) **Video Surveillance System Failure:** Failure of more than two Video Cameras or failure of their related transmission/control system which would render the cameras inoperative.
- vi) **Video Incident Detection System Failure:** Failure of more than one Video Cameras or failure of their related transmission/control system which would render the cameras inoperative.

- vii) **Display at Control Centre:** Whenever Control Centre is unable to get display of messages initiated by the Control Centre in-charge.

In addition to the above the system shall be considered unavailable when failure of the integrated ATMS Software or its hardware persists for more than 8 hours.

816.5 Reliability Requirements

The supplier shall ensure that ATMS supplied shall comply with the following reliability requirements:

ATMS (Sub-Systems)	Mean Time Before Failure - MTBF
Outdoor Equipment	15,000 hours
Transmission System Equipment	15,000 hours
Control Centre Equipment	15,000 hours
Power Supply Equipment	15,000 hours

816.6 Maintainability Requirements

The Mean-Time-to-Repair (MTTR) of the ATMS to full normal operation following a failure shall be less than 8 hours all inclusive.

816.7 System Safety Requirements

The ATMS is classified as a safety related system and a minimum of CENELEC standards EN50128 software integrity level 2 shall apply. All equipment must comply with and be installed in accordance with IEC 65, IEC 364. All metal enclosures shall be provided with an earthing terminal and earthing of all equipment shall be carried out in accordance with overall earthing policy.

816.8 Environmental/Climatic Requirements

816.8.1 Indoor Equipment

Temperature (Operating)	:	0°C to + 50°C
Relative Humidity	:	up to 95% (non-condensing)

816.8.2 Outdoor Equipment

Temperature (Operating)	:	5°C to + 60°C
Relative Humidity	:	up to 95% (non-condensing)

The system and the equipment used as a minimum shall meet the following climatic and environmental requirements as specified in IS:9000:

Tests	Severities
Change of Temperature (Temp cycling) as per IS:9000 (part xiv/sec1)	i) Low Temp 0°C + 3°C ii) High Temp 60°C + 2°C Rate of cooling and heating 1°C/m iii) Duration for each cycle 3 hours iv) No of Cycles, 3
Damp heat (Cyclic) test as per IS: 9000 (part v/sec 2) variant 1	i) Upper Temp 40°C + 2°C ii) Lower Temp 25°C iii) One Cycle 12 h iv) Relative humidity 95 percent v) No. of Cycles 6
Vibration (Sinusoidal) test as per IS:9000	i) Freq. range 10 Hz – 55 Hz ii) Vibration Amplitude 0.35 mm iii) Duration of endurance for sweep 20 sweep cycles (10 Hz – 55 Hz) iv) No of axes 3 co-ordinate axis v) Duration at Resonant frequency 30 min+1 min

816.9 Emergency Call Box

816.9.1 General

The apparatus is a communication medium to be installed on the highway and to be used by the road users to make alarm call to the Control Centre in case of accidents and other emergency problems on the road or any incident. The Emergency Call Boxes shall be located in pairs on opposite sides of the highway. Main ECB unit (Master) shall be located on one side and the secondary unit (Slave) on the opposite side.

816.9.2 System Configuration

The Emergency phone shall comprise loud speaker, microphone, activation button, ringing

tone to indicate progress of call when button is pressed, confidence tone to indicate call is still connected when on hold, recorded message in case the line is busy and LED indication during conversation. These components shall be provided in FRP (Fibre Reinforcement Plastic)/stainless steel/Aluminium Alloy housing.

816.9.3 General Requirements

The ECB shall be designed for hands free operation. It shall be identified by reflective guide sign placed approx. 10 m ahead of the ECB . It shall have a provision for mounting on a concrete base with cast-in bolts, nuts and washers and the whole shall be installed so as the persons using the instrument will normally be facing the oncoming traffic. The enclosure shall be equipped with retro-reflective sticker that is clearly visible at night. The sticker shall read 'SOS' along with a telephone symbol. It shall have provision for the instructions of operation to be written clearly on the outside surface in two languages. Voice Logger Software shall be provided to handle and log all calls from the network. There shall be up to four programmable auto dial numbers associated with the push button. The ECB shall automatically dial subsequent numbers if the first number is busy or unavailable.

816.9.4 Technical Requirements

816.9.4.1 The ECBs shall work on DC supply and operate in full duplex mode. It shall be able to operate in a noise level of up to 95 db. and suitably protected against external EMI/ ESI Interference through shielding/grounding. It shall have in-built programming port/feature for addressing. The same must be capable of being addressed using Laptop or Palmtops in fields. The ECB Central software shall use this address for identification of ECB. The ECB shall use latest components and a micro controller of adequate capacity to meet the system requirements. It shall have in-built fault diagnostics features for on-site maintenance and have extant protection against lightning. It shall be powered from the communication cable/ solar panel. The solar panel and battery shall be adequately rated to support the ECB working under idle conditions and a talk time of minimum 90 minutes over 3 days in succession under worst climatic conditions. At each location one ECB shall be Master and the other Slave. The master ECB shall be equipped with fibre optic interface, solar panel, battery back-up and voice communication mechanism and shall also comply with all the requirements specified in this section for ECBs. The slave ECB shall be equipped at least with – activation button, vandal sensing mechanism, call progress indication LED, Microphone, Speakers, Handicapped operation activation – in a weather proof housing as detailed in these specifications. The system shall detect vandalism and give audio-visual alarm at the control centre. The ECB system shall have a product support guarantee of 10 years from the manufacturer. The ECB central system shall communicate with the Central Traffic Management System and all the events and alarms shall also be displayed and stored in the Central Traffic Management

server. The ECBs shall meet the specification as per the following:

- i) Electromagnetic compatibility: be suitably protected against external EMI/ESI Interface through shielding/grounding.
- ii) Lightning Protection: to be suitably protected.
- iii) Drop and topple: BS:2011 or equivalent.
- iv) Enclosure: IP 65.

The equipment shall conform to all applicable electrical standards in India.

816.10 Mobile Radio Communication System

816.10.1 General

The mobile communication system shall be provided to establish voice communication on radio between the Control Centre and the emergency mobile vehicles such as ambulances, cranes and patrolling vehicles. The system shall comprise base station unit, repeater unit, mobile radio unit and control centre equipment. Its Base Station Unit shall comprise transmitter, receiver antenna switch, radio engineering terminal, radio data terminal, radio operator terminal and power supply. Its Repeater Unit shall comprise transmitter, receiver, antenna, repeater and power supply. Its Mobile Radio Unit shall comprise transmitter, receiver, antenna, control unit and power supply. The Control Centre Equipment shall have Network Management System.

816.10.2 General Requirements

The system shall cover the entire route. The system design shall be modular in concept. The system shall be compact and rugged in design having ease of maintenance and shall work satisfactorily under adverse conditions like storm, rain and vandalism resistant. The system shall neither affect functioning of other telecom equipment installed adjacent or along it, nor get affected by the presence of other equipment/systems. The Mobile Radio shall have provision for mounting the mobile set on ambulances, cranes and patrolling vehicles. The repeater station equipment and antenna shall be installed at sub centres. Each mobile unit shall have a unique address code. The system equipment shall work on re-chargeable batteries with 24 hr back-up.

The control panel of mobile unit and base station unit shall have the following features:

- i) Power ON-OFF switch
- ii) Emergency calling button
- iii) Adjustment of loudspeaker volume

- iv) Digital display
- v) Functional buttons

816.10.3 Functional Requirements

The modulation shall be either frequency or phase type (FSK) and shall operate in semi-duplex mode. The equipment shall have provision to eliminate collision of data. It shall have facility to configure the network for individual, sub-group or broadcast mode of operation for both selective calling and group calling operation. All components used in the assembly of equipment shall be of industrial grade specification. The equipment shall conform to ETS European standards and shall be suitably protected through shielding/grounding against external EMI/ESI Interference, and shall be immune to RFI, ESD and lightning.

816.10.4 Technical Requirements

The system shall have the facility to connect mobile to mobile, mobile to controller and controller to mobile. The system shall have the facilities for waiting calls, holds calls and transfer calls. The system shall have a facility such that the Control Centre can select between the call modes of individual call, group/all-call and call to mobiles listed in the queue. The system shall use primary channels for calling from mobiles to the Control Centre and vice-versa whereas the secondary channels shall be used for mobile to mobile connection. The system shall have the facility to terminate the mobile to mobile connection under the following conditions:

- a) One of the two parties hangs up
- b) One of the two parties receives a call from the Control Centre
- c) The duration of the conversation exceeds 5 minutes limit.

In case of emergency, the system shall have the facility to receive alarm calls from mobile radio. The mobile radio shall be integrated with the Fibre Optic Communication system. The system shall use frequencies to be obtained by the contractor from WPC in the complete stretch as per scope. The system shall have the provision for communication on the PSTN Network. The system shall have suitable voting system to select the better signal at base stations as well as mobile units. The system shall have provision to handle calls from/to at least 20 mobile sets. The system shall have self-diagnostic features. The system shall be protected against any damage due to power supply fluctuations, transients and surges.

816.11 Variable Message Signs

816.11.1 Scope

The work shall cover supply and installation of Variable Message Signs (VMSs) which provide to road users the advance en-route traveller information of road conditions ahead in real time. The provisions contained in IRC:SP:85 shall be followed.

816.11.2 Fixed VMS

Fixed VMS shall be mounted on a sturdy and aesthetically pleasing gantry structure whereby the vertical clearance of at least 5.5 m is available from the road. Safety barriers shall be provided at gantry support column(s) for their protection and for safety of road users. The concrete pedestal for support column should be flushed with ground but in no case should protrude more than 1.5 m.

816.11.2.1 The minimum distance of VMS on expressways should be 1.5 km prior to decision point and that for National Highways it should be 1 km. The signs should be visible from a distance of 250 m. It should not be located on a curve and on a highway sections having grade exceeding 4 percent.

816.11.2.2 There should be clear distance between existing sign and VMS. The minimum distance between road signs and VMS should be at least 250 m on expressways and 150 m on National Highways.

816.11.3 Portable VMS

816.11.3.1 Portable signs shall be mounted at the back of a truck or similar vehicle. The portable VMS signs mounted on a truck shall be powered by solar energy or battery and show the sign of 'men at work' and/or speed limits in the construction zone. They shall be so placed that they are effective. The placement must give adequate time to the motorists to react to the message and take corrective action. On Expressways and National Highways placement of these at 2 km prior to the decision points should be done with repetition at every 500 m and 50 m prior to the point of decision. It should provide a sight distance of 200 m and should not interfere with other traffic control devices. If the portable VMS set-up and a message is not to be required for a period of next four hours or more, the sign panel should be turned away from the traffic, parallel to the road centre line. Non blank signs should be facing the drivers for an extended period.

816.11.3.2 Under no circumstances shall VMS be used for advertising of any kind. It would be in blank mode when traffic, roadway, environment or pavement conditions or public service announcements do not warrant the display of message or messages.

816.11.4 Technical Requirements

The design of the system shall be modular. The system shall use LEDs/high gain Tran reflective LCDs for outdoor full sunlight. The failure of one LED module should not affect the output of any other LED cluster. Its design shall be such that the display is legible from a distance of 300 m on Expressways and from 250 m on other highways.

The equipment will comply with the following:

i)	Overall Size Board	Length minimum 3000 mm Height minimum 1800 mm Depth 200 mm
ii)	Number of Display Lines	3
iii)	Number of Characters per line	15
iv)	Height of Characters	minimum 400 mm for English Alphabet and 380 mm for any other local script excluding vowel connotations.
v)	Language	Three languages (English, Hindi and Regional Language)
vi)	Contrast Ratio	> 30:1 perpendicular to the board face >10:1 at an angle of + 70° to perpendicular.
vii)	Memory	Capable of storing minimum 10 frames that can be triggered on receiving the tele-command.
viii)	Housing	Powder coated housing with IP55 or other equivalent international standard for protection easing against dust, sprayed water and winds.
ix)	Mounting	Pole mounted as gantry and or cantilever with vertical clearance of 5.5 m from the surface.
x)	Interface Standard	RS422 and RS485 interfaces with compatibility on Ethernet.
xi)	Special Features	Automatic diagnostic and reporting of failure/fault of arrays/rows.
xii)	Protection against EMI	Circuitry and wiring inside VMS to be protected against any kind of EMI interference
xiii)	Additional Features and humidity sensor	Incorporation of temperature sensor
xiv)	Luminous Intensity (LED)	> 3000 mcd
xv)	Life of Components of VMS	> 10 years

Elaborate Fault diagnostics shall be provided as per EN 12966 or other equivalent international standards. Each pixel shall be monitored and feed back shall be provided for the health status. Minimum of following shall be provided:

- i) Power Failure at VMS
- ii) Processor PCB Failure
- iii) LED Cluster Failure
- iv) Loss of incoming message/data not properly received.
- v) Temperature monitoring.

The controller unit shall provide brightness control facility. Monitoring of ambient temperature of the housing. The controller shall be capable of automatically diagnosing and reporting component failure or any electronic fault. The controller shall be provided with a test port for local diagnostics via laptop. It shall be possible to perform fault diagnostics from the central control room via the software. The LED Clusters shall be mounted suitably for providing better viewing angle. Each display module shall have its own display interface to the Central processor. VMS shall be designed to comply with the following protocols:

NMCS2, MESSAGE CONTROL, TR2070D, NTCIP Version 2 or other equivalent international protocols.

816.11.5 Testing

The equipment shall be tested for functional requirements as below:

Messages shall be displayed using the central software and local terminal. The fault conditions shall be simulated. Messages/fault logs shall be checked for:

- a) LED FAULT
- b) Communication failure
- c) Power failure
- d) Brightness of Pixels

816.11.6 Installation Requirements

The structure on which the VMS is mounted shall be sturdy and aesthetically looking and capable of bearing wind loads up to 200 kmph. The lowest hung part of the display board shall have vertical clearance of at least 5.5 m from the road level. It shall be provided with a walkway to allow at least six persons to carry out maintenance of the VMS without obstructing the carriageway.

816.12 Transmission System**816.12.1 General**

The Transmission system provides connectivity between Control Centre and outdoor equipment such as Emergency Call Boxes, Variable Message Signs, Meteorological Data System, Video Cameras, Traffic Sensors, etc. The system shall comprise Cable System, Interface System and Optical Fibre Transmission System.

816.12.2 Cable System

The system shall comprise copper cable, Backbone Optical fibre cable (for connectivity between the sub-centers and main control centre) and auxiliary fibre optic cable for connectivity of the road side equipment to the sub-centre and Coaxial cable. The cable system along with interface equipment shall work satisfactorily under adverse conditions like storm, etc. The Optical Fibre Cable system shall interconnect with the defined optical transmission sources and also if required with associated network devices for signal transmission without any impairment. A separate and independent (auxiliary) Optical Fibre Cable system shall be used for the transmission of video signals, data signals from the equipment locations to the sub-centers where copper cable has limitations for transmission of signal

All Optical Fibre Cable shall be of TEC (Govt. of India) approved design.

The Co-axial Cable System shall provide immediate interface to carry signals from CCTV/VIDS Cameras located at strategic locations to the nearest sub centre. Optical Fibre Cable shall also be used with transmitters and receivers if the distance is large and high quality signal transmission and reception is not possible using co-axial system. The signals shall, without any impairment, be routed to the Control Centre via the sub-centers using the auxiliary Optical Fibre cable.

816.12.3 Interface System

Interface System shall comprise Sensor interface equipment, Optical fibre cable interface equipment and Control Centre interface equipment. The Interface System shall cover the Copper Cable, Co-axial Cable and Optical Fibre Cable System and transmit and process the composite signals to achieve the desired reliability/availability requirement. The Interface sub-systems shall be capable of handling the composite audio, video and data signals at various interface levels and process them. The Interface sub-systems shall be designed optimally at various levels i.e. from the individual sub-systems level to integrator through Control Centre.

816.12.4 OFC Transmission System

The system shall comprise optical line terminals, interface cards and network management. The Backbone Optical Fibre Cable System shall interconnect the sub-centre/integrators

and the Control Centre. The Optical Fibre Cable system shall interconnect with the defined optical transmission sources and also if required with associated network devices for signal transmission without any impairment. The backbone communication of Cable system shall be used only to interconnect the sub-centers to the main control centre. This cable shall be terminated only at the sub-centres and main control centre. It shall not be allowed to interface any other sub-systems in the field to this cable or any spare cores in the cable directly or through branching. A separate and independent (auxiliary) Optical Fibre Cable system shall be used for the transmission of video signals, data signals from the equipment locations to the sub-centers where copper cable has limitations for transmission of signals. This would be finalized during approval of detailed design by the successful bidder. All Optical Fibre Cable shall be of TEC (Govt. of India) approved design.

816.12.5 Power Supply System

The Power Supply System shall support the requirements of individual sub-systems. The Power Supply System proposed for individual sub-systems shall take into account the overall availability/reliability requirements. The Power Supply System design shall take into consideration local power availability, temperature and other climatic variations, and easy maintainability. A 230 V AC, 50 Hz single phase power supply shall be used. The equipment components shall have adequate surge and lightning protection.

816.13 Meteorological Data System

816.13.1 General

The Meteorological Data System shall consist of wind sensors for monitoring wind speed and direction, visibility sensors for detection of visibility changes resulting from fog or dust storm, atmospheric sensors to measure air temperature and humidity and road condition sensor to read road surface temperature. The system configuration shall therefore comprise thermocouple/dynamometer, humidity meter, anemometer and visibility meter.

816.13.2 Technical Requirements

The Meteorological Data System shall communicate the measurement to the Control Center. It shall be compact, rugged in design and having ease of maintenance and shall be capable of detecting and keeping track of the surface temperature of the Highway surface and initiate appropriate alarms at the Control Centre.

The Met. Sensor shall meet following requirements

Relative Humidity Sensor

Range	:	1100%
Minimum Accuracy	:	± 2% RH

Resolution	:	0.1%
Temperature Range	:	-5°C to +60°C
Sensor Mechanism	:	The sensor shall be adequately protected against dust/pollution and shall provide a linear output voltage for 0-100% humidity

Air Temperature Sensor

Range	:	-30°C to +70°C
Sensing Element	:	should provide a linear output for the entire range of temperature
Resolution	:	0.1% of range
Accuracy	:	±0.3% of range
Visibility Sensor		
Range	:	50 to 1500 m
Wavelength	:	880 nm
Sensor Type	:	Infrared sensor, source and detector
Accuracy	:	±15%
Wind Direction Sensor		
Threshold Speed	:	Less than 0.3 m/s
Accuracy	:	Better than ±5%
Damping ratio	:	0.7
Wind Seed Sensor		
Range	:	Up to 79 m/s
Threshold Speed	:	Less than 0.3 m/s
Accuracy	:	±2%
Output Signals	:	Average Wind/Average Gust

Road Condition Sensor

Temperature Sensor Range	:	-10°C to +60°C
Resolution	:	0.1°C
Accuracy	:	±0.2°C
Wet/Dry Sensor		
Output	:	ON/OFF

816.13.3 Data Acquisition Controller

The Data Acquisition Controller shall meet the following requirements:

- i) Be suitable for all the supplied sensors,
- ii) Have appropriate number and type of inputs in order to service all the sensors,
- iii) Incorporate an LCD display to allow local monitoring of the data,
- iv) Have a memory backup (up to 7 days) to retain data locally in case of communication failure.

816.14 Automatic Traffic Counter-cum-Classifier**816.14.1 General**

This system shall be provided for identifying and recording all types of vehicles on the highway for effective monitoring and data collection at Control Centre. Besides, the system shall be capable of classifying any other vehicle category as per user needs. Vehicle classification should be user selectable based on length of vehicle and/or detuning of the loop inductivity. The system shall be robust and be capable of operating with minimum maintenance. The system shall interface with the ATMS/ATMS Software for central monitoring. The indicative classification of common vehicles in India, based on wheel base, is as given below.

	Type of Vehicle	Probable Range of Wheel Base (mm)
1)	Two Wheelers (Motorised) Scooters, Mopeds, Motor Cycle	0-1350
2)	Three Wheelers (Auto/Tempo)	1400-1800
3)	Four Wheelers Cars, jeeps, vans etc.	1801-2675
4)	Light Motor Vehicles	2690-3400
5)	Trucks/Buses	3401-5600
6)	Multi Axle Vehicles	5000-18000

Vehicle Classification should be user selectable based on length of vehicle and number of axles. The system shall have the capability of accommodating multiple installations through installation of detectors/sensors which can be left permanently in place and connected as required to the recording device when traffic counts are made at that particular location. It shall also be capable of taking inputs from portable sensors and should be modular in design. The system shall have capability of interfacing with the integrators for central monitoring. It shall have suitable interface for transmitting information from ATCC System to the Control Centre.

816.14.2 Technical Requirements**816.14.2.1 Sensors**

The sensors should be a combination of piezo-electric sensors and inductive loops, enabling counting/classification of up to 4-lane traffic (expandable to at least 6-lane traffic) with user set time periods.

816.14.2.2 Electronics

Vehicle counting/classification interval shall be programmable from one minute to 1440 minutes (24 hours) and system should accept user programmable recording intervals to count and classify during a 24 hour period. The system should be able to count and classify vehicle by each lane.

816.14.2.3 Data Collection

The system shall be capable of sending data to the ATMS/ATMS Software which shall enable the ATMS/ATMS Software to classify the vehicles, detect average speed per lane, vehicle occupancy and headway as a minimum. Data collection shall be by RS232, RS422 or RS485 interface or IP connection. The system shall be capable of recording, for later analysis, on an individual vehicle basis, time/date, speed, direction. Number of axles, axle spacing, and site identification.

816.14.2.4 Data Storage

The system should be able to record and store vehicle data for a period of at least two weeks with daily traffic volumes of up to 10,000 vehicles.

816.14.2.5 Operating Language

English

816.14.2.6 System Accuracy

The accuracy of the system in recording speeds and headways/gaps shall as per **Table 800-15**.

816.14.2.7 Data Retrieval

The system should have the capability of data retrieval, direct data transfer through a serial link to computer, Leased line/GSM/CDMA.

816.14.2.8 Software

Software and manuals to analyze the data from output of vehicle counts, classification speeds and headways shall be provided. Capability of graphic/tabular presentation of analyzed data shall also be offered.

Table 800-15 : System Accuracy Requirements

Parameter	Accuracy	Conditions
Average Speed	10 percent	There are at least 25 vehicles in the group, individual vehicle speeds are between 10 kmph and 195 kmph and the vehicles conform to normal highway driving behaviour.
Average Headway	10 percent	There are at least 25 vehicles in the group, individual vehicle speeds are between 10 kmph and 195 kmph, individual vehicle head-ways are between 1 and 10 seconds and the vehicles conform to normal highway driving behaviour.
Flows	5 percent	There are at least 100 vehicles of each category in group and vehicles conform to normal highway driving behaviour.
Occupancy	10 percent	There are at least 25 vehicles in the group, individual vehicle speeds are between 10 kmph and 195 kmph, individual vehicle headways are between 1 and 10 seconds and the vehicles conform to normal highway driving behaviour.

816.14.2.9 Mode of Operation

This will be user programmable up to at least 12 speed and 15 vehicle class bins, of vehicles operating in India (user specified). System capability in this regard may be indicated. Counter shall also bin simultaneously in speed, axle and count or any combination of the three.

816.14.2.10 Capability

The system shall have capability of recording vehicle counting and classification, speed, headway at set interval of 1-10 minutes.

816.15 Video Surveillance System**816.15.1 General**

The System shall be provided to monitor the movement of vehicles on the highway. System configuration shall comprise video camera, video camera housing, pan and tilt heads, optical transmission units for video and data (if required) and mounting poles at camera locations. The Control centre configuration shall comprise monitors for individual cameras, matrix switcher, multiplexer and digital video recorder with suitable interface for the integrated highway package

and optical interface units to the backbone communication system wherever required (where the video and data cannot be transported from camera location to the Sub-centre on co-axial cable). The Video Camera location shall be easily identifiable. The Video Camera shall be of dome type to avoid pilferage, be resistant to vandalism and weather-proof. The mounting and equipment housing shall be able to withstand adverse weather conditions and the Video Camera shall be capable of working satisfactorily under worst weather conditions. The Video Camera and associated units shall be water ingress and dust proof. The Video Camera mounting shall have easy accessibility for maintenance purposes.

816.15.2 Technical Requirements

816.15.2.1 The Video Camera shall meet the following minimum technical as requirements:

a)	Image Sensor	¼" CCD with 22 x optical zoom
b)	Active Pixels	752(H)x582(V)
c)	Horizontal Resolution	Minimum 470 lines
d)	Sensitivity	0.02 lux @ 1/1.5 Second shutter speed
e)	Focus	Automatic (with manual override/preset facility)
f)	Signal to Noise	>50 dB
g)	AGC	Automatic with manual override
h)	White Balance	Automatic with manual override
i)	Auto Shutter	Yes
j)	Signal Format	NTSC/PAL

816.15.2.2 The video camera shall have angular travel as below:

Horizontal	:	360° continuous pan
Vertical Tilt	:	+2° to -92°

The Video Camera shall have speed as below:

Manual Speed

Pan	:	1/10° to 80°/second (Variable)
Tilt	:	1/10° to 40°/second (Variable)

Preset Speed

Pan	:	250°/second
Tilt	:	200°/second

816.15.2.3 The dome drive shall have 40 presets with labels and shall have an accuracy of $\pm 0.25^\circ$ preset accuracy. It shall have built-in protection against power Line Surge and Lightning and provision for Onscreen-compass and Tilt display, integral, auto sensing multi-protocol receiver/drive and provision for Auto-flip dome rotation. There shall be programmable limit stops for Auto/random/frame scan modes. The Video Camera shall be connected to the control centre/sub-centre through co-axial cable and data cable/optical fibre cable as per the site requirement and shall have remotely selectable operating modes and shall be operated from the Control Centre. The video images from camera shall be transmitted in real time. The video image shall be made available at the control centre without any distortion or loss of information. The video camera system shall have the facility for zone blanking, auto identification of zones when the pan movement of camera is active and infra-red compatibility for night operation.

816.16 Video Incident Detection System

816.16.1 The system shall be an intelligent image detection system using CCTV cameras. The cameras shall have inbuilt intelligence to ascertain when the image has meaningfully deviated from the Standard Image originally recorded. On sensing the incident, the system shall automatically start recording the image at the control centre.

816.16.2 The Incident Detection system shall capable of the following:

- a) Measurement of traffic flow speed between 0 and 150 km/hr for up to 6-lanes
- b) Detection of vehicles driving in wrong direction
- c) Automatic detection of 5 types of traffic flow: normal, dense, delayed, congested, and stop and go
- d) Detection of stopped vehicles, within 10 secs and for up to 16 detection zones.
- e) Monitor Zone occupancy of the detection area
- f) Detection of deceleration
- g) Detection of fog/smoke

816.16.3 Alarms for following events:

- a) Queue
- b) Stop
- c) Inverse direction
- d) Speed drop
- e) Fog/smoke
- f) No video signal
- g) Error

816.17 Control Centre**816.17.1 General**

The Control Centre shall accommodate following equipment and software:

- i) Central Computer Server (with integrated ATMS/ATMS Software)
- ii) Emergency call management system equipment and software
- iii) CCTV Console and other Equipment
- iv) Mobile radio operator and configuration equipment and software
- v) Video incident detection system console and other equipment
- vi) Backbone communication equipment and NMS for the same.
- vii) Large Display Board
- viii) Printer
- ix) Uninterrupted Power Supply with supply system and back up
- x) Power supply equipment.

816.17.2 Emergency Call Management

Emergency Call Management system located at the Control Centre shall carry out the following functions:

- i) Attend to incoming calls from ECB's using a PC based console, and navigate the highway section under supervision using graphical representation of the network which shall be displayed on the PC monitor.
- ii) Provide audible and visual alert on the screen for any incoming calls from the Emergency call boxes. Colour of the icon representing the Call boxes on the graphical map shall change indicating the states of call box (phone) healthy, call box (phone) faulty, incoming call, conversation in progress and call on hold.
- iii) Provide for call waiting signal to the ECB and put the call on queue in case of several calls at the same time.
- iv) Create log and record all conversations from and to the Control Centre from the ECBs.
- v) Further the system shall automatically check periodically (the interval of which shall be operator selectable) the health of phones and generate an audio visual alarm in case of faults.

- vi) The system shall generate a unique call number for each and every call and allow the operator to provide annotation.
- vii) There shall be one Emergency Call Manager's terminal easily expandable to more operator stations by connecting more operator terminals.
- viii) Holding of any call by the operator.
- ix) Terminating any call by the operator.
- x) Seamless configuration on addition/deletion of ECBs on the network.
- xi) Database generation, display on the monitor and logging of all parameters of call progress.
- xii) Recording of communication between the operator and road users.
- xiii) Audio visual alarm in case of vandalism.
- xiv) Audio visual alert in case of operation by handicapped.

816.17.3 Integrated ATMS Software

The ATMS software shall manage the following on a single server platform:

- a) Emergency Communication System
- b) Variable Message Signs System
- c) Meteorological Data System
- d) Automatic Traffic Counter cum Classifier System
- e) Video incident Detection System
- f) CCTV Surveillance System.

816.17.4 System Architecture

816.17.4.1 Hardware for Central Server

The system shall run on a powerful dual-processor server with RAID facilities to provide continuity of hard disk storage. Storage capacity should be large ;and comfortably sufficient to cater for the demands of a modern traffic management system. The system shall have client-server architecture so that multiple users may access the system simultaneously.

Minimum hardware specification shall be as follows:

- a) Server from reputed company
- b) Dual Core 2.2 GHz Processor or Higher

- c) Hard Disc: 5* 146 (RAID 5 Support)
- d) 4Gb RAM or higher
- e) Operating system: Industry standard
- f) The database: Industry standard
- g) Tape drive for backup/archive
- h) Facility for remote diagnosis and support.

816.17.4.2 Hardware for Work Stations/Operator Console

The workstations shall have the following specifications:

- a) Pentium IV 2.0 GHz
- b) 512 Mb RAM
- c) 80GB ; Hard Drive
- d) 19" TFT monitor

816.17.5 System Software

The System software shall run on industry standard Server platform incorporating either MS Windows or Linux operating system in a client server mode. All the above subsystems shall be displayed and managed by the Supervisor which will show the status of all the above subsystems simultaneously as graphic symbols/icons. The graphic operator interface shall be menu driven for ease of operation. The operator shall be able to configure, set values, commands, perform database operations, reports, archive using these menus. The Integrated ATMS software shall monitor and record online all data from ATCC, Met Sensors, VMS, Traffic control system, CCTV, VIDS and ECBs. It shall be possible to configure the sub-systems as well as add/delete components of the system such as ECB, VMS, MET sensor, ATCC, VIDS, and CCTV in the ATMS software online seamlessly.

The Integrated ATMS Software shall also have following features:

- i) The system server shall be configured so as to minimize the risk of data loss in the event of system failure of power loss. It shall support client terminals operating on a LAN, WAN or remote connection. Access to the database and client terminals shall be username and password controlled. Access level shall be determined by the system supervisor and shall range from "read only" to full edit/supervisor rights. The system shall not bypass/violate access rights setup on slave systems. It shall not be possible to send shut down or "Kill" commands form the database management system.
- ii) For system monitoring it shall be possible to configure a view only user with access to the map and embedded/linked data only. Such

a terminal could be used by police, highway engineers, emergency services, etc. It shall be possible to relay urgent faults/incidents/System alarms (supervisor configurable) to remote operators/staff via an SMS message for any requirements in future.

- iii) The system shall have proven and modular Web interfaces. It should be possible to integrate the same if required in future for providing highway information such as CCTV images, traffic flow, journey time, etc., to the general public via internet web pages.
- iv) The system shall have proven and modular interfaces to automatic license plate recognition system. It shall be possible to integrate the same in future if required.

816.17.6 System Functions

816.17.6.1 Sub-system Monitoring and Control

The System software shall monitor and control ATMS sub-systems as below:

- i) It shall monitor and record online all data from Meteorological Data System installed on the highway. The data shall be updated every five minutes.
- ii) It shall monitor and record online all data from the ATCC. The system shall provide the user with the information/display of traffic flow conditions on the MAP. The data shall be updated every one minute.
- iii) It shall monitor health of the Emergency telephones on a continuous basis.
- iv) It shall monitor and control the variable message signs. The operator shall be able to generate new messages for signs. The system shall react intelligently and automatically to the highway conditions and set up suitable messages on the VMS. It shall also be possible to schedule the pre-defined messages to be displayed on the VMS. The display period shall be operator selectable. The priorities of the messages shall also be operator selectable.
- v) The System software shall provide information regarding incidents (VIDS) and store/archive them for future use.
- vi) The system shall interface with intelligent traffic control systems for traffic control and monitoring specially at interchanges and access points.
- vii) The system shall interface to CCTV system to select cameras for display and control of images.

- viii) The system shall process above referred data acquired through above system for decision taking, display information on respective VDU monitors and central Large Display Board.
- ix) Provide continuously clear and comprehensive displays and print log of events.
- x) Access to historical data files of ATMS.
- xi) Execution of operator commands with access code security.
- xii) Generation of reports at specified times (operator selectable)
- xiii) System timekeeping.
- xiv) Connectivity and data transfer to other control centers if required.

816.17.6.2 Graphic User Interface (GUI)

The GUI for the system shall be map based and menu driven. The changes commands/ menu shall be simple to be executed by the operator. There shall be a screen depicting the map of the highway along with other equipment installed on the route. The highway map shall be capable of displaying an overview level showing the whole area covered by the system. It shall then be possible with no loss of definition, to zoom to a detailed map. It shall be possible to display both static and dynamic data on the Map. Two level of mapping shall be supported as a minimum:

- 1) Highway Overview.
- 2) Highway section wise detailed view.

Icons shall be placed on the map to identify different equipment types. Both shall be automatically tagged with grid reference data to allow them to appear in the correct relative positions at both levels of map. Positioning the mouse pointer over an icon or poly-line shall display the corresponding equipment status information.

For poly-lines representing route data, the user shall be able to configure a number of thresholds for the different data types available. An example would be congestion for links where up to X% percentage thresholds can be defined. Each threshold shall be represented by a distinct colour or changed shapes. The map shall use this scheme to display the poly-lines based on comparisons with the current real-time data.

The user shall have the ability to configure the map view to display the data layers of choice, for example to show Met Sensor only or ATCC together with current incidents.

It shall be possible for the operator to place icons or "active" symbols on the map to represent

- a) Access control/ramp metering system
- b) Traffic control system

- c) Variable Message signs
- d) CCTV cameras
- e) Incidents such as Accident, Roadworks, Event, Diversion, Breakdown and Road closure
- f) Strategy
- g) Weather station data
- h) Flow, speed classification information
- i) User defined fields

Icons will be either active or non-active. Active icons will link to the associated system and show their current status change of state (colour or flash) and by displaying detailed information triggered user action.

816.17.7 Database Management

The database used by the ATMS software shall be an industry standard database like ORACLE, SQL, dbase etc. The system shall have facility to perform certain selected database operations only by authorized users.

816.17.7.1 Data Presentation and Storage

The presentation of data shall reflect the use of the system as a real time tool for the operator to monitor and control the highway. It shall be possible to present current data (day) in comparison with profile data or date comparison (same day last year). It shall be possible to create predictive traffic data and trends. The data shall be stored in the system in a format to present weekly and monthly average for congestion and summary flow for weeks and months. The system shall store at least 12 months of data. Older data may be archived. However, the system shall provide tools for the retrieval, manipulation and presentation of data. Data store shall be clearly marked with an indicator to show day or period type e.g. normal, holiday, weekly off; by reference to the system calendar. It shall be possible to export data to an external system for further analysis. Transfer shall be available in .xls, csv or any standard formats. It shall be possible to display data or combinations of data in graphical manner and to print graphs, e.g., Graphs of current, profile, historic, and combinations for

- a) Flow
- b) Occupancy
- c) Congestion

816.17.7.2 Archive and Restore

This facility shall allow the archiving of the database to a tape/External HD/DVD . The data archived shall then be deleted from the database. Data may only be archived when it is more

than two years old. Only one archive request may be outstanding at a time. Once archived, part or all of the data may be restored by copying from the tape back onto the system, where it remains for 30 days. Only one restore request may be outstanding at a time.

It shall be possible to define a series of notification levels which will raise an alarm when the disk space reaches a specified limit. This is used to alert an operator to the need to archive data.

816.17.7.3 Database Back-up

The system management procedures for producing daily and weekly back-ups shall not need any operator intervention.

816.17.7.4 Reports

The system shall have detailed reports for:

- a) Status reports for the sub-systems (alarms, faults etc.)
- b) Detailed traffic reports-speed, count, occupancy etc.
- c) Detailed weather report for all variables from weather sensor
- d) Detailed report of emergency call.

816.17.7.5 Timetable and Calendar

The system shall have a time Table facility. The timetable shall allow commands by day of the week, time of day, day type. The system calendar shall allow days to be marked as normal, holiday, weekly off, etc.

816.17.7.6 System Log

The system shall retain a log of all events, alarms, timetable actions, and operator actions(together with operator username). In addition to system generated events the operators shall have facilities to enter events or incidents into the log. It shall be possible to search the log by time/date, event type, operator user name, strategy, location.

The log facility shall provide the means to:

- a) Record all important events that occur in the operation of the integrated highway management system, both manual and automatic View and manage the status of alarm events,
- b) Collect and collate incident information from both manual and automatic sources,

- c) Allow the user to record routine operational messages,
- d) View all changes and actions taken on the ATMS,
- e) Record and view useful contact names and other details.

816.17.7.7 Asset Management

- a) The system shall incorporate a facility to store records of assets for ATMS.
- b) The asset register shall store data relating to location, type, and number of equipments as well as electricity ratings.

816.17.7.8 User Management

This facility shall provide the means to make user access to ATMS secure. Only the system administrator(s) shall have access to this facility and will set up details for other users. Each user shall have a username that needs to be configured so that it matches a PC log-in. Hence logging on to the PC will automatically mean that access to ATMS is available for the chosen users. Each user can also be configured to have access to none, some or all of the ATMS facilities.

816.17.8 Operator Interface and Control

816.17.8.1 Fault and Alarm Management

Fault and Alarm Monitoring (FAM) for ATMS shall have following features:

- a) The FAM system shall be provided with the capabilities to monitor system alarm status on a real-time basis.
- b) The FAM system shall have the ability to store alarms in the database for future enquiries, and to access the fault alarm history database for retrieval of alarm data in the alarm history memory.
- c) All ATMS controlled equipment as well as VMS display boards shall be provided with fault monitoring and reporting to the FAM system.

816.17.8.2 Alarm Handling

- a) The following alarm conditions shall be provided to the FAM system as a minimum:
 - i) Loss of communication link
 - ii) Loss of the entire ATMS facilities at a location
 - iii) Loss of interface link with the ECB

- iv) Alarm from MET Sensor-Air Temperature, Visibility, Humidity, Road Surface temperature, Road Surface wet/dry, Wind Speed, wind direction etc.
 - v) VMS Faults e.g Communication Fault, LED Fault, Data parity fault, Power supply fault, Protocol polling fault to I/O Device, etc.
 - vi) ATCC faults e.g. Sensor fault, communication link failure etc.
 - vii) CCTV faults
 - viii) Traffic control system faults-Lamp LED Fault, Sensor fault, communication link failure, etc.
 - ix) Power supply unit failure
 - x) Automatic Message priority conflict.
- b) All failure alarms shall be stamped with time and date.
 - c) All failure alarms shall remain on the active alarm display list until they have been acknowledged by the operator on the FAM system via the management workstation.
 - d) All alarms removed from the active alarm display list shall automatically be inserted into the alarm history database when they occur.
 - e) The alarm history database shall be provided with sufficient storage capacity to store the anticipated alarms for a period of at least four weeks without carrying out any housekeeping function.

816.17.8.3 Alarm Displays

- a) Alarms shall be displayed on the workstation via a detailed full screen alarm browser application.
- b) The alarm Display shall provide as a minimum the following general capabilities and characteristics for the ABA for alarm display list and alarm history:
 - i) A colour coding scheme indicating the alarm severity according to the alarm classifications.
 - ii) The display of the alarms with their associated time stamps.
 - iii) Scrolling capabilities to enable the operator to view more alarms that can be displayed on one single screen.
 - iv) The facilities to acknowledge alarms.
 - v) The facilities to clear alarms from the display.

816.17.8.4 Fault Diagnostics

The fault diagnostics system shall perform the following diagnostics features as a minimum.

- i) detect the alarm conditions as listed in Clause 815.17.7.2.
- ii) All fault status information and associated equipment test results shall be presented to the workstation immediately after the alarms are triggered.

816.17.8.5 Failure Modes

When power is restored following a power failure to the system, the system shall perform all necessary self-testing processes and then resume functioning fully in the same configuration as before the shutdown. This shall be completed automatically within 5 minutes of power restoration.

816.17.9 Back Bone Communication System

The backbone communication system shall connect the sub-centers with the Control Centre. The auxiliary Optical Fibre communication system shall provide connectivity for peripheral systems like ATCC, CCTV, mobile radio, emergency call management system, VIDS, Traffic Control System, Mobile Radio and LAN interface for Tolling Systems to the Control Centre. There shall be a node for the backbone communication system at every sub-center and the Control Centre. The network management system (NMS) shall be located at main control centre. It shall however be possible to connect the NMS at any sub-center location which houses a communication node. The NMS shall be installed on a PC.

816.17.10 Large Display Board**816.17.10.1 Functions**

- a) The device shall be used for monitoring the traffic through CCTV/VIDS to display the ATMS Graphical User Interface (GUI). The large display board shall be displayed on the wall of the Control Centre. The Application software shall consist of a built-in module for display board.
- b) It shall be possible to create customized data acquisition screen and drag icons by simple click of the mouse.
- c) It shall be possible to create backgrounds using scanned photographs, maps, one-line diagrams, engineering drawings, etc., using popular graphic or engineering applications.
- d) It shall be possible to create new process diagrams that represent various sections of the highway at different levels of levels of details using the package.

816.17.10.2 Equipment

The Large Display Board shall be highly reliable for installation and round the clock operation in the Control Centre. The Display Board shall be driven by the Central Computer using the main console. The design of the Display Board system shall be modular and expandable. The Display Board shall use high gain trans-reflective LCDs for ambient indoors. The Board shall meet the following specifications:

i)	Overall board size	:	Length minimum 3000 mm Height minimum 1200 mm
ii)	Display	:	Graphic
iii)	Contrast Ratio	:	minimum 1000:1
iv)	Housing	:	Structure coated housing with IP54 Protection casing against dust, sprayed water
vii)	Interface Standard	:	RS 422, RS 485 (Ethernet compatible)
viii)	Special Features	:	Automatic diagnostics and failure reporting

816.17.11 Uninterrupted Power Supply**816.17.11.1 Functions**

The uninterrupted power supply shall be installed at the Control Centre for providing clean uninterrupted power supply to all the operational Equipment at the centre. The uninterrupted power supply shall be capable of providing full load for the operational equipment for a minimum period of 60 minutes. The Control Centre shall be powered from 230V AC from the State Electricity Board (SEB) supply. Any loss of AC power to the Control Centre from the SEB shall not cause loss of any data on the computers or any resetting of system parameters. The following requirements will be met:

Features

Rating	:	To meet the load requirement
Input Voltage	:	230 V AC (+10% to -15%)
Input Frequency	:	50 HZ \pm 10%
Inverter Type	:	High frequency switching sinusoidal multiple Pulse

Output Voltage	:	230 V
Output Frequency	:	Free running 50 Hz \pm 0.1% Tracking bypass \pm 2%
Output Voltage Waveform	:	Sinusoidal
Output Voltage Regulation	:	Better than \pm 1% for simultaneous variation of no. to full load and input Voltage to any extremes. \pm
Total harmonic distortion	:	<5%
Inverter efficiency	:	>87%
Transmit Response	:	for 100% step load Dip-Typical 5% max. <8% Peak-Typical 5% max. <8% Recovery to normal up to 60 msec. i.e. 3 cycles.
Overload capacity	:	125% for 10 msec. 800% on static bypass for 10 msec.
Audible indication	:	<55 dBA at 1 meter distance for i) Mains OK ii) Inverter OK iii) Overload iv) On battery v) Low battery vi) Inverter trip

Four extra LED indications shall be available with automatic bi-directional static switch for

- i) By pass OK
- ii) Load on inverter
- iii) Load on By Pass
- iv) By Pass frequency out of range
- v) Metering for voltage, frequency and current
- vi) Battery capacity required for minimum 1-hour back up at full load.

816.18 Warranty

The Contractor/Supplier of the Advanced Traffic Management Systems (ATMS) shall furnish the Warranty/Guarantee for successful commissioning and operation of ATMS for a minimum

period of 5 years. He shall also furnish the certificate that there is no proprietary item and that the Systems shall be interoperable. All components and equipments shall be tested for commissioning. The documents with regard to design, technical details, installation details, testing and commissioning, details of fault diagnostics, operation and maintenance manuals and reports shall be submitted to the Engineer by the Contractor/Supplier.

816.19 Payment

The payment shall be made for design, configuration, installation and commissioning the ATMS, as complete job on the identified stretch of highway, as specified in the Contract or as per directions of the Engineer.

900

**QUALITY CONTROL FOR
ROAD WORKS**

901 GENERAL

901.1 All materials to be used, all methods to be adopted and all works to be performed shall be strictly in accordance with the requirements of these Specifications. The Contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out Quality Control for works and all the required tests as per Specifications and/or as directed by the Engineer. The provision and maintenance of the laboratory shall be as per Clause 120 and/or as directed by the Engineer. The list of equipment and the facilities to be provided shall be got approved from the Engineer in advance.

901.2 The Contractor's laboratory shall be manned by a qualified Materials Engineer/Civil Engineer assisted by experienced technicians, and the set-up should be got approved by the Engineer.

901.3 The Contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. In the absence of clear indications about method and or frequency of tests for any item, the instructions of the Engineer shall be followed.

901.4 For satisfying himself about the quality of the materials and work, quality control tests will also be conducted by the Engineer (by himself, by his Quality Control Units or by any other agencies deemed fit by him), generally to the frequency set forth hereunder. Additional tests may also be conducted where, in the opinion of the Engineer, need for such tests exists.

901.5 The Contractor shall provide necessary co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This shall include provision of laboratory equipment, transport, consumables, personnel including labour attendants, assistants in packing and dispatching and any other assistance considered necessary in connection with the tests.

901.6 For the work of embankment, subgrade and pavement, construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission from the Engineer. Similar permission from the Engineer shall be obtained in respect of all other items of works prior to proceeding with the next stage of construction.

901.7 The Contractor shall carry out modifications in the procedure of work, if found necessary, as directed by the Engineer. Works falling short of quality shall be rectified/redone by the Contractor at his own cost, and defective work shall also be removed from the site of works by the Contractor at his own cost.

901.8 The cost of laboratory building including essential supplies like water, electricity, sanitary services and their maintenance and cost of all equipment, tools, materials,

labour and incidentals to perform tests and other operations of quality control according to the Specification requirements shall be deemed to be incidental to the work and no payment shall be made for the same. If, however, there is a separate item in the Bill of Quantities for setting up of a laboratory and installing testing equipment, such work shall be paid for separately.

901.9 For testing of soils/soil mixes, granular materials and mixes, bituminous materials and mixes, cement concrete materials and mixes, aggregates, cores etc., samples in the required quantity and form shall be supplied by the Contractor at his own cost.

901.10 For cement, bitumen, steel, emulsion, road marking paint, sign boards, geo-synthetics and similar other materials where essential tests are to be carried out in the presence of Engineer at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor.

Manufacturer's test certificate together with invoice or delivery challan shall be furnished for every lot of supply apart from tests to be conducted at site laboratory for prime properties of the material like cement, bitumen, etc. Where facilities for testing of materials are not available at site laboratory the same shall be tested at an outside laboratory in the presence of the Engineer. For specialized items such as sign boards, road marking paint, etc. the Engineer may order for third party test from an approved laboratory.

901.11 The method of sampling and testing of materials shall be in accordance with the requirements of the relevant Indian Standards and these Specifications. Where they are contradicting, the provisions in these Specifications shall be followed. Where they are silent, sound engineering practices shall be adopted. The sampling and testing procedure to be used shall be as approved by the Engineer and his decision shall be final and binding on the Contractor. The cost of all tests shall be borne by the Contractor.

901.12 The materials for embankment construction shall be got approved from the Engineer. The responsibility for arranging and obtaining the land for borrowing or exploitation in any other way shall rest with the Contractor who shall ensure smooth and uninterrupted supply of materials in the required quantity during the construction period.

Similarly, the supply of aggregates and other materials for construction shall be from sources approved by the Engineer. Responsibility for arranging uninterrupted supply of materials from the source shall be that of the Contractor.

901.13 Defective Materials

All materials which the Engineer has determined as not conforming to the requirements of the Contract shall be rejected whether in place or not; they shall be removed immediately

from the site as directed. Materials, which have been subsequently corrected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the Contractor to comply with any instruction of the Engineer, the Engineer shall have authority to cause the removal of rejected material and to deduct the removal cost thereof from any payments due to the Contractor.

901.14 Imported Materials

The Contractor shall furnish a list of materials/finished products manufactured, produced or fabricated outside India which he proposes to use in the work. The Contractor shall not be entitled to extension of time for acts or events occurring outside India and it shall be the Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant Specifications of the Contract. In case where materials/finished products are not covered by the Specifications in the Contract, the details of laboratories/establishments where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certified mill test reports clearly identified in the lot of materials shall be furnished at the Contractor's cost.

902 CONTROL OF ALIGNMENT, LEVEL AND SURFACE REGULARITY

902.1 General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer, subject to the permitted tolerances described herein-after.

902.2 Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 10 mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ± 25 mm.

902.3 Surface Levels

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road

shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table 900-1.

Table 900-1 : Tolerances in Surface Levels

1)	Subgrade	±20 mm
2)	Sub-base a) Flexible pavement b) Concrete pavement	±10 mm ±6 mm
3)	Base-course for flexible pavement a) Bituminous Base/Binder course b) Granular i) Machine laid ii) Manually laid	±6 mm ±10 mm ±15 mm
4)	Wearing course for flexible pavement a) Machine laid b) Manually laid	±6 mm ±10 mm
5)	Cement concrete pavement	±5 mm

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than the following limits:

- 4 mm for bituminous wearing course of thickness 40 mm or more
- 3 mm for bituminous wearing course of thickness less than 40 mm
- 5 mm for concrete pavement slab

For checking compliance with the above requirement for subgrade, sub-base and base course, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

For checking the compliance with the above requirement for bituminous wearing courses and concrete pavements, measurements of the surface levels shall be taken on a grid of points spaced at 6.25 m along the length and at 0.5 m from the edges and at the centre of the pavement. In any length of pavement, compliance shall be deemed to be met for the final road surface, only if the tolerance given above is satisfied for any point on the surface.

902.4 Surface Regularity of Pavement Courses

The longitudinal profile shall be checked with a 3 metre long straight edge/moving straight-edge as directed by the Engineer at the middle of each traffic lane along a line parallel to the centre line of the road.

The maximum permitted number of surface irregularities shall be as per Table 900-2.

Table 900-2 : Maximum Permitted Number of Surface Irregularities

Irregularity	Surfaces of Carriageways and Paved Shoulders				Surfaces of Laybys, Service Areas and all Bituminous Base Courses			
	4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75
Number of Surface Irregularities on National Highways/ Expressways*	15	9	2	1	40	18	4	2
Number of Surface Irregularities on Roads of lower Category*	40	18	4	2	60	27	6	3

* Category of each section of road as described in the Contract.

The maximum allowable difference between the road surface and underside of a 3 m straight-edge when placed parallel with, or at right angles to the centre line of the road at points decided by the Engineer shall be:

for pavement surface (bituminous and cement concrete)	3 mm
for bituminous base courses	6 mm
for granular sub-base/base courses	8 mm
for sub-bases under concrete pavements	10 mm
for subgrade	15 mm

902.5 Rectification

Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances in Clause 902.4, the Contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

- i) **Subgrade:** Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of Clause 305.

- ii) **Granular Sub-base:** Same as at (i) above, except that the degree of compaction and the type of material to be used shall conform to the requirements of Clause 401.
- iii) **Lime/Cement Stabilized Soil Sub-base:** For lime/cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material is less than 2 hours, the surface shall be scarified to a depth of 50 mm, supplemented with freshly mixed materials as necessary and recompactd as per the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material to Specification. This shall also apply to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

- iv) **Water Bound Macadam/Wet Mix Macadam Sub-base/Base:** Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompactd as per Clause 404 in the case of Water Bound Macadam and to Clause 406 in the case of Wet Mix Macadam.
- v) **Bituminous Constructions:** For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat, if needed, and recompactd as per specifications. Where the surface is high, the extra thickness in the affected layer shall be removed and replaced with fresh material and compactd to Specifications.

For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compactd to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 m in length and not less than 3.5 m in width.

- vi) **Dry Lean Concrete Sub-Base:** The defective length of the course shall be removed to full depth and replaced with material conforming to **Clause 601**. The area treated shall be at least 3 m long, not less than 1 lane width and extend to the full depth. Before relaying the course, the disturbed subgrade or layer below shall be corrected by levelling, watering and compactd.

- vii) **Cement Concrete Pavement:** The defective areas having irregularity exceeding 3 mm but not greater than 6 mm when tested with a 3 metre long straight edge may be rectified by scrabbling or grinding using approved equipment. When required by the Engineer, areas which have been reduced in level by the above operation(s) shall be retextured in an approved manner either by cutting grooves (5 mm deep) or roughening the surface by hacking the surface. If high areas in excess 6 mm or low areas in excess of 3 mm occur, exceeding the permitted numbers and if the Contractor cannot rectify, the slab shall be demolished and reconstructed at the Contractor's expense and in no case the area removed shall be less than the full width of the lane in which the irregularity occurs and full length of the slab.

If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerances shall be demolished and reconstructed at the Contractor's cost.

902.6 Riding Quality

The riding quality of bituminous concrete wearing surface, as measured by a standard towed fifth wheel bump integrator, shall not be more than 2000 mm per Km.

903 QUALITY CONTROL TESTS DURING CONSTRUCTION

903.1 General

The materials supplied and the works carried out by the Contractor shall conform to the specifications prescribed in the Clauses for the relevant items of work.

For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described hereinafter. The testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to carry out additional tests as frequently as he may deem necessary, to satisfy himself that the materials and works comply with the appropriate specifications. However, the number of tests recommended in Tables 900-3 and 900-4 may be reduced at the discretion of the Engineer if it is felt that consistency in the quality of materials can still be maintained with the reduced number of tests.

Test procedures for the various quality control tests are indicated in the respective Sections of these Specifications or for certain tests within this Section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer.

**Table 900-3 : Control Tests and their Minimum Frequency for Sub-Bases and Bases
(Excluding Bitumen Bound Bases)**

S. No.	Type of Construction	Test	Frequency (min.)
1)	Granular	i) Gradation ii) Atterberg limits iii) Moisture content prior to compaction iv) Density of compacted layer v) Deleterious constituents vi) CBR	One test per 400 cu.m One test per 400 cu.m One test per 400 cu.m One test per 1000 sq.m As required As required
2)	Lime/Cement Stabilised Soil Sub-base	i) Quality of lime/ cement ii) Lime/Cement content iii) Degree of pulverization iv) CBR or Unconfined Compressive Strength test on a set of 3 specimens v) Moisture content prior to compaction vi) Density of compacted layer vii) Deleterious constituents	One test for each consignment subject to a minimum of one test per 5 tonnes Regularly, through procedural checks Periodically as considered necessary As required One set of two tests per 500 sq.m One set of two tests per 500 sq.m As required
3)	Water Bound Macadam	i) Aggregate Impact Value ii) Grading of aggregate iii) Combined Flakiness and Elongation Indices iv) Atterberg limits of binding material v) Atterberg limits of screenings	One test per 1000 cu.m of aggregate One test per 250 cu.m One test per 500 cu.m of aggregate One test per 50 cu.m of binding material One test per 100 cu.m of aggregate
4)	Wet Mix Macadam	i) Aggregate Impact Value ii) Grading of aggregate iii) Combined Flakiness and Elongation Indices iv) Atterberg limits of portion of aggregate passing 425 micron sieve v) Density of compacted layer	One test per 1000 cu.m of aggregate One test per 200 cu.m of aggregate One test per 500 cu.m of aggregate One test per 200 cu.m of aggregate One set of three tests per 1000 sq.m

Table 900-4 : Control Tests for Bituminous Works and their Minimum Frequency

S. No.	Type of Construction	Test	Frequency (min.)
1)	Prime Coat/Tack Coat/Fog Spray	i) Quality of binder ii) Binder temperature for application iii) Rate of spread of Binder	Number of samples per lot and tests as per IS:73, IS:217 and IS:8887 as applicable At regular close intervals Three tests per day
2)	Seal Coat/Surface Dressing	i) Quality of Binder ii) Aggregate Impact Value or Los Angeles Abrasion Value iii) Combined Flakiness and Elongation Indices iv) Stripping value of aggregates (Immersion Tray Test) v) Water absorption of aggregate vi) Water sensitivity of mix vii) Grading of aggregate viii) Soundness (Magnesium Sulphate/ Sodium Sulphate) ix) Polished stone value (not applicable for SAM/SAMI) x) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction xi) Rate of spread of materials (xii) Percentage of fractured faces (When gravel is used)	Same as mentioned under Serial No. 1 One test per 200 cu.m of each source and whenever there is change in the quality of aggregate One test per 100 cu.m of aggregate for each source and whenever there is change in the quality of aggregate One test of each source and whenever there is change in the quality of aggregate -do- -do- Two tests per day One test for each source and whenever there is change in the quality of aggregate -do- At regular intervals Same as mentioned under Serial No. 1 One test per 100 cu.m of aggregate
3)	Open-graded Premix Surfacing/Close-graded Premix Surfacing	i) Quality of binder ii) Aggregate Impact Value or Los Angeles Abrasion Value iii) Combined Flakiness and Elongation Indices iv) Stripping value v) Water absorption of aggregates vi) Water Sensitivity of mix vii) Grading of aggregates	Same as mentioned under Serial No. 1 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2

S. No.	Type of Construction	Test	Frequency (min.)
		viii) Soundness(Magnesium Sulphate and Sodium Sulphate) ix) Polished stone value x) Temperature of binder at application xi) Binder content xii) Percentage of fractured faces	Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 At regular interval Two tests per day per plant Same as mentioned under Serial No. 2
4)	Bituminous Macadam	i) Quality of binder ii) Aggregate Impact Value or Los Angeles Abrasion Value iii) Combined Flakiness and Elongation Indices iv) Stripping value v) Water absorption of aggregates vi) Water Sensitivity of mix vii) Grading of aggregates viii) Soundness (Magnesium Sulphate/ Sodium Sulphate) ix) Percentage of fractured faces x) Binder content xi) Control of temperature of binder and aggregate for mix and of the mix at the time of laying and rolling xii) Density of Comp layer xiii) Rate of spread of Mixed Material	Same as mentioned under Serial No. 1 Same as mentioned under Serial No. 2 One test per 350 cu.m for each source Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 2 Same as mentioned under Serial No. 3 Same as mentioned under Serial No. 2 One test per 700 sq.m area At regular intervals
5)	Dense Bituminous Macadam/Bituminous Concrete	i) Quality of binder ii) Aggregate Impact Value/ Los Angeles Abrasion Value iii) Flakiness and Elongation Indices iv) Soundness test (Sodium or Magnesium Sulphate test) v) Water absorption of aggregates	Number of samples per lot and tests as per IS:73 or IRC:SP:53, IS:15462 One test per 350 cu.m of aggregate for each source and whenever there is change in the quality of aggregate One test per 350 cu.m of aggregate for each source and whenever there is change in the quality of aggregate One test for each source and whenever there is change in the quality of aggregate One test for each source and whenever there is change in the quality of aggregate

S. No.	Type of Construction	Test	Frequency (min.)
		vi) Sand equivalent test	One test for each source and whenever there is change in the quality of aggregate
		vii) Plasticity Index	One test for each source and whenever there is change in the quality of aggregate
		viii) Polished stone value	One test for each source and whenever there is change in the quality of aggregate
		ix) Percentage of fractured face	One test per 350 cu.m of aggregate when crushed gravel is used
		x) Mix grading	One set for individual constituent and mixed aggregate from dryer for each 400 tonnes of mix subject to minimum of two tests per day per plant
		xi) Stability and voids analysis of mix including theoretical maximum specific of loose mix	Three tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant
		xii) Moisture Susceptibility of mix (AASHTO T283)	One test for each mix type whenever there is change in the quality or source of coarse or fine aggregate
		xiii) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	At regular intervals
		xiv) Binder content	One set for each 400 tonnes of mix subject to minimum of two tests per day per plant
		xv) Rate of spread of mix material	After every 5 th truck load
		xvi) Density of Compacted layer	One test per 700 sq.m area
6)	Sand Asphalt Base course	i) Quality of binder	Same as mentioned under Serial No. 2
		ii) Aggregate Impact Value or Los Angeles Abrasion Value	Same as mentioned under Serial No. 2
		iii) Sand equivalent test	Same as mentioned under Serial No. 2
		iv) Plasticity Index	Same as mentioned under Serial No. 5
		v) Mix grading & binder content	Same as mentioned under Serial Nos. 2 and 3
		vi) Stability of Mix	Same as mentioned under Serial No. 5
		vii) Control of temperature of binder in boiler, aggregate in the dryer and mix at the time of laying and rolling	Same as mentioned under Serial No. 2
		viii) Thickness of layer	Same as mentioned under Serial No. 5
		ix) Density of Compacted layer	Same as mentioned under Serial No. 5

S. No.	Type of Construction	Test	Frequency (min.)
7)	Slurry seal and Micro surfacing	i) Quality of Aggregate Sand Equivalent Value Water Absorption Soundness Test (Sodium/ Magnesium Sulphate Test) ii) Quality of Emulsion iii) Aggregate Moisture iv) Aggregate Gradation v) Binder Content vi) Calibration of Machine vii) Quantity of Slurry (By weight of aggregate)	One per source/ site One per lot of 20 t as per IS:8887 Two per day Two per day at site Two per lane per Km Once per Project Daily (Travel time of Machine)
8)	Stone Matrix Asphalt	i) Quality of binder ii) Aggregate Impact Value/ Los Angeles Abrasion Value iii) Flakiness and Elongation Indices iv) Soundness Test (Sodium and Magnesium Sulphate Test) v) Water absorption of aggregate vi) Sand equivalent test vii) Plasticity Index viii) Polished stone value ix) Percent of fractured faces x) Mix grading xi) Air voids and VMA analysis of mix including theoretical maximum specific gravity of loose mix xii) Moisture Susceptibility of mix (AASHTO T 283) xiii) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	Number of samples per lot and tests as per IS:73 or IRC:SP:53, IS:15462 One test per 100 cu.m of aggregate One test per 100 cu.m of aggregate One test for each method for each source and whenever there is change in the quality of aggregate One test for each source and whenever there is change in the quality of aggregate One test for each source One test for each source One test for each source One test per 50 cu.m of aggregate when crushed gravel is used One set for individual constituent and mixed aggregate from dryer for each 400 tonnes of mix subject to minimum of two tests per day per plant Three tests per day One test for each mix type whenever there is change in the quality or source of coarse or fine aggregate At regular intervals

S. No.	Type of Construction	Test	Frequency (min.)
		(xiv) Binder content	One set for each 400 tonnes of mix subject to minimum of two tests per day per plant
		(xv) Rate of spread of mix material	After every 5 th truck load
		(xvi) Density of compacted layer	One test per 250 sq.m area
9)	Mastic asphalt	i) Quality of binder	Same as mentioned under Serial No. 5
		ii) Aggregate Impact Value and Los Angeles Abrasion Value	Same as mentioned under Serial No. 5
		iii) Combined Flakiness and Elongation Indices	Same as mentioned under Serial No. 5
		iv) Stripping value	Same as mentioned under Serial No. 2
		v) Water Sensitivity of mix	Same as mentioned under Serial No. 5
		vi) Grading of aggregates	Two tests per day per plant on the individual constituent and mixed aggregates from the dryer
		vii) Water absorption of aggregates	Same as mentioned under Serial No. 5
		viii) Soundness (Magnesium Sulphate/ Sodium Sulphate)	Same as mentioned under Serial No. 5
		ix) Percentage of fractured faces	Same as mentioned under Serial No. 5
		x) Binder content and aggregate grading	Same as mentioned under Serial No. 3
		xi) Control of temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	At regular close intervals
		xii) Rate of Spread of Mixed Material	Regular control through check of layer thickness
		xiii) Hardness number	Minimum two tests per day
10)	Recycled Material Grading of aggregate		Two tests per day
11)	Cold Mixes		All tests as per S. No.5
12)	Quality of Modified Binder		Number of samples per lot and tests as per IS:15462.
13)	Geotextiles		The requirements of Section 700 shall apply

Note : Daily, weekly, monthly reports on test results shall be prepared indicating the location of sampling and testing, deviation from the specified values for materials and works and remedial action taken in respect of removal of defective work shall certified be prepared by the Contractor. The test record shall be certified by the Engineer that these tests were done in his presence and testing carried as per prescribed methodology.

903.2 Tests on Earthwork for Embankment, Subgrade Construction and Cut Formation

903.2.1 Borrow Material

Grid the borrow area at 25 m c/c (or closer, if the variability is high) to full depth of proposed working. These pits should be logged and plotted for proper identification of suitable sources of material. The following tests on representative samples shall be carried out for every 3000 cum for each source:

- a) Sand Content [IS:2720 (Part-4)]: 2 tests per 3000 cu.m of soil.
- b) Plasticity Test [IS:2720 (Part-5)]: Each type to be tested, 2 tests.
- c) Density Test [IS:2720 (Part-8)]: Each soil type to be tested, 2 tests.
- d) Deleterious Content Test [IS:2720 (Part-27)]: As and when required by the Engineer.
- e) Moisture Content Test [IS:2720 (Part-2)]: Two tests.
- f) CBR Test on materials to be incorporated in the subgrade on soaked/ unsoaked samples [IS:2720 (Part-16)] : One CBR test (average of three specimens) or closer as and when required by the Engineer.

903.2.2 Compaction Control

Control shall be exercised on each layer by taking at least one set of ten measurements of density for each 3000 sq.m of compacted area, or closer as required to yield the minimum number tests results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS: 2720 (Part-28). Test locations shall be chosen only through random sampling techniques. If non-destructive tests are carried out, the number of tests shall be doubled. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased. The acceptance criteria shall be subject to the condition that the mean density is not less than the specified density plus:

$$\left[1.65 - \frac{1.65}{(\text{No. of samples})^{0.5}} \right] \text{ times the standard deviation}$$

However, for earthwork in shoulders (earthen) and in the subgrade, at least one set of ten density measurements shall be taken for every 2000 sq.m for the compacted area. In other respects, the control shall be similar to that described earlier.

903.2.3 Cut Formation

Tests for the density requirements of cut formation shall be carried out in accordance with Clause 903.2.2.

903.3 Tests on Sub-bases and Bases (Excluding Bitumen Bound Bases)

The tests and their frequencies for the different types of bases and sub-bases shall be given in Table 900-3. The evaluation of density results and acceptance criteria for compaction control shall be on lines similar to those set out in Clause 903.2.2.

903.3.1 Acceptance Criteria

the acceptance criteria for tests on the strength of cement/lime stabilized soil and distribution of stabilizer content shall be subject to the condition that the mean value is not less than the specified value plus:

$$\left[1.65 - \frac{1.65}{(\text{No. of samples})^{0.5}} \right] \text{ times the standard deviation}$$

903.4 Tests on Bituminous Construction**903.4.1 Tests and Frequency**

The tests and their minimum frequencies for the different types of bituminous works shall be as given in Table 900-4. The Engineer may direct additional testing as required.

903.4.2 Acceptance Criteria

The acceptance criteria for tests on density shall be subject to the condition that the mean value is not less than the specified value plus:

$$\left[1.65 - \frac{1.65}{(\text{No. of samples})^{0.5}} \right] \text{ times the standard deviation}$$

903.4.3 Where the Contract specifies the surface roughness requirements, in terms of Bump Integrator value, the surface roughness shall be measured by a calibrated Bump Integrator as per the procedure described in IRC:SP:16. The measurements shall be taken at centre line of each lane for a minimum completed length of one Km.

903.5 Quality Control Tests for Concrete Road Construction**903.5.1 Dry Lean Concrete Sub-base****903.5.1.1 Sampling and Testing of Cubes**

Samples of dry lean concrete for making cubes shall be taken from the uncompacted material from different locations immediately before compaction at the rate of 3 samples for each 1000 sq.m or part thereof laid each day. The sampling of mix shall be done from the paving site.

Test cubes of 150 mm size shall be made immediately from each mix sample.

Cubes shall be made in accordance with the methods described in IS:516 except that the cubes shall be compacted by means of a vibratory hammer with the moulds placed on a level and rigid base. The vibrating hammer shall be electric or pneumatic type fitted with a square or rectangular foot having an area of between 7500 to 14000 sq.mm. The compaction shall be uniformly applied for 60 ± 5 seconds with a downward force of between 300 N and 400 N on to each of the three layers of the lean concrete material placed into the mould. The surface of each compacted layer shall be scarified before the next layer is added to give key for the next layer. The final layer shall be finished flush with the top of the cube mould.

The dry lean concrete shall be cured in accordance with IS:516.

903.5.1.2 In-situ Density

The dry density of the laid material shall be determined from three density holes at locations equally spaced along a diagonal that bisects each 2000 sq.m or part thereof laid each day and shall comply with the requirements as per Clause 601.6.5.1. This rate of testing may be increased at the discretion of the Engineer in case of doubt or to determine the extent of defective area in the event of non-compliance. Density holes at random may be made to check the density at edges.

903.5.1.3 Thickness

The average thickness of the subbase layer as computed by the level data of sub-base and subgrade or lower sub-base shall be as per the thickness specified in the contract drawings. The thickness at any single location shall not be 8 mm less than the specified thickness. Such areas shall be corrected as stated in Clause 601.6.5.5. Areas which cannot be repaired should be replaced over full width. The extent of deficient area should be decided based on cores.

903.5.1.4 Frequency of Quality Control Tests

The frequency of quality control tests for levels, alignment and materials shall be as given in Table 900-6.

903.5.2 Pavement Concrete

903.5.2.1 Sampling and Testing of Beam and Cube Specimens

At least three beams and three cube specimens, one set of three each for 7 day and 28 day strength tests shall be cast for every 150 cu.m (or part thereof) of concrete placed during construction. On each day's work, not less than three pairs of beams and cubes

shall be made for each type of mix from the concrete delivered to the paving plant. Each pair shall be from a different delivery of concrete and tested at a place to be designated by the Engineer in accordance with the testing procedure as outlined in Clause 602.3.3. Groups of four consecutive results from single specimens tested at 28 days shall be used for assessing the strength for compliance with the strength requirements. The specimens shall be transported in an approved manner to prevent sudden impact causing fractures or damage to the specimen. The flexural strength test results shall prevail over compressive strength tests for compliance.

903.5.2.2 A quality control chart indicating the strength values of individual specimens shall be maintained for continuous quality assurance. Where the requirements are not met with, or where the quality of the concrete or its compaction is suspect, the actual strength of the concrete in the slab shall be ascertained by carrying out tests on cores cut at the rate of 2 cores for every 150 cu.m of concrete. The average of the results of crushing strength tests on these cores shall not be less than 0.8 x 0.85 times the corresponding characteristic compressive strength of cubes, where the height to diameter ratio of the cores is two. Where height to diameter ratio is not two, necessary corrections shall be made in calculating the crushing strength of cubes in the following manner.

The crushing strengths of cylinders with height to diameter ratios between 1 and 2 may be corrected to correspond to a standard cylinder of height to diameter ratio of 2 by multiplying with the correction factor obtained from the following equation:

$$f = 0.11 n + 0.78$$

where f = correction factor and
 n = height to diameter ratio

The corrected test results shall be analysed for conformity with the specification requirements for cube samples. Where the core tests are satisfactory, they shall have precedence for assessing concrete quality over the results of moulded specimens. The diameter of cores shall not be less than 150 mm.

If, however, the tests on cores also confirm that the concrete is not satisfying the strength requirements, then the concrete corresponding to the area from which the cores were cut should be replaced, i.e., at least over an area extending between two transverse joints where the defects could be isolated or over larger area, if necessary, as assessed by additional cores and their test results. The equivalent flexural strength at 28 days shall be estimated in accordance with Clause 602.3.3.2.

In order to ensure that the specified minimum strength at 28 days is attained in 1 in 20 of all test beams, the mix shall be proportioned to give an average strength at 28 days exceeding the specified strength by 1.65 times the standard deviation calculated first from the flexural strengths of test beams made from the trial mix and subsequently from the accumulating result of flexural strengths of job control test beams.

The standard deviation shall be re-calculated from the test results obtained after any change in the source or quality of materials and the mix shall be adjusted as necessary to comply with the requirements.

An individual 28 day test strength below the specified strength shall not be evidence for condemnation of the concrete concerned if the average 28 day strength of this beam plus the preceding 5 and succeeding 4 beams exceeds the specified strength by 1.65 times the standard deviation and provided that there is no other evidence that the concrete mix concerned is substandard.

Beams shall be made each day in pairs at intervals, each pair being from a different batch of concrete. At the start of the work, and until such time as the Engineer may order a reduction in the number of beams required, at least six pairs of beams and cubes shall be made each day, one of each pair for testing at 28 days for determination of minimum permissible flexural strength and the other for testing at an early age for the Engineer to assess the quality of the mix. When the first thirty number of 28-day results are available, and for so long as the Engineer is satisfied with the quality of the mix, he may reduce the number of beams and cubes required.

During the course of construction, when the source of any material is to be changed, or if there is any variation in the quality of the materials furnished, additional tests and necessary adjustments in the mix shall be made as required to obtain the specified strength.

The flexural strengths obtained on beams tested before 28 days shall be used in conjunction with a correlation between them and the 28 day flexural strengths to detect any deterioration in the quality of the concrete being produced. Any such deterioration shall be remedied without awaiting the 28 day strengths but the earlier strengths shall not constitute sole evidence of non-compliance of the concrete from which they were taken.

Concrete shall be deemed not to comply with the Specification when more than one test beam in a batch has a 28 day strength less than the specified strength and the average 28 day flexural strength of the batch of beams is less than the specified strength plus 1.65 times the standard deviation of the batch.

Should the concrete fail to comply with the Specification for strength as described above, the Contractor may, all at his own expense, elect to cut cores from the suspect concrete as the Engineer shall direct. From the relation between cube strength and flexural strength, the core strength shall be converted to flexural strength.

The equivalent flexural strength at 28 days shall be the estimated in-situ strength multiplied by 100 and divided by the age-strength relation obtained from Table 900-5.

Any concrete that fails to meet the strength specification shall be removed and replaced at Contractor's expense.

Table 900-5 : Age-Strength Relation of Concrete (Related to 100 percent at 28 Days)

Days	0	2	4	6	8
0	—	41.0	60.0	71.0	77.5
10	81.5	85.0	87.5	90.0	92.0
20	94.0	96.0	97.5	98.5	100.0
30	101.0	102.0	103.5	104.5	105.5
40	106.5	107.0	108.0	109.5	110.0
50	110.5	111.0	112.0	112.5	113.0
60	114.0	114.5	115.0	115.5	116.0
70	116.5	117.0	117.5	118.0	118.5
80	119.0	119.5	119.5	120.0	120.5
90	121.0	121.5	122.0	122.0	122.5
100	123.5	123.5	123.5	124.0	124.5
110	125.0	125.0	125.5	125.5	126.0
120	126.0	126.0	127.0	127.0	127.5
130	127.5	128.0	128.5	128.5	129.0
140	129.0	129.5	129.5	130.0	130.0
150	130.5	130.5	131.0	131.0	131.5
160	131.5	131.5	132.0	132.0	132.5
170	132.5	132.5	133.0	133.0	133.5
180	133.5	134.0	134.0	134.5	134.5
190	135.0	135.0	135.0	135.5	135.5
200	135.5	135.5	136.0	136.0	136.5
210	136.5	136.5	137.0	137.0	137.0
220	137.0	137.5	137.5	137.5	138.0
230	138.0	138.5	138.5	138.5	138.5
240	139.0	139.0	139.0	139.5	139.5
250	139.5	140.0	140.0	140.0	140.0
260	140.5	140.5	140.5	140.5	141.0
270	141.0	141.0	141.5	141.5	141.5
280	142.0	142.0	142.0	142.0	142.0
290	142.5	142.5	142.5	142.5	142.5
300	143.0	143.0	143.0	143.0	143.5

Days	0	2	4	6	8
310	143.5	143.5	144.0	144.0	144.0
320	144.0	144.5	144.5	144.5	144.5
330	144.5	145.0	145.0	145.0	145.0
340	145.0	145.5	145.5	145.5	145.5
350	146.0	146.0	146.0	146.0	146.0
360	146.0	146.0	146.5	146.5	146.5

903.5.2.3 In-situ Density

The density of the compacted concrete shall be such that the total air voids are not more than 3 percent. The air voids shall be derived from the difference between the theoretical maximum dry density of the concrete calculated from the specific gravity of the constituents of the concrete mix and the average value of three direct density measurements made on cores at least 150 mm diameter. Three cores shall be taken from trial lengths and in first two km length of the pavement, while the slab is being constructed during normal working. The proportions of the mix and the vibratory effort imparted i.e. the frequency and magnitude of vibration shall be adjusted to achieve the maximum density.

All cores taken for density measurement in the trial section shall also be checked for thickness. The same cores shall be made use of for determining in-situ strength. In case of doubt, additional cores may be ordered by the Engineer and taken at locations decided by him to check the density of concrete slab or the position of dowel/tie bars without any compensation being paid for the same.

In calculation of the density, allowance shall be made for any steel in cores.

Cores removed from the main carriageway shall be reinstated with compacted concrete with mix proportions of 1 part of Portland cement : 2 parts of fine aggregate:2 parts of 10 mm nominal size single sized coarse aggregate by weight. Before filling the fine mix, the sides shall be hacked and cleaned with water. Thereafter cement-sand slurry shall be applied to the sides just prior to filling the concrete mix.

903.5.2.4 Thickness

Thickness shall be controlled by taking levels as indicated in Clause 902.3. Thickness of the slab at any point checked as mentioned above shall be within a tolerance of -5 mm to + 10 mm of the specified thickness as per Drawing. Thickness deficiency more than 5 mm may be accepted and paid for at a reduced rate given in Clause 602.16.3. In no case, however, thickness deficiency shall be more than 10 mm.

903.5.2.5 Summary of Control Tests

Table 900-6 gives a summary of frequency of testing of pavement concrete.

Table 900-6 : Frequency of Quality Control Tests for Pavement Concrete

1) Levels, alignment and texture			
i) Level tolerance		Clause 902.3	
ii) Width of pavement and position of paving edges		Clause 902.2	
iii) Pavement thickness		Clause 902.3 and 903.5.2.4	
iv) Alignment of joints, widths, depth of dowel grooves		To be checked @ one joint per 400 m length or a day's work	
v) Surface regularity both transversely and longitudinally		Once a day or one day's work without disturbing the curing	
vi) Alignment of dowel bars and their accuracy/tie bars		To be checked in trial length as per Clause 602.6.5.2 and once on every 2 km.	
vii) Texture depth		Clause 602.12	
2) Quality of materials and concrete shall be as under :			
1) Cement Physical and chemical Tests		IS:269 IS:455 IS:1489 IS:8112 IS:12269	Once for each source of supply and occasionally when called for in case of long/improper storage. Besides, the Contractor also will submit daily test data on cement released by the manufacturer
2) Coarse and Fine Aggregates	i) Gradation	IS:2386	One test for every day's work of each fraction of coarse aggregate and fine aggregate, initially; (may be relaxed later at the discretion of the Engineer)
	ii) Deleterious constituents	IS:2386 (Pt. 2)	-do-
	iii) Water absorption	IS:2386 (Pt. 3)	Regularly as required subject to a minimum of one test a day for coarse aggregate and two tests a day for fine aggregate. This data shall be used for correcting the water demand of the mix on a daily basis.
3) Coarse Aggregate	i) Los Angeles Abrasion value or Aggregate Impact test	IS:2386 (Pt. 4)	Once for each source of supply and subsequently on monthly basis.
	ii) Soundness	IS:2386 (Pt. 5)	Before approving the aggregates and every month subsequently.
	iii) Alkali aggregate reactivity	IS:2386 (Pt. 7) IS:456	-do-

4) Water	Chemical Tests	IS:2386	Once for approval of source of supply, subsequently only in case of doubt.
5) Concrete	i) Strength of concrete	IS:516	2 cubes and 2 beams per 150 cu.m or part thereof (one for 7 day and other for 28 day strength) or minimum 6 cubes and 6 beams per day's work whichever is more.
	ii) Core strength on hardened concrete	IS:516	As per the requirement of the Engineer, only in case of doubt.
	iii) Workability of fresh concrete- Slump Test	IS:1199	One test per each dumper load at both Batching plant site and paving site initially when work starts. Subsequently sampling may be done from alternate dumper.
	iv) Thickness determination		From the level data of concrete pavement surface and sub-base at grid points of 5/6.25 m x 3.5 m
	v) Thickness measurement for trial length		3 cores per trial length
	vi) Verification of level of string line in the case of slip form paving and steel forms in the case of fixed form paving		String line or steel forms shall be checked for level at an interval of 5.0 m or 6.25 m. The level tolerance allowed shall be ± 2 mm. These shall be got approved 1-2 hours before the commencement of the concreting activity.

1000

**MATERIALS FOR
STRUCTURES**

1001 GENERAL

Materials to be used in the work shall conform to the specifications mentioned on the drawings, the requirements laid down in this section and specifications for relevant items of work.

If any material, not covered in these Specifications, is required to be used in the work, it shall conform to relevant Indian Standards, if there are any, or to the requirements specified by the Engineer.

1002 SOURCES OF MATERIALS

The Contractor shall identify the sources of materials like coarse aggregate and fine aggregate and notify the Engineer regarding the proposed sources prior to delivery.

Samples of materials from the source shall be tested in the presence of Engineer for conformity to specifications. It shall also be ensured that the variation in test results of different samples, is within acceptable limits.

For manufactured items like cement, steel reinforcement and pre-stressing strands, the contractor shall intimate the Engineer the details of the source, testing facilities available with the manufacturer and arrangements for transport and storage of material at site. If directed by the Engineer, the contractor shall furnish samples and test results of recently received material. The Engineer, at his discretion, in case of doubt, may require the contractor to test the materials in an independent laboratory approved by the Engineer and furnish test certificates. The cost of these tests shall be borne by the contractor. The sampling and testing procedures shall be as laid down in the relevant Indian Standards and where they are not available, the same shall be carried out as per the directions of the Engineer. Only materials from sources approved by the Engineer shall be brought to the site. If the material from the approved source proves unacceptable at any time, the contractor shall identify new sources of acceptable materials conforming to specifications.

If any proprietary items are proposed to be used in the works, they shall be governed by the provisions of Clause 115.4 of these Specifications.

1003 BRICKS

Burnt clay bricks shall conform to the requirements of IS:1077, except that the minimum compressive strength when tested flat, shall not be less than 8.4 MPa for individual bricks and mean strength not less than 10.5 MPa for a group of 5 specimens. They shall be free from cracks and flaws and nodules of free lime. The brick shall have smooth rectangular faces with sharp corners and emit a clear ringing sound when struck. The size may be according to local practice with a tolerance of ± 5 percent.

1004 STONES AND BLOCKS**1004.1 Stones**

Stones shall be of the type specified. They shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stones with round surface shall not be used.

The stones, when immersed in water for 24 hours, shall not absorb water of more than 5 percent of their dry weight when tested in accordance with IS:1124.

The length of stone shall not exceed three times its height and the width on the base shall not be greater than three-fourth of the thickness of the wall nor less than 150 mm.

1004.2 Blocks

Solid concrete blocks made of cement and suitable aggregates shall conform to relevant provisions of IS:2185 Part 1 in respect of dimension, mix, manufacturing, curing, drying and physical requirements. The minimum compressive strength of solid concrete blocks when tested as per IS:2185 Part 1 shall not be less than 10.5 MPa. Hollow light weight concrete blocks shall not be used in works.

The thickness of concrete block shall not be less than 200 mm and the width shall not be less than 200 mm. The density of concrete block shall not be less than 2.2 ton/cu.m.

1005 CAST IRON

Cast iron shall conform to IS:210. The grade number of the material shall not be less than 14.

1006 CEMENT

Cement to be used shall be any of the following types with the prior approval of the Engineer.

- a) Ordinary Portland cement, 33 Grade, conforming to IS:269.
- b) Ordinary Portland cement, 43 Grade, conforming to IS:8112.
- c) Ordinary Portland cement, 53 Grade, conforming to IS:12269.
- d) Sulphate resisting Portland cement, conforming to IS:12330.
- e) Portland Pozzolana cement (fly ash based) conforming to IS:1489 (Part 1)

- f) Portland slag cement conforming to IS:455
- g) Rapid Hardening Portland cement, conforming to IS:8041.
- h) Low heat Portland cement conforming to IS:12600

Cement of 33 grade conforming to IS:269 shall be used only after ensuring that the minimum required design strength can be achieved without exceeding the maximum permissible cement content of 450 Kg/cum of concrete (excluding any mineral admixture).

Cements of 43 and 53 grades conforming to IS:8112 and IS:12269 respectively may be used provided the minimum cement content mentioned elsewhere from durability considerations, is not reduced.

Sulphate resisting cement conforming to IS:12330 shall be used when sodium sulphate and magnesium sulphate are present in large enough concentration to be aggressive to concrete. The recommended threshold values as per IS:456 are: sulphate concentration in excess of 0.2 percent in surrounding soil or 300 ppm (0.03 percent) in ground water. Cement conforming to IS:12330 shall be carefully selected from strength considerations to ensure that the minimum required design strength can be achieved without exceeding the maximum permissible cement content of 450 kg/cum (excluding any mineral admixture).

Alternatively, Portland slag cement conforming to IS:455 with slag content more than 50 percent can be used instead of sulphate resisting cement when the sulphate content in the surrounding soil is less than 1 percent or the sulphate content in the ground water is less than 2500 ppm.

Cement conforming to IS:8041 shall be used only for precast concrete products after specific approval of the Engineer.

Total chloride content shall be 0.1 percent by mass of cement for the cement to be used in structures other than prestressed concrete structures and 0.05% by mass of cement in prestressed concrete structures. Also, total sulphur content calculated as sulphuric anhydride (SO_3) shall in no case exceed 3.5 percent.

Where chloride is encountered along with sulphates in soil or ground water, ordinary Portland cement with C_3A content from 5 to 8 percent shall be preferably used in concrete, instead of sulphate resisting cement.

Manufacturer's test certificate shall be submitted to the Engineer by the contractor for every consignment of cement. The certificate shall cover all the tests for chemical requirements, physical requirements and chloride content as per relevant codes as applicable.

Independent tests of samples drawn from the consignment, shall be carried out at the site laboratory or in an independent laboratory approved by the Engineer, immediately after

delivery. The following properties shall be tested:

- i) Compressive strength.
- ii) Setting time.

The cost of the tests shall be borne by the Contractor.

Cement in bags in local storage for more than 3 months after completion of tests, may be re-tested for compressive strength and setting times (initial and final) before use and may be rejected if it fails to conform to any of the requirements.

Lot size for independent testing of cement at site shall be the quantity received at site on any day, subject to a maximum of 500 tonnes.

1007 COARSE AGGREGATES

For plain and reinforced cement concrete (PCC and RCC) or prestressed concrete (PSC) works, coarse aggregates shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone, crushed gravel, natural gravel or a suitable combination thereof or other approved inert material. They shall not contain pieces of disintegrated stones, soft, flaky, elongated particles, salt, alkali, vegetable matter or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the steel reinforcement. Coarse aggregates having positive alkali-silica reaction shall not be used. All coarse aggregates shall conform to IS: 383 and tests for conformity shall be carried out as per IS:2386, Parts I to VIII.

The contractor shall submit for the approval of the Engineer, the entire information indicated in Appendix A of IS:383.

Maximum nominal size of coarse aggregate for various structural components in PCC, RCC or PSC, shall conform to Section 1700 of these Specifications.

The maximum value for flakiness index for coarse aggregate shall not exceed 35 percent. The coarse aggregate shall satisfy the requirements of grading as given in Table 1000-1:

Table 1000-1 : Grading Requirements of Coarse Aggregate

IS Sieve Size	Percentage Passing for Graded Aggregate of Nominal Size		
	40 mm	20 mm	12.5 mm
63 mm	—	—	—
40 mm	95 – 100	100	—
20 mm	30 – 70	95 – 100	100
12.5 mm	—	—	90 – 100
10 mm	10 – 35	25 – 55	40 – 85
4.75 mm	0 – 5	0 – 10	0 – 10

1008 FINE AGGREGATES

For masonry work, sand shall conform to the requirements of IS:2116.

Natural sand, crushed stone sand or crushed gravel sand or a suitable combination of natural sand, crushed stone or gravel, shall be used as fine aggregates in plain, reinforced and prestressed concrete works. The fine aggregates shall be dense, durable, clean and free from veins and adherent coating and other deleterious substances. They shall not contain dust, lumps, soft or flaky materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the embedded steel. Mechanised sand washing machines should be used to remove impurities from sand. Fine aggregates having positive alkali-silica reaction shall not be used. All fine aggregates shall conform to IS:383 and tests for conformity shall be carried out as per IS:2386, (Parts I to VIII). The Contractor shall submit to the Engineer the entire information indicated in Appendix A of IS:383. The fineness modulus of fine aggregate shall neither be less than 2.0 nor greater than 3.5.

Fine aggregate for structural concrete shall conform to the following grading requirements:

Table 1000-2 : Grading Requirements of Fine Aggregates

IS Sieve Size	Percent Passing for		
	Grading Zone I	Grading Zone II	Grading Zone III
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-30	12-40
150 micron	0-10	0-10	0-10

Note : When the grading falls outside the limits of any particular grading zone of sieves other than 600-micron IS Sieve by a total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. However for crushed stone sand, the permissible limit on 150-micron IS Sieve is increased to 20 percent. Reference shall be made to Clause: 4.3 of IS:383.

1009 STEEL**1009.1 Cast Steel**

The use of cast steel shall be limited to bearings and other similar parts. Steel for castings shall conform to Grade 280-520N of IS:1030. In case where subsequent welding is unavoidable

in the relevant cast steel components, the letter N at the end of the grade designation of the steel casting shall be replaced by letter W. To increase the corrosion resistance properties, 0.3% to 0.5% copper may be added.

1009.2 Steel for Prestressing

The prestressing steel shall conform to any one of the following standards:

- a) Plain hard drawn steel wire conforming to IS:1785 (Part I) and IS:1785 (Part II)
- b) Cold drawn indented wire conforming to IS:6003
- c) High tensile steel bar conforming to IS:2090
- d) Uncoated stress relieved strands conforming to IS:6006
- e) Uncoated stress relieved low relaxation seven ply strand conforming to IS:14268

Data in respect of modulus of elasticity, relaxation loss at 1000 hours, minimum ultimate tensile strength, stress strain curve etc. shall be obtained from the manufacturer. Pre-stressing steel shall be subjected to acceptance tests prior to actual use in the works.

1009.3 Reinforcement/Untensioned Steel

1009.3.1 Reinforcing Bars

For plain and reinforced cement concrete (PCC and RCC) or prestressed concrete (PSC) works, the reinforcement/untensioned steel as the case may be, shall consist of the following grades of reinforcing bars.

Table 1000-3 : Grades of Reinforcing Bars

Grade Designation	Bar Type Conforming to Governing Specifications	IS Characteristic Strength f_y MPa	Elastic Modulus GP
Fe240	IS:432 Part I Mild Steel	240	200
Fe 415	IS:1786 High Strength Deformed Steel Bars (HSD)	415	200
Fe 500 or Fe 500D	IS:1786 High Strength Deformed Steel Bars (HSD)	500	200
Fe 550 or Fe 550D	IS:1786 High Strength Deformed Steel Bars (HSD)	550	200
Fe 600	IS:1786 High Strength Deformed Steel Bars (HSD)	600	200

Note : If any grade of steel given in the above table is not available steel of next higher grade may be used.

All steel shall be procured from 'Original producers' who manufacture billets directly from iron ores and roll the billets to produce steel conforming to IS:1786. No re-rolled steel shall

be incorporated in the works. However, in case the original producers give certificate that they are unable to supply the steel within the required time period or that they are not producing bars of the required diameter, the Engineer may allow the procurement of steel from other suppliers, provided that the reinforcement is manufactured from billets procured from the original producers. In such cases, the manufacturer's certificate alone shall not be considered as sufficient and the steel shall be got tested by the Engineer in the NABL accredited laboratories only, as a third party check. It shall be ensured that all the test results conform to IS:1786 requirements.

Only new steel shall be delivered to the site. Every bar shall be inspected before assembling on the work and defective, brittle or burnt bars shall be discarded. Bars with cracked ends shall be discarded.

For the steel procured from original producers also, the Engineer / Employer may carry out occasional checks on materials through third party as mentioned above, for confirming the test results shown in the certificates, in case of any doubt regarding the quality of steel supplied.

1009.3.2 Coating of Reinforcing Bars

1009.3.2.1 Fusion Bonded Epoxy Coated Reinforcement

Fusion bonded epoxy coated reinforcement shall conform to IS:13620 or other international standards as approved by Engineer. The location of the source of supply of the coated bars shall be such as to ensure that the bars are not transported for a distance of more than 300 Km.

Additional requirements for the use of such reinforcement bars are given below:

- a) Patch up materials shall be procured in sealed containers with certificates from the agency who has supplied the fusion bonded epoxy bars.
- b) PVC coated G.I. binding wires of 18G shall only be used in conjunction with fusion bonded epoxy bars.
- c) Chairs for supporting the reinforcement shall also be of fusion bonded epoxy coated bars.
- d) The cut ends and damaged portions shall be touched up with repair patch up material.
- e) The bars shall be cut by saw-cutting and not by flame cutting.
- f) While bending the bars, the pins of work benches shall be provided with PVC or plastic sleeves.

- g) The coated steel shall not be directly exposed to sun rays or rains and shall be protected with opaque polyethylene sheets or such other approved materials.
- h) While concreting, the workmen or trolley shall not move directly on coated bars but shall move only on wooden planks placed on the bars.

1009.3.2.2 Hot Dipped Galvanized Bars

Hot dipped galvanized reinforcing steel shall be provided wherever specified. The coating shall conform to IS:12594–1988.

1009.4 Grey Iron Castings

Grey Iron castings to be used for bearings shall have the following minimum properties:

i) Minimum ultimate tensile strength	370 MPa
ii) Modulus of Elasticity	147000 MPa
iii) Brinell Hardness	230 MPa
iv) Shear Strength	370 MPa
v) Compressive Strength	1370 MPa

The testing shall be as specified in IS:210.

1009.5 Steel Forgings

Forged steel pins shall comply with clause 3, 3A or 4 of IS:1875 and steel forgings shall comply with clause 3, 3A or 4 of IS:2004. Raw materials of the forging shall be as per IS:1875 with minimum reduction ratio of 1.8:1. Alternatively, if forging is made from ingot, the minimum reduction ratio shall be 4:1. Forging shall be normalized.

1009.6 Structural Steel

Unless otherwise permitted, all structural steel shall, before fabrication, comply with the requirements of the following Indian Standards:

IS:226	:	Structural Steel (Standard Quality)
IS:961	:	Structural Steel (High Tensile)
IS:2062	:	Weldable Structural Steel
IS:8500	:	Weldable Structural Steel (medium and high strength qualities)

IS:1148	:	Hot rolled rivet bars (upto 40 mm dia) for structural purposes
IS:1149	:	High tensile rivet bars for structural purposes
IS:1161	:	Steel tubes for structural purposes
IS:4923	:	Hollow Steel sections for structural use
IS:11587	:	Structural weather resistant steel
IS:808	:	Specifications for Rolled Steel Beam, Channel and Angle Sections
IS:1239	:	Mild Steel Tubes
IS:1730	:	Dimension for Steel Plate, sheet and strip for structural and general Engineering purposes.
IS:1731	:	Dimension for Steel flats for structural and general engineering purposes
IS:1732	:	Dimension for round and square steel bars for structural and general engineering purposes.
IS:1852	:	Rolling and cutting tolerances for hot rolled steel products

The use of structural steel not covered by the above standards may be permitted with the specific approval of the Engineer. Refer to Section 1900 of these Specifications for further details.

1009.7 Stainless Steel

Stainless steel shall be austenitic chromium-nickel steel, possessing rust, acid and heat resistant properties conforming to IS:6603 and IS:6911. Mechanical properties/grade for such stainless steel shall be as specified by the accepting authority, but in no case inferior to mild steel. Generally, stainless steel is available as per AISI grades. AISI 304 which is equivalent to grade 04 Cr 18 Ni 110 of IS:6911 satisfies the requirements for mechanical properties of structural steel. Other grades of stainless steel for specific purposes may be provided as per specific requirements. For application in adverse/corrosive environment, stainless steel shall conform to AISI 316L or 02G17 Ni Mo2 of IS:6911.

1010 WATER

Water used for mixing and curing shall be clean and free from oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel.

In case of doubt regarding development of strength, the suitability of water proposed to be used for the production of concrete shall be ascertained by carrying out tests for the compressive strength of concrete and initial setting time of cement using the same water.

The sample of water taken for testing shall represent the water proposed to be used for concreting, taking into account seasonal variations, if any. The sample shall not receive any treatment before testing other than that being given to the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

Average 28 days compressive strength of at least three 150 mm concrete cubes prepared with water proposed to be used, shall not be less than 90 percent of the average strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with the requirements of IS:516.

The initial setting time of test block made with the appropriate cement and the water proposed to be used shall not be less than 30 minutes and shall not be more than 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of IS:4031 (Part 5).

pH value of water shall not be less than 6. Potable water is generally considered satisfactory for mixing concrete. Mixing and curing with sea water shall not be permitted.

As a guide, the following concentrations represent the maximum permissible values:

- a) To neutralize 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5 ml of 0.02 normal NaOH. For details of test refer IS:3025(Part 22).
- b) To neutralize 100 ml sample of water, using mixed indicator, it should not require more than 25 ml of 0.02 normal. H_2SO_4 . For details of test refer IS: 3025(Part 23).
- c) The Permissible limit's for solids shall be as follows

	Tested as Per	Permissible Limit max
Organic	IS:3025(Pt.18)	200 mg/lit
Inorganic	IS:3025(Pt.18)	3000 mg/lit
Sulphates (SO_3)	IS:3025(Pt.28)	400 mg/lit
Chlorides (Cl)	IS:3025(Pt.32)	2000 mg/lit for concrete work not containing embedded steel and 500 mg/lit for prestressed/reinforced concrete work
Suspended matter	IS:3025(Pt.17)	2000 mg/lit

All samples of water (including potable water) shall be tested and suitable measures taken, where necessary, to ensure conformity of the water to the requirements stated herein.

1011 TIMBER

The timber used for structural purposes shall conform to IS:883.

1012 CONCRETE ADMIXTURES**1012.1 General**

Admixtures may be added to the concrete before or during mixing with a view to modifying one or more of the properties of concrete in the plastic or hardened state.

1012.2 Mineral Admixtures

Any of the following mineral admixtures may be used as part replacement of Portland Cement with the approval of the Engineer.

Fly ash: conforming to of IS:3812-3

Granulated slag: Ground granulated slag obtained by grinding granulated slag conforming to IS:12089.

Silica fume: Silica fume is very fine, non- crystalline SiO_2 , obtained as a by-product of Silicon and Ferro – Silicon alloy industries and shall conform to IS:15388

1012.3 Chemical Admixtures**1012.3.1 Information Required from the Manufacturer**

Chemical admixtures are proprietary items of manufacture and shall be obtained only from established manufacturers with proven track record, quality assurance and full fledged laboratory facilities for the manufacture and testing of concrete.

The contractor shall provide the following information concerning each admixture, after obtaining the same from the manufacturer:

- a) Normal dosage and detrimental effects, if any, of under dosage and over dosage.
- b) The chemical names of the main ingredients.
- c) The chloride content, if any, expressed as a percentage by weight of the admixture.
- d) Values of dry material content, ash content and relative density which can be used for Uniformity Tests.

- e) Whether it leads to the entrainment of air when used as per the manufacturer's recommended dosage, and if so to what extent.
- f) Confirmation regarding its compatibility with type of cement.
- g) Whether it increases the risk of corrosion of reinforcement or other embedments.
- h) Whether it affects the durability of concrete adversely.

1012.3.2 Physical and Chemical Requirements

Admixtures shall conform to the requirements of IS:9103. In addition, the following conditions shall be satisfied.

- a) "Plasticisers" and "Super-Plasticisers" shall meet the requirements indicated for "Water reducing Admixture".
- b) Except where resistance to freezing and thawing and to disruptive action of deicing salts is required, the air content of freshly mixed concrete in accordance with the pressure method given in IS:1199, shall not be more than 2 percent higher than that of the corresponding control mix and in any case not more than 3 percent of the test mix.
- c) The chloride content of the admixtures shall not exceed 0.2 percent when tested in accordance with IS:6925. In addition, the maximum permissible limit of chloride content of all the constituents as indicated in Section 1700 of these Specifications shall also not be exceeded.
- d) Uniformity tests on the admixtures are essential to compare qualitatively the composition of different samples taken from batch to batch or from the same batch at different times.

The tests that shall be performed along with permissible variations are as follows:

- i) Dry Material Content : within 3 percent and 5 percent of liquid and solid
 - ii) Ash content : within 1 percent of the value stated by the manufacturer.
 - iii) Relative Density (for liquid admixtures) : within 2 percent of the value stated by the manufacturer.
- e) All tests relating to concrete admixtures shall be conducted periodically at an independent laboratory and the results compared with the data given by the manufacturer.

1013 REINFORCED AND PRESTRESSED CONCRETE PIPES

Reinforced concrete pipes for highway structures shall be of NP4 type conforming to the requirements of IS:458. Prestressed concrete pipes (NP4) conforming to IS: 784 can also be used depending on the requirement.

1014 STORAGE OF MATERIALS**1014.1 General**

All materials shall be stored at proper places so as to prevent their deterioration, intrusion of foreign matter and ensure their satisfactory quality and fitness for the work. The storage space must also permit easy inspection, removal and re-storage of the materials. All such materials, even though stored in approved godowns/places, must be subjected to acceptance test prior to their immediate use.

1014.2 Bricks

Bricks shall not be dumped at site, but shall be stacked in regular tiers as they are unloaded, to minimize breakage and defacement. Bricks selected for use in different situations shall be stacked separately. Sufficient supply of bricks as required for the works, shall be available at site at any time.

1014.3 Aggregates

Aggregate stockpiles may be made on ground that is hard, well drained and devoid of vegetation.

Coarse aggregates, unless otherwise agreed by the Engineer in writing, shall be delivered to the site in separate sizes (2 sizes when nominal size is 25 mm or less and 3 sizes when the nominal size is 32 mm or more). In case of aggregates placed directly on the ground the material in the stock pile only up to a level of 30 cm above the ground level shall be taken out and used initially. Remaining material shall be permitted to be used in the final stages of work only after it has been fully cleaned.

1014.4 Cement

Cement shall be transported, handled and stored on the site in such a manner as to avoid deterioration or contamination. Cement shall be stored above ground level in perfectly dry and water-tight sheds and shall be stacked to a height of not more than eight bags. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirement at site. The containers shall be cleaned at least once every 3 months.

Cement shall be used in the sequence in which it is delivered at site. Each consignment shall be stored separately so that it may be readily identified and inspected. Any consignment or part of a consignment of cement which has deteriorated in any way during storage, shall not be used in the works and shall be removed from the site by the Contractor at his own cost.

The Contractor shall prepare and maintain proper records at site in respect of delivery, handling, storage and use of cement and these records shall be available for inspection by the Engineer at all times.

The Contractor shall submit a monthly return to the Engineer showing the quantities of cement received and issued during the month and in stock at the end of the month.

1014.5 Reinforcement/Untensioned Steel

The reinforcement bars, shall be stored above the surface of the ground upon platforms, skids or other supports, and shall be protected from mechanical injury and from deterioration by exposure.

1014.6 Prestressing Materials

All prestressing steel, sheathing, anchorages and sleeves or couplers shall be protected during transportation, handling and storage. The prestressing steel, sheathing and other accessories shall be stored under cover from rain or damp ground and protected from the ambient atmosphere if it is likely to be aggressive. Period of storage at site must be kept to the absolute minimum.

- a) **Tendons** : Wires, strands and bars from which tendons are to be fabricated shall be stored about 300 mm above the ground in a suitably covered and closed space so as to avoid direct climatic influences and to protect them from splashes from any other materials and from the cutting operation of an oxy-acetylene torch or arc welding process in the vicinity. Under no circumstances shall tendon material be subjected to any welding operation or on site heat treatment or metallic coating such as galvanizing. Storage facilities and the procedures for transporting material into or out of the store, shall be such that the material does not become kinked or notched. Wires or strands shall be stored in large diameter coils which enable the tendons to be laid out straight. As a guide, for wires above 5 mm dia, coils of about 3 m dia without breaks or joints shall be obtained from manufacturer. Protective wrapping for tendons shall be chemically neutral. All prestressing steel must be provided with temporary protection during storage.
- b) **Anchorage Components** : The handling and storing procedures shall maintain the anchorage components in a condition in which they can

GROUP PERSONAL ACCIDENT POLICY ADDITION LIST AS ON 11/07/2013

Sr.No	ID Code	Name	Site	Salary	Joining Date	Designation	Birth Date	Risk Group	Table A	Table C
1	4268	Patel Piyushkumar Bipinbhai	Court Building, Vadodara	6500	04/06/2013	Office Assistant (HR & Adm	16/08/1988	1	234,000	156,000
2	4274	Gope Rajeshkumar Ramesh	Vasad Tarapur Road	4000	04/06/2013	Jr Engineer (Mech)	14/07/1991	1	144,000	96,000
3	4290	Khan Sali Leela	OPRC - PUNJAB	5500	05/06/2013	Office Boy	12/11/1989	1	198,000	132,000
4	4291	Vishwakarma Sudhakar Ramji	OPRC - PUNJAB	10000	05/06/2013	Jr Engineer (Mechanic)	10/07/1989	1	360,000	240,000
5	4296	Tarwar Jitendrasingh Madansingh	Jaipur-Tonk Deoli Site	5500	05/06/2013	Office Asst (HR & Admin)	01/07/1989	1	198,000	132,000
6	4297	Shankar Thapa Dhanbahadur	OPRC - PUNJAB	6000	05/06/2013	Cook	23/05/1992	1	216,000	144,000
7	4301	Rakesh S Sharma	Vasad Tarapur Road	6000	06/06/2013	Office Asst (Stores)	00/01/1900	1	216,000	144,000
8	4310	Vegada Chiman Arjunbhai	Dhasha Bhavnagar Road	6500	08/06/2013	Office Asst (Stores)	15/08/1984	1	234,000	156,000
9	4311	Simpul Shakarvar	Rajkot Bhavnagar Road	7500	08/06/2013	Jr Accountant	07/01/1989	1	270,000	180,000
10	4312	Varadonya Amit Babubhai	Vasad Tarapur Road	6500	10/06/2013	Jr Accountant (HR)	29/06/1990	1	234,000	156,000
11	4313	Shah Vishal Parshbhai	Vasad Tarapur Road	12500	10/06/2013	Accountant	07/11/1985	1	450,000	300,000
12	4314	Khengar Chudasama	Dhasha Bhavnagar Road	8000	10/06/2013	Supervisor (Civil)	16/01/1979	1	288,000	192,000
13	4316	Stavan Chandrakant Parmar	Anand Office	12000	10/06/2013	Executive (IT)	19/06/1989	1	432,000	288,000
14	4315	Patel Jigneshkumar Dineshbhai	Anand Office	20000	11/06/2013	Sr. Executive (IT)	12/11/1980	1	700,000	300,000
15	4318	Shalish D Parmar	OPRC - PUNJAB	8500	11/06/2013	Jr. Executive (Stores)	26/01/1979	1	306,000	204,000
16	4319	Darji Ketakumar Kanubhai	Jilla Seva Sadan at Anand	9000	12/06/2013	Supervisor (Civil)	02/05/1987	1	324,000	216,000
17	4321	Prem Prakashkumar Nageshwar Singh	OPRC - PUNJAB	20000	13/06/2013	Sr Executive (Stores)	15/06/1980	1	700,000	300,000
18	4322	Chokhada Yogesh Arvindbhai	Timba Quarry Site	6000	15/06/2013	Office Asst (Stores)	14/01/1991	1	216,000	144,000
19	4331	Vireet Kumar	OPRC - PUNJAB	49500	18/06/2013	Section Incharge	16/03/1982	1	700,000	300,000
20	4327	Pathan Firz Khan Mehboobkhan	Dhasha Bhavnagar Road	22500	19/06/2013	Engineer (Road)	06/09/1966	1	700,000	300,000
21	4388	Kalavadiya Ravi Devrajbhai	Head Office	5500	19/06/2013	Office Assisit (Accounts)	26/10/1992	1	198,000	132,000
22	4332	Santosh Kumar	OPRC - PUNJAB	12000	21/06/2013	Surveyor	18/01/1987	1	432,000	288,000
23	4333	Parshbhai Desai	PS OMT Maintenance, ADESA	5500	21/06/2013	Computer Operator	01/06/1989	1	132,000	88,000
24	4334	Vishwajeet Channalal Mevada	V. S Hospital at Ahmedabad	16500	21/06/2013	Jr Engineer (Bldg)	14/02/1989	1	594,000	396,000
25	4336	Girish Dhandukiya	Head Office	5000	21/06/2013	Office Asst (Accounts)	26/09/1991	1	180,000	120,000
26	4338	Ritesh Dobariya	Vasad Tarapur Road	13000	21/06/2013	Accountant	24/08/1984	1	468,000	312,000
27	4337	Piyush Mansukhbhai Cholaliya	Head Office	10000	21/06/2013	Jr Accountant	05/04/1985	1	360,000	240,000
28	4338	Padav Saiyendrakumar Sri	OPRC - PUNJAB	46500	22/06/2013	Section Incharge	05/02/1979	1	700,000	300,000
29	4342	Mishra Mohan Sri	OPRC - PUNJAB	7000	24/06/2013	Computer Operator	02/03/1989	1	252,000	168,000
30	4350	Parmar Virpalbhai Virbahadrabhai	Timba Quarry Site	4500	24/06/2013	Jr. Computer Operator	09/01/1990	1	162,000	108,000
31	4356	Sujash Chander Virpalsingh	OPRC - PUNJAB	16000	24/06/2013	Asst. Engineer (Planning &	10/10/1989	1	576,000	384,000
32	4360	Chaudry Saiyavan Ganesh	OPRC - PUNJAB	131000	24/06/2013	Project Manager	05/11/1969	1	700,000	300,000
33	4363	Kumar Roushan Ashok	OPRC - PUNJAB	10000	24/06/2013	Jr Supervisor (Civil)	15/07/1985	1	360,000	240,000
34	4366	Singh Pushparaj Balmik	OPRC - PUNJAB	5000	24/06/2013	Supervisor (Civil)	15/07/1993	1	180,000	120,000
35	4370	Sanjaykumar	OPRC - PUNJAB	52200	24/06/2013	Sr Engineer (QC)	01/02/1984	1	700,000	300,000
36	4375	Kumar Pankaj Santer	OPRC - PUNJAB	31500	24/06/2013	Engineer (Road)	09/11/1982	1	700,000	300,000
37	4376	Singh Jagdeep Jagdev	OPRC - PUNJAB	5000	25/06/2013	Supervisor (Civil)	10/05/1984	1	180,000	120,000
38	4377	Kumar Virendra Sri	OPRC - PUNJAB	5000	25/06/2013	Supervisor (Civil)	02/01/1974	1	180,000	120,000
39	4378	Singh Rajesh Gaya	OPRC - PUNJAB	5000	25/06/2013	Supervisor (Civil)	15/08/1980	1	180,000	120,000
40	4380	Srivastava Ranjeet Ramavtar	OPRC - PUNJAB	6000	26/06/2013	Supervisor (Civil)	02/12/1983	1	216,000	144,000
41	4391	Patidar Shobhararm Parmanand	OPRC - PUNJAB	29700	28/06/2013	Sr Engineer (QC)	12/08/1985	1	700,000	300,000
42	4392	Gurmeet Singh Chanan Singh	OPRC - PUNJAB	40000	28/06/2013	Sr Manager (Accounts)	10/10/1957	1	700,000	300,000
43	4393	Rethod Parsh A	M S Building Gandhinagar	14000	28/06/2013	Jr Engineer (Bldg)	21/11/1989	1	504,000	336,000
44	4394	Avtar singh Ram Singh	OPRC - PUNJAB	14000	28/06/2013	Jr Engineer (Auto cad)	04/11/1989	1	504,000	336,000

93	4305	Patel Surena Chhotial	Vasad Tarapur Road	4000	08/06/2013	Helper (Mechanic)	05/11/1994	2	144,000	96,000
94	4308	Tanwar Indarsingh Shitaisingh	Vasad Tarapur Road	5000	08/06/2013	Helper (Lab)	05/06/1993	2	180,000	120,000
95	4309	Nain Mohammad Julikar	Vasad Tarapur Road	5000	08/06/2013	Driver (L)	10/02/1985	2	180,000	120,000
96	4317	Dave Chetanbhai Chandubhai	Samakha Site	6500	11/06/2013	Driver (L)	12/12/1975	2	234,000	156,000
97	4323	Shah Chetanbhai Arvindbhai	Dhasha Bhavnagar Road	9500	17/06/2013	Driver (H)	19/08/1970	2	342,000	228,000
98	4324	Upendrakumar Mehta	Dhasha Bhavnagar Road	9500	17/06/2013	Driver (H)	30/04/1989	2	342,000	228,000
99	4325	Nageswar Mahit	Dhasha Bhavnagar Road	9500	17/06/2013	Driver (H)	01/01/1979	2	342,000	228,000
100	4326	Mehta Vijayprasad	Dhasha Bhavnagar Road	9500	17/06/2013	Driver (H)	15/11/1982	2	342,000	228,000
101	4328	Yadav Girijesh Gabbu	Vasad Tarapur Road	4000	18/06/2013	Helper	05/07/1994	2	144,000	96,000
102	4329	Pasavan Narendra Devnarayan	Vasad Tarapur Road	9500	18/06/2013	Driver (H)	23/10/1982	2	342,000	228,000
103	4330	Rampati Patel Paras Nath	Vasad Tarapur Road	9500	18/06/2013	Driver (H)	22/07/1977	2	342,000	228,000
104	4338	Ayar Vastibhai	PS OMT Maintenance, ADESA	5000	22/06/2013	Driver (L)	01/06/1983	2	180,000	120,000
105	4341	Mateswarprasad Jodhanpur	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	01/01/1947	2	342,000	228,000
106	4343	Patel Yagnikumar Arvindbhai	Samakha Plant	5000	24/06/2013	Helper (Tractor)	08/09/1989	2	180,000	120,000
107	4344	Singh Saroj Ramjee	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	16/02/1985	2	324,000	216,000
108	4345	Singh Manoj Ramjee	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	01/01/1980	2	342,000	228,000
109	4346	Yadav Virendrakumar Virju	Vasad Tarapur Road	9500	24/06/2013	Driver (H)	04/07/1986	2	342,000	228,000
110	4347	Pardey Raju Saheddayal	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	04/07/1986	2	342,000	228,000
111	4348	Thakor Vijay Kumar Kanubhai	Vasad Tarapur Road	4000	24/06/2013	Helper (Mech)	08/08/1990	2	144,000	96,000
112	4349	Dubey Vinayshankar Divakar	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	10/05/1986	2	324,000	216,000
113	4351	Dubey Rajkumar Aatmaram	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	10/02/1984	2	324,000	216,000
114	4352	Singh Rajendra Swaminath	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	06/04/1962	2	342,000	228,000
115	4353	Khawal Amarnath Simaram	OPRC - PUNJAB	5000	24/06/2013	Helper (Mech)	06/04/1992	2	180,000	120,000
116	4354	Singh Rajkumar Bhoja	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	01/01/1970	2	342,000	228,000
117	4355	Singh Pawankumar Atma	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	15/06/1988	2	324,000	216,000
118	4357	Singh Gurmeet Buta	OPRC - PUNJAB	8000	24/06/2013	Driver (H)	03/01/1980	2	288,000	192,000
119	4358	Singh Abhaypratap Khanit	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	01/07/1981	2	342,000	228,000
120	4359	Singh Balkrishna Bahadar	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	10/07/1979	2	324,000	216,000
121	4361	Singh Satendra Mohendra	OPRC - PUNJAB	8000	24/06/2013	Driver (L)	04/06/1972	2	288,000	192,000
122	4362	Yadav Mahendra Chanchal	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	02/01/1976	2	324,000	216,000
123	4364	Chandanji Jaiswal Vishwanath	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	04/08/1968	2	342,000	228,000
124	4365	Singh Mukesh Surendra	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	10/11/1986	2	324,000	216,000
125	4367	Singh Jasbir Kashmir	OPRC - PUNJAB	9000	24/06/2013	Driver (H)	18/07/1986	2	324,000	216,000
126	4368	Singh Jasbir Kashmir	OPRC - PUNJAB	10000	24/06/2013	Operator (Excavator)	24/08/1986	2	360,000	240,000
127	4369	Singh Surender Tehal	OPRC - PUNJAB	8000	24/06/2013	Driver (H)	20/11/1966	2	288,000	192,000
128	4371	Prasad Shankar Rama	OPRC - PUNJAB	9500	24/06/2013	Driver (H)	01/01/1976	2	342,000	228,000
129	4372	Singh Arjun Subedar	OPRC - PUNJAB	7500	24/06/2013	Helper (Boiler)	29/02/1992	2	270,000	180,000
130	4373	Yadav Binod Prayag	OPRC - PUNJAB	10000	24/06/2013	Operator (Roller)	01/01/1905	2	360,000	240,000
131	4374	Yadav Ram Kheilo	OPRC - PUNJAB	10000	24/06/2013	Operator (Roller)	05/08/1966	2	360,000	240,000
132	4379	Kumar Shivan Bindi	OPRC - PUNJAB	15500	25/06/2013	Operator (Paver)	04/04/1974	2	558,000	372,000
133	4381	Mohammad Kurban Shafigue	Dhasha Bhavnagar Road	9500	27/06/2013	Driver (H)	15/10/1978	2	342,000	228,000
134	4382	Das HirakDebedra	Rajkoi Bhavnagar Road	8500	27/06/2013	Driver (H)	01/01/2005	2	306,000	204,000
135	4383	Kauli Suneel Sundarai	Rajkoi Bhavnagar Road	4000	27/06/2013	Helper	05/07/1992	2	144,000	96,000
136	4384	Yadav Divankar Mansingh	Rajkoi Bhavnagar Road	6500	27/06/2013	Driver (L)	10/07/1992	2	234,000	156,000
137	4385	Gusni Subhanakar Sarkar	Rajkoi Bhavnagar Road	8500	27/06/2013	Driver (H)	21/03/1982	2	306,000	204,000
138	4386	Tiwari Sunilkumar Paras Nath	Samakha Plant	8500	27/06/2013	Driver (H)	20/07/1987	2	306,000	204,000
139	4387	Jena Ramakant	OPRC - PUNJAB	10000	27/06/2013	Operator (HM plant)	02/01/2005	2	360,000	240,000
140	4389	Mohammad Kirban Mohammad Sha	Dhasha Bhavnagar Road	9500	28/06/2013	Driver (H)	17/08/1986	2	342,000	228,000
141	4390	Abdal Akbarhusen Yakuba	Dhasha Bhavnagar Road	5500	28/06/2013	Driver (L)	01/05/1980	2	198,000	132,000
142	4397	Jena Manoranjan Ganesh	OPRC - PUNJAB	23000	28/06/2013	Operator (HM Plant)	15/01/1979	2	700,000	300,000

143	4406	OPRC - PUNJAB	9000	28/06/2013	Driver (H)	15/02/1963	2	324,000	216,000
144	4407	OPRC - PUNJAB	10000	28/06/2013	Welder	03/12/1962	2	360,000	240,000
145	4408	OPRC - PUNJAB	15000	28/06/2013	Electrician	30/03/1969	2	540,000	360,000
146	4410	OPRC - PUNJAB	11000	28/06/2013	Operator (Roller)	12/03/1974	2	396,000	264,000
147	4413	OPRC - PUNJAB	6000	28/06/2013	Cook	06/05/1989	2	216,000	144,000
		Premium Calculation						17073.60	18,804,000
		Total Premium						79397.60	
		Add : 25% Premium of Medical Exp.						19849.40	
		Total Premium						99247.00	
		Less : 40% Discount						39698.80	
		Total Premium						59548.20	
		Premium for Balance Period						28224.22	
		Add : 10.30% Service Tax						2907.09	
		Net Premium (Rs.)						31131.31	
		Say Premium (Rs.)						31131.00	

REFUND OF PREMIUM FOR THE EMPLOYEES WHO RESIGNS FROM THE COMPANY AS ON 11/06/2013

Emp ID	Name	Site	Gross Salary	Date Of Joining	Designation	Birth date	Risk Group	Table A
1056	Bhartsinh Janakiprasad Yadav	Vasad Tarapur Road	5250	01/08/2002	Watchman	03/08/1966	1	189,000
2569	Ranjeet kajomal Berva	Jaipur-Tonk Deoil Site	5000	01/02/2011	Jr. Computer Operator	20/12/1989	1	180,000
2745	Sukhveersinh R. Meena	Jaipur-Tonk Deoil Site	6000	01/07/2011	Supervisor (Civil)	30/06/1984	1	216,000
2821	Parbat Maganbhai Thakor	PS OMT Maintenance, ADESAR	7500	01/10/2011	Supervisor (Civil)	01/06/1972	1	270,000
2892	Narayan Chhagan Puri	Jaipur-Tonk Deoil Site	8500	01/12/2011	Cook	24/09/1991	1	306,000
3375	Niraj A Patel	Rajkot Bhavnagar Road	6500	15/07/2012	Office Assistant (HR & Ad	14/04/1990	1	234,000
3409	Chintan Thakorbhai Patel	Vasad Tarapur Road	4000	03/08/2012	Helper (Surveyor)	30/12/1984	1	144,000
3439	Yogesh Dinkarrray Bhatt	Jilla Seva Sadan at Anand	8000	13/08/2012	Jr. Accountant	06/08/1960	1	288,000
3529	Akash Rameshbhai Trada	Rajkot Bhavnagar Road	5000	04/10/2012	Jr. Computer Operator	17/12/1991	1	180,000
3753	Mohamad Alam Akhtar	PS OMT Maintenance, CHADOTAR	9000	17/12/2012	Jr. Engineer (Road)	00/01/1900	1	324,000
3799	Kritikumar Ganabhai Pranami	Vasad Tarapur Road	14400	01/01/2013	Surveyor	15/06/1976	1	518,400
3836	Raunak Bhansali	Anand Office	10000	07/01/2013	Jr. Executive (IT)	25/06/1989	1	360,000
3855	Umesh V Vala	Vasad Tarapur Road	6000	16/01/2013	Computer Operator	28/10/1988	1	216,000
3952	Macnil Maheshbhai Parmar	Vasad Tarapur Road	4000	06/02/2013	Office Assistant	04/05/1989	1	144,000
4021	Karmesh Rajeshbhai Patel	Ahmedabad Vadodara ExpressWay	5000	10/02/2013	Jr. Computer Operator	04/11/1993	1	180,000
4153	Mahesh Laxmanbhai Joshi	PS OMT Maintenance, CHADOTAR	5000	02/04/2013	Jr. Computer Operator	01/06/1988	1	180,000
4078	Yogesh Madhusudan Bhatt	Anand Office	30000	01/03/2013	Company Secretary	31/10/1981	1	700,000
4174	Harpalisinh Rajendraisingh Gohil	Samras Hostel -Bhavnagar	9000	11/04/2013	Jr. Engineer	10/08/1991	1	324,000
4246	Raj Vishwakarma Gajjar	Vasad Tarapur Road	58500	14/05/2013	Sr. Section Incharge(Stru	18/05/1967	1	700,000
							Total	5,653,400
							Premium Calculation	2,261,36
1843	Premial Ramlal Moria	Jaipur-Tonk Deoil Site	4000	24/05/2008	Helper	25/12/1990	2	144,000
2300	Anil kumar Pareda	Jaipur-Tonk Deoil Site	16000	01/06/2010	Operator (Grader)	02/06/1989	2	576,000
2456	Mahaveerkumar Moolchand Khatik	Jaipur-Tonk Deoil Site	7500	01/12/2010	Driver (H)	25/01/1983	2	270,000
2458	Rajaram Panchuram Mehra	Jaipur-Tonk Deoil Site	7500	01/12/2010	Driver (H)	01/01/1988	2	270,000
2460	Shanker Poluram Berawa	Jaipur-Tonk Deoil Site	4000	01/12/2010	Helper (Weigh Bridge)	28/09/1989	2	144,000
2511	Mohanlal Motilal Regar	Jaipur-Tonk Deoil Site	7500	01/12/2010	Driver (H)	00/01/1900	2	270,000
2577	Gopalal Lala Nath	Jaipur-Tonk Deoil Site	7500	12/02/2011	Driver (H)	07/01/1971	2	270,000
2597	Ramesh shankarlal Sharma	Jaipur-Tonk Deoil Site	7500	27/02/2011	Driver (H)	15/06/1970	2	270,000

3125	Ram ji Gupta	Rajkot Bhavnagar Road	8000	17/03/2012	Operator (Roller)	2	01/07/1989	288,000
3093	Rajesh Shambhu Gaur	Rajkot Bhavnagar Road	8500	18/03/2012	Driver (H)	2	01/01/1973	306,000
3096	Noor Alam Idres Alam	Rajkot Bhavnagar Road	8500	18/03/2012	Driver (H)	2	05/05/1968	306,000
3094	Chhotelal Rangalal Gaur	Rajkot Bhavnagar Road	4000	19/03/2012	Helper	2	00/01/1900	144,000
3190	Pappu Gangaram Bairwa	Jaipur-Tonk Deoli Site	6000	01/04/2012	Asst. Operator (WMM Pk)	2	01/05/1977	216,000
3228	Bhanushar Ker Manilal Trivedi	PS OMT Maintenance, ADESAR	8500	01/05/2012	Driver (H)	2	17/03/1956	306,000
3291	Suvankar Sarkar Gushi Sarkar	Rajkot Bhavnagar Road	8500	20/05/2012	Driver (H)	2	28/03/1986	306,000
3302	Arjun Ramanbhai Raval	V. S. Hospital at Ahmedabad	3500	01/06/2012	Helper	2	06/01/1992	126,000
3314	Sanjay Ma'atbhai Parmar	Vasad Tarapur Road	4000	01/06/2012	Helper (Lab)	2	15/04/1993	144,000
3323	Subhash Mahendrabhai Thakur	Vasad Tarapur Road	5000	08/06/2012	Driver (L)	2	10/02/1985	180,000
3426	Lalit Ramasevakbhai	Vasad Tarapur Road	4000	16/08/2012	Helper (Surveyor)	2	17/08/1992	144,000
3427	Upendra Jarad	Vasad Tarapur Road	4000	16/08/2012	Helper	2	22/07/1993	144,000
3428	Amarjiti Dipchand	Samras Hostel -Bhavnagar	4000	18/08/2012	Helper	2	01/08/1992	144,000
3435	Rakesh V Pandya	Vasad Tarapur Road	9000	23/08/2012	Operator (Hydra)	2	05/05/1984	324,000
3463	Navinbhai Ashokbhai Gupta	Extra Rajkot Bhavnagar Road	4500	07/09/2012	Helper	2	01/06/1990	162,000
3475	Paramhans Lalilan Pal	Vasad Tarapur Road	8500	08/09/2012	Driver (H)	2	00/01/1900	306,000
3549	Indrajeet Shivmaruti Patel	Vasad Tarapur Road	8500	17/10/2012	Driver (H)	2	20/07/1978	306,000
3579	Premal Bhimpal Singh	Vasad Tarapur Road	8500	05/11/2012	Driver (H)	2	01/01/1968	306,000
3654	Ramkrpal Heeraman Kor	Rajkot Bhavnagar Road	4000	27/11/2012	Helper	2	12/06/1990	144,000
3626	Chhotubhai Mayjibhai Rathod	Vasad Tarapur Road	5000	01/12/2012	Driver (L)	2	01/06/1956	180,000
3751	Ram Bilas Paswan	PS OMT Maintenance, CHADOTAR	8500	01/12/2012	Driver (H)	2	00/01/1900	306,000
3740	Dinesh Koyabhai Dindor	Rajkot Bhavnagar Road	4000	19/12/2012	Helper (Paver)	2	03/06/1991	144,000
3748	Ismailbha Mir mohamad Kachela	PS OMT Maintenance, CHADOTAR	6000	19/12/2012	Driver (L)	2	01/06/1971	216,000
3769	Sadanand Tulsiprasad Verma	PS OMT Maintenance, CHADOTAR	8000	26/12/2012	Operator (Roller)	2	00/01/1900	288,000
3793	Pappu Chathiall Morya	Jaipur-Tonk Deoli Site	4500	01/01/2013	Helper(Browser)	2	04/07/1993	162,000
3816	Bharat Ganeshbhai Valaganth	PS OMT Maintenance, ADESAR	4000	05/01/2013	Helper (Survey)	2	02/08/1993	144,000
3876	Prahladi Joytaji Thakor	PS OMT Maintenance, CHADOTAR	4500	10/01/2013	Driver (Tractor)	2	20/10/1984	162,000
3984	Sanjay Ghurabhai Vadav	Rajkot Bhavnagar Road	8500	18/01/2013	Driver (H)	2	01/10/1979	306,000
3894	Girish Solanki	Vasad Tarapur Road	4000	23/01/2013	Helper (Surveyor)	2	04/12/1982	144,000
3987	Kailash shreepliel Kor	Rajkot Bhavnagar Road	8500	01/02/2013	Driver (H)	2	02/07/1983	306,000
3989	Ashish Lalmoorsinh Morya	Rajkot Bhavnagar Road	4000	01/02/2013	Helper (Paver)	2	25/10/1992	144,000
4039	Javed Latifkhan Kachela	PS OMT Maintenance, CHADOTAR	4500	01/02/2013	Helper (Boizer)	2	01/06/1985	162,000
4074	Nareesh Jasmer Singh	Extra PRS -Chadotar	7500	01/03/2013	Operator (JCB)	2	17/03/1979	270,000
4081	Chhotelal Ramcharan Chauhan	Vasad Tarapur Road	8500	01/03/2013	Driver (H)	2	01/07/1960	306,000
4119	Santosh Pooran Singh	PS OMT Maintenance, ADESAR	8500	01/03/2013	Driver (H)	2	18/08/1977	306,000
4146	Raja Babanbhai Mehto	Rajkot Bhavnagar Road	4000	02/03/2013	Helper	2	09/04/1994	144,000
4110	Bhimrao Narayana Chikati	PS OMT Maintenance, ADESAR	8000	12/03/2013	Weider	2	01/05/1990	288,000
4123	Suryabhan Bagwanbhan Patel	Vasad Tarapur Road	8500	20/03/2013	Driver (H)	2	02/05/1981	306,000

4135	Pavan Brijwasi Pathak	PS OMT Maintenance, ADESSAR	23000	22/03/2013	Sr. Operator (Plant)	11/11/1979	2	700,000
4140	Saddam Husain Ashik ali	Vasad Tarapur Road	8500	22/03/2013	Driver (H)	02/06/1991	2	306,000
4154	Sachin Naranbhai Patei	Samarkha Site	6000	03/04/2013	Driver (L)	28/03/1984	2	216,000
4194	Dipak Hrudananda Das	Vasad Tarapur Road	4500	23/04/2013	Helper (Lab)	18/07/1980	2	162,000
4221	Mohammad Mansuralam Monu	Vasad Tarapur Road	4000	24/04/2013	Helper	01/01/1990	2	144,000
4223	Premchandra Yadunath Dwivedi	Rajkot Bhavnagar Road	4500	24/04/2013	Helper (Grader)	04/02/1988	2	162,000
4233	Avadesh Harendra Yadav	PS OMT Maintenance, CHADOTAR	8500	08/05/2013	Operator (JCB)	00/01/1900	2	306,000
Premium Calculation								
Grand Total (Table A + C)								
Add : 25% Premium of Medical Exp.								
Total Premium								
Less : 40% Discount								
Total Premium								
Remaining Days/365								
Add : 10.30% Service Tax								
Net Premium (Rs.)								
Soy Premium (Rs.)								
7677.60								
12,796,000								

subsequently perform their function to an adequate degree. Components shall be handled and stored so that mechanical damage and detrimental corrosion are prevented. The corrosion of the gripping and securing system shall be prevented. The use of correctly formulated oils and greases or of other corrosion preventing material, shall be guaranteed by the producer to be non-aggressive and non-degrading.

Prestressing steel which shall be absolutely clean and without any signs of rust, shall be stored in a closed store having single door with double locking arrangements and no windows. The air inside the store shall be kept dry as far as possible by using various means to the satisfaction of the Engineer, so as to eliminate the possibility of initial rusting of prestressing steel during storage. Instrument measuring the air humidity shall be installed inside the store. The prestressing steel shall be coated with water-soluble grease.

All prestressing steel shall be stored at least 300 mm above ground level and shall be invariably wrapped with a protective covering of tar paper or polythene or any other approved material.

The Contractor should ensure that prestressing steel is used within 3 months of its manufacture. He should chalk out his prestressing programme in such a manner as to avoid the possibility of initial corrosion before placing in position.

1014.7 Water

Water shall be stored in containers/tanks covered at top and cleaned at regular intervals in order to prevent intrusion of foreign matter or growth of organic matter. Use of water from shallow, muddy or marshy sources, shall not be permitted. The intake pipe shall be suitably enclosed to exclude silt, mud, grass and other solid materials and there shall be a minimum depth of 0.60 m of water below the intake at all times.

1015 TESTS AND STANDARD OF ACCEPTANCE

All materials, even though stored in an approved manner shall be subjected to an acceptance test in accordance with the relevant IS specification prior to their immediate use.

Independent testing of cement for every consignment shall be done by the Contractor at site or in the laboratory approved by the Engineer before use. Any cement with lower quality than that shown in manufacturer's certificate shall be debarred from use. In case of imported cement, the same series of tests shall be carried out before acceptance.

1015.1 Testing and Approval of Material

The Contractor shall furnish test certificates from the manufacturer/supplier of materials along with each batch of material(s) delivered to site.

The Contractor shall set up a field laboratory with necessary equipment for testing of all materials, finished products used in the construction as per requirements of conditions of contract and the relevant specifications. The testing of all the materials shall be carried out by the Engineer for which the shall make all the necessary arrangements and bear the entire cost.

Test which cannot be carried out in the field laboratory have to be got done at the Contractor's cost at any recognized laboratory/testing establishments approved by the Engineer.

1015.2 Sampling of Materials

Samples provided to the Engineer for inspection are to be in labelled boxes suitable for storage.

Samples required for testing and approval must be supplied well in advance by at least 48 hours or before the minimum period required for carrying out the relevant tests. Delay to works arising from the late submission of samples, will not be acceptable as a reason for delay in completion of the works.

If materials are brought from abroad, the cost of sampling/testing whether in India or abroad shall be borne by the Contractor.

1015.3 Rejection of Materials not Conforming to the Specifications.

Any stack or batch of material(s) of which sample(s) does (do) not conform to the prescribed tests and quality shall be rejected by the Engineer and such materials shall be removed from site by the Contractor at his own cost. Such rejected materials shall not be made acceptable by any rectifications.

1015.4 Testing and Approval of Plant and Equipment

All plants and equipment used for preparing, testing and production of materials for incorporation into the permanent works, shall be in accordance with manufacturer's specifications and shall be got approved by the Engineer before use.

1100

PILE FOUNDATIONS

1101 DESCRIPTION

1101.1 This work shall consist of construction of all types of piles for structures in accordance with the details shown on the drawings and conforming to the requirements of these Specifications or as directed by the Engineer.

1101.2 The construction of pile foundations requires a careful choice of the piling system depending on subsoil conditions and loading characteristics and type of structure. The permissible limits of total and differential settlements, unsupported length of pile under scour, impact/entanglement of floating bodies and any other special requirements of project, are also equally important criteria for selection of the piling system. The method of installing the piles, including details of the equipment shall be submitted by the Contractor and got approved from the Engineer before commencement of work.

1101.3 The work shall be carried out as per IS:2911 except as modified herein.

1102 SUBSURFACE INVESTIGATIONS

1102.1 The complete subsurface investigations of strata in which pile foundations are proposed shall be carried out in advance along with in-situ pile tests. For details of geo-technical subsurface explorations, refer Section 2400 of these Specifications.

Borings should be carried up to sufficient depths so as to ascertain the nature of strata around the pile shaft and below the pile tip. Depth of boring shall not be less than:

- i) 1.5 times estimated length of pile in soil or 15 m below the proposed founding level
- ii) 15 times diameter of pile in ordinary / jointed rock but minimum 15 m in such rock
- iii) 4 times diameter of pile in hard rock but minimum 3 m in such rock

1102.2 The subsurface investigations shall adequately define stratification of substrata including the nature and type of strata, their variation, extent and specific properties. The investigations shall be adequate for the purpose of selection of appropriate piling system and for estimating design capacities for different diameters and length of piles.

1102.3 Pressure meter tests may be used in the case of rock, ground or soil for direct evaluation of strength and compressibility characteristics. Though these tests are of specialized nature, they are more appropriate for difficult/uncertain substrata and especially for important projects.

1102.4 For piles socketed into rock, it is necessary to determine the uni-axial compressive strength of the rock and its quality.

The investigations shall also include location of ground water table and other parameters including results of chemical tests showing sulphate and chloride content and any other deleterious chemical content in soil and/or ground water, likely to affect durability.

1103 TYPE OF PILES

1103.1 Piles may be of reinforced concrete, prestressed concrete, steel or timber and circular, square, hexagonal, octagonal, "H" or "I" Section in shape. They may be of solid or hollow sections or steel cases filled with concrete. Timber piles may be used for temporary bridges. Cast in-situ concrete piles may be driven cast in-situ or bored cast in-situ. Similarly, precast concrete piles also may be driven precast or bored precast. In bored precast piles, precast piles are lowered into pre-formed bores and annular space grouted.

1103.2 Minimum diameter of concrete pile shall be 1 m for river/marine bridges. For bridges beyond the water zone and bridges on land, the minimum diameter may be 750 mm.

1104 MATERIALS

1104.1 The basic materials shall conform to Section 1000 of these Specifications. The specifications for steel reinforcement, structural concrete, prestressed concrete and structural steel to be used in pile foundations shall conform to Sections 1600, 1700, 1800 and 1900 respectively of these Specifications.

1104.2 Concrete in Piles

For both precast and cast in in-situ piles, the grade of concrete, minimum cement content, water cement ratio and slump at the time of placement shall be as per Table 1100-1 :

Table 1100-1 : Requirements for Concrete in Piles

	Cast in-situ Concrete by Tremie	Precast Concrete
Grade of concrete	M 35	M 35
Minimum cement content	400 kg/m ³	400 kg/m ³
Minimum water cement ratio	0.4	0.40
Slump (mm) as measured at the time of placement	150-200	50 - 75

The terms 'minimum cement content' and 'minimum water cement' ratio mentioned Table 1100-1, are to be based on total cementitious material (inclusive of all mineral admixtures called additives) mentioned in Clause 1007 of these Specifications. Maximum limits for such additives shall be as specified in Clause 1716.2 of these Specifications.

High alumina cements (i.e. quick setting cement) shall not be used in marine conditions. When both chlorides and sulphates are present, in soil or ground water, sulphate resistant cement shall not be used. For improving resistance against the penetration of chlorides and sulphates from surrounding soils or water, mineral admixtures such as fly ash, silica fumes, GGBS conforming to respective BIS/International Standards and as per IRC:112, may be used.

1105 TEST PILES

1105.1 Test piles which are shown on the drawings or specified in the contract or installed by the Contractor on his own to determine the lengths of piles to be furnished, shall conform to the requirements for piling as indicated in these Specifications. Test piles which are used to arrive at the load carrying capacity shall not be incorporated in the structure.

All test piles shall be installed with the same type of equipment that is proposed to be used for piling in the actual structure.

Test piles which are not to be incorporated in the completed structure shall be removed to at least 600 mm below the proposed soffit level of pile cap and the remaining hole so formed shall be backfilled with earth or other suitable material.

The piles shall be load tested in accordance with provisions laid down in this Section.

1106 PRECAST CONCRETE PILES

1106.1 General

Precast concrete piles shall be of the size and shape as shown in the approved drawings. If a square section is employed, the corners shall be chamfered by at least 25 mm unless otherwise specified on the drawings. The length of pile shall not normally exceed 25 m. However, where special equipments for handling and installation are available to the satisfaction of the Engineer, longer length could be permitted.

1106.2 Stacking, Storing and Handling

Care shall be taken that at all stages of transporting, lifting and handling, the piles are not damaged or cracked. During transport and stacking of piles, they shall be supported at the same points as those provided for lifting purposes. If the piles are put down temporarily during handling, they shall be placed on trestles or blocks located at the same points.

Piles shall be stored at least 300 mm above firm level ground, which is not liable to unequal subsidence or settlement under the weight of the stack of piles. They shall be placed on timber supports which are level and spaced so as to avoid bending. The supports in different layers, shall be vertically one above the other. Spaces shall be left round the piles to enable

them to be lifted without difficulty. The order of stacking shall be such that the older piles can be withdrawn without disturbing newer piles. Separate stacks shall be provided for different lengths of piles. Where piles are stacked in layers, the number of layers shall not exceed three. Whenever curing is needed during storage, arrangements shall be made to enable the piles to be watered. For detailed precautions with regard to curing operations for structural concrete, refer Section 1700 of these Specifications.

Before the operation of handling and driving the piles, the minimum periods counted from the time of casting shall be as indicated in Table 1100-2. Prestressed pile shall not be lifted or handled until fully stressed.

Table 1100-2 : Time for Curing Precast Piles

Type of Cement Used in Casting the Pile	Minimum Periods from Time of Casting			
	Strike Side-Shutters (Hours)	End of Wet Curing (Days)	Lift from Bed (Days)	Casting Drive (days)
Ordinary Portland	24	7	10	28
Rapid hardening Portland	12	7	7	10

1106.3 Lengthening of Piles

Where a pile is to have additional length cast on it during driving, the longitudinal reinforcement shall preferably be joined by full penetration butt welding. The concrete at the top of the original pile shall be cut down to expose not less than 200 mm of the bars to avoid spalling of the concrete by heat of welding. The added bars have to be held accurately and rigidly in position during welding. Where facilities on site are insufficient to make proper butt welding practicable, the joint may be made by lapping. The reinforcement at the head of pile will need to be exposed for full anchorage length or 600 mm whichever is greater and the new bars over-lapped for this distance. Unless otherwise specified, the extension of the pile shall be formed to the same cross-sectional profile and with concrete of at least the same strength as that specified for the original pile. The stirrup spacing shall in no case be greater than 150 mm. Not more than one extension shall be permitted. In case more than one extension is permitted by the Engineer, only approved mechanical couplers shall be used.

Driving shall not be resumed until:

- a) The strength of the concrete in the extension is at least equal to the specified characteristic strength of concrete in pile; and
- b) The approval of the Engineer has been obtained.

1106.4 Removal of Surplus Length

Any length of pile surplus to that required for incorporation in the structure shall be cut off neatly and removed. During the process of cutting off, it shall be ensured that projecting reinforcement to be anchored into the pile cap and the prestressing strands/wires are not damaged. When stripping prestressed concrete piles, sudden release of tendons shall be avoided. Reference may also be made to Clause 7.7.1 of IS:2911 (Part I, Section 3) in this connection.

1106.5 Risen Piles

Level of top of each pile shall be taken after driving and again after all the piles are driven. Piles which are found to have risen due to ground heave or as a result of driving adjacent piles, shall be re-driven to the original depth or resistance unless re-driving tests on adjacent piles have shown this to be unnecessary.

1106.6 Manufacture

The pile should be cast in one continuous operation from end to end of each pile. Manufacture of precast concrete piles shall conform to the guidelines contained in Clause 7.1, 7.2 and 7.3. or IS:2911 (Part I, Section 3).

Piles shall be provided with suitable metal shoe for protecting the tip of the pile during driving in hard ground.

Piles shall not be moved from casting bed until the concrete has hardened sufficiently.

Piles shall not be driven in less than 28 days after casting or unless their strength at the time of driving is at least that specified for 28 days.

1106.7 Prestressed Concrete Piles

Additional specifications for precast prestressed concrete piles shall conform to those contained in Clause 8 of IS:2911 (Part I, Section 3).

1107 CAST IN-SITU CONCRETE PILES**1107.1 General**

Cast in-situ concrete piles may be either installed by drilling a bore into the ground and removing the material or by driving a metal casing with a shoe at the tip and displacing

the material laterally. The two types of piles are termed as "bored piles" and "driven piles" respectively. Cast in-situ concrete piles may be cast in metal shells which may remain permanently in place. However, other types of reinforced concrete cast in-situ piles, cased or uncased, may be used if in the opinion of the Engineer the soil conditions permit their use and if their design and the methods of placing are satisfactory.

Certain specific requirements regarding driving of cast in-situ driven piles shall be as per Clauses 1110 and 1111.

Any liner or borehole which is improperly located or shows partial collapses that would affect the load carrying capacity of the pile, shall be rejected or repaired as directed by the Engineer at the cost of the Contractor.

Boring shall be carried out using rotary equipment. Percussion type of equipment shall be used only if approved by the Engineer.

The diameter of the finished pile shall not be less than that specified. A continuous record shall be kept by the Engineer as to the volume of concrete placed in relation to the length of pile that is cast.

Defective piles shall be removed or left in place as judged convenient without affecting the performance of adjacent piles or pile cap. Additional piles shall be provided to replace the defective piles.

1107.2 Concreting

Wherever practicable, concrete should be placed in a clean dry hole. Prior to the placing of the reinforcement cage, the pile shaft shall be cleaned of all loose materials. Before concreting of the pile is commenced, it is essential to ensure that no debris remains at the bottom of the shaft, as inadequate cleaning of the base can lead to formation of a soft base or soft toe which may result in reduction of load bearing capacity of the pile.

Reinforcement for the pile as shown on the drawing shall be tied in place to form a cage which is lowered into the pile shaft. Suitable spacers shall be provided to maintain the required cover to reinforcing steel. Reinforcements at the bottom should not be provided with L-bends as these may interfere with cleaning of the pile base.

Where concrete is placed in dry and a casing is present, the top 3 m of the pile shall be compacted using internal vibrators.

Where the casing is withdrawn from cohesive soils for the formation of cast in-situ pile, the concreting should be done with necessary precautions to minimize the softening of the soil by excess water. Where mud flow conditions exist, the casing of cast in-situ piles shall not be allowed to be withdrawn.

Care shall be taken during concreting to prevent the segregation of the ingredients. The displacement or distortion of reinforcement during concreting and while extracting the casing, shall also be avoided.

If the concrete is placed inside precast concrete tubes or consists of precast sections, these shall be free from cracks or other damage before being installed.

The concrete shall be properly graded, shall be self-compacting and shall not get mixed with soil, excess water, or other extraneous matter. Special care shall be taken in silty clays and other soils which have the tendency to squeeze into the newly deposited concrete and cause necking. Sufficient head of green concrete shall be maintained to prevent inflow of soil or water into the concrete.

The placing of concrete shall be a continuous process from the toe level to the top of the pile. To ensure compaction by hydraulic static heads, rate of placing concrete in the pile shaft shall not be less than 6 m (length of pile) per hour.

1107.3 Casing

When concreting is carried out for a pile, a temporary casing should be installed to sufficient depth so as to ensure that fragments of soil from the sides of the hole do not drop into the concrete as it is placed. When the bore hole is stabilized using drilling mud, the temporary casing is not required except near the top.

The metal casing shall be of sufficient thickness and strength to hold its original form and show no harmful distortion while driving or when adjacent casings are driven.

Cast in-situ concrete driven piles shall be installed using a properly designed detachable shoe at the bottom of the casing.

Bored cast in-situ piles in soils which are stable, may often be installed with only a small casing length at the top. A minimum of 2 m length of top of bore shall invariably be provided with casing to ensure against loose soil falling into the bore. In cases in which the side soil can fall into the hole, it is necessary to stabilize the side of the bore hole with drilling mud, or a suitable steel casing. Permanent steel liner shall be provided at least up to maximum scour level. The minimum thickness of steel liner shall be 6 mm.

Permanent steel liner shall be provided for the full depth of the pile in the following situations where:

- i) The surrounding soil is marine clay
- ii) Soft soil is present
- iii) Surrounding soil has sulphate content equal to or more than 1%

- iv) Surrounding water has sulphate content equal to or more than 2500 ppm
- v) Leakage of sewage is expected

For bored cast in-situ piles, casing/liner shall be driven open ended with a pile driving hammer capable of achieving penetration of the liner to the depth shown on the drawing or as approved by the Engineer. Materials inside the casing shall be removed progressively by air lift, grab or percussion equipment or other approved means.

Where bored cast in-situ piles are used in soils liable to flow, the bottom of the casing shall be kept sufficiently in advance of the boring tool to prevent the entry of soil into the casing, leading to formation of cavities and settlements in the adjoining ground. The water level in the casing should generally be maintained at the natural ground water level for the same reasons. The joints of the casing shall be made as leak-tight as possible to minimize inflow of water or leakage of slurry during concreting.

The diameter of the boreholes shall not be more than the inside diameter of the liner when the liners are installed before boring. When the liners are installed after boring, the diameter of the boreholes shall not be more than the outside diameter of liner + 2 mm, unless otherwise approved by Engineer.

1107.4 Use of Tremie

The concrete should invariably be poured through a tremie with a funnel, so that the concrete can be properly deposited in the hole without segregation. For concreting done by tremie, the following requirements which are particularly applicable shall be ensured:

- a) The hopper and tremie should be a leak proof system.
- b) Diameter of tremie shall be not less than 200 mm for use with 20 mm diameter down aggregate.
- c) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it or with a steel plate with adequate charge to prevent mixing of concrete and water. However, the plug should not be left in the concrete as a lump.
- d) The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal of the pipe. The tremie should be always full of concrete.
- e) The pile should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile, to prevent laitance from being entrapped within the pile.
- f) All tremie tubes shall be thoroughly cleaned after use.

- g) For concrete placed through tremie, there is no need to add 10 percent extra cement.
- h) Concreting of piles shall be carried out continuously. In exceptional cases of interruption of concreting the tremie shall not be taken out of the concrete under any circumstances. The tremie pipe shall be raised and lowered slowly from time to time to prevent it from getting stuck in the concrete while ensuring its lower end does not come out of concrete. The concreting shall be resumed before final setting time of concrete, which shall be established before the start of the piling operation. For achieving longer setting time of the concrete, super plasticizers having retarding properties/retarders can be used. If any of these requirements are not met, the pile shall be rejected.

1107.5 Removal of Concrete above Cut-off Level

It is desirable that the concrete above cut-off level, is removed before the concrete is set. This may be done manually or by specially made bailer or other device. Such removal of concrete helps in preventing the damage of the good concrete below the cut-off level, which results from chipping by percussion method.

The removal of concrete shall be within ± 25 mm from the specified cut off level, preferably on the minus side. After removal of such concrete, the concrete shall be compacted with rammer with spikes or vibrated.

In case the concrete is not removed before setting, a groove shall be made on outer perimeter by rotary equipment before chipping by percussion method.

The minimum embedment of cast in-situ concrete piles into pile cap shall not be less than 50 mm. Any defective concrete at the head of the completed pile shall be cut away and made good with new concrete. The clear cover between the bottom reinforcement in pile cap from the top of the pile shall be not less than 25 mm. The reinforcement in the pile shall be exposed for full anchorage length to permit it to be adequately bonded into the pile cap. Exposing such length shall be done carefully to avoid damaging the rest of the pile.

1108 STEEL PILES

Steel piles shall be of "H" or "I" sections as shown on the drawings and shall be of structural steel conforming to Section 1000 of these Specifications.

Steel piles shall be protected by suitable anti-corrosive painting as specified on the drawing or as directed by the Engineer. Piles shall be stored above the ground having protective packing to minimize damage to surface coating. Each pile shall be supplied preferably in one piece without splices.

At the option of the Contractor, steel piles consisting of structural steel plates welded together may be substituted for the rolled sections specified, provided the depth, width and average thicknesses are at least equal to those of the rolled sections, the steel plates conform to **Section 1000** of these Specifications. The flanges shall be welded to the web with continuous fillet welds on either side of the web, and the welding shall conform to Clause 1904.8 of these Specifications.

The length of the steel pile may be built up in sections either before or during driving operations. The sections shall be of identical cross-section. Pile splices shall be made with full penetration butt welds over the whole cross-section. Pile splices shall develop at least the yield strength of pile.

The connections shall be made by butt welding the entire cross-section in accordance with the provisions in Clause 1904.8 of these Specifications. Care shall be taken to properly align the sections connected so that the axis of the pile will be straight. The number of welded connections in the length of pile shall be as few as possible.

1109 TIMBER PILES

The Engineer shall stamp each pile on the butt with a stamp which shall make an impression that is readily legible. Treated timber piles will be inspected by the Engineer after treatment. Untreated timber piles may be used as test piles. Treated timber piles shall be driven within 6 months after treatment.

Timber piles shall be furnished with tip protection and protected by the use of steel straps. Tip protection shall be suitable for use on timber piling of the size to be driven. Details of tip protection shall be furnished to the Engineer for review and approval before driving piles. Not less than 2 separate steel straps shall be placed within 600 mm of the butt of each pile after the pile is square cut. Not less than 2 separate steel straps shall be placed within 300 mm of the tip of each pile. Additional intermediate steel straps shall be placed at intervals of not more than 3 m measured along the length of the pile.

Timber piles which are to be capped shall be separately cut off so that true bearing is obtained on every pile. Piles inaccurately cut off shall be replaced. Splicing of timber piles shall not be permitted except by written permission of the Engineer.

1110 DRIVING EQUIPMENT

Piles or their casings may be driven with any type of drop hammer, diesel hammer or single-acting steam or compressed air hammer, provided they penetrate to the prescribed depth to attain the designed resistance without being damaged. The weight or power of the hammer should be sufficient to ensure a penetration of at least 5 mm per blow unless rock has been reached. It is always preferable to employ the heaviest hammer practicable and to limit the stroke, so as not to damage the pile. The minimum weight of the hammer shall be 2.5t. In

the case of precast concrete piles the mass of the hammer shall be not less than 30 times the mass of 300 mm length of pile.

Steam or air hammers shall be furnished along with boiler or air compressor of capacity at least equal to that specified by the manufacturer of the hammers. The boiler or air compressor shall be equipped with an accurate pressure gauge at all times. The valve mechanism and other parts of steam, air or diesel hammers shall be maintained in first class condition so that the length of stroke and number of blows per minute for which the hammer is designed, will be obtained. Inefficient steam, air or diesel hammers shall not be permitted to be used on the work.

1111 DRIVING

1111.1 General Procedure

Details of the equipment and the method proposed for driving the piles shall be submitted for scrutiny and approval of the Engineer. Piles shall be installed from firm ground or from temporary supports or from fixed platform. The arrangement shall provide sufficient rigidity to ensure accuracy of pile driving under all conditions of tide, stream flow or hammer drop.

During driving the top of pile shall be protected by a suitable helmet of substantial steel construction. The helmet shall provide uniform bearing across the top of the pile and shall hold the pile centrally under the hammer. No pile shall be driven unless inspected and approved by the Engineer.

Piles shall be driven from a fixed frame of sufficient rigidity to ensure accuracy of driving within specified tolerances. The force of the hammer shall be directed centrally and axially during driving. Forces producing undue bending or torsional stresses in piles shall not be applied during driving.

The stroke of a single acting or drop hammer shall be limited to 1.2 m unless otherwise permitted by the Engineer. A shorter stroke may be necessary when there is danger of damaging the pile.

Piles shall not be bent or sprung into position but shall be effectively guided and held on line during the initial stages of driving. Attempts to correct any tendency for the pile to run off line by the application of significant horizontal restraint will not be permitted. Shortly after the commencement of driving and at regular intervals throughout the driving operation, checks shall be made to ensure that the pile frame does not exert any undue lateral force on the pile due to restraint within the helmet.

If the indications are that a pile will finish outside the specified tolerances, driving operations on that pile will cease. The pile shall be withdrawn, the hole filled and the pile re-driven at the cost of the Contractor.

To avoid the possibility of premature "set-up", pile driving shall be continuous in the later stages, without any deliberate stops. (delays of an hour or less may lead to significant "set-up" in piles i.e. resistance to further driving increases after driving is stopped).

If any pile is damaged in any way during driving, it shall be repaired or replaced as directed by the Engineer, at the cost of the Contractor. If during driving, the head of a pile is damaged to the extent that further driving is not possible, the head shall be cut off and driving continued. The cost of cutting off shall be borne by the Contractor and where, as a result of such cutting off the head, the pile is too short, the Contractor, shall, at his own cost, supply and splice on sufficient length of pile to restore the pile to its correct length.

Piles should be driven to the minimum acceptable penetration shown on the drawings. This may require pre-boring and/or jetting as indicated in Clause 111.2, with the approval of the Engineer.

Piles shall be driven to nominal refusal or the required ultimate dynamic capacity mentioned on the drawings or until the top of the pile is at the level required and specified on the drawing whichever gives the lowest toe elevation. The Engineer's decision in these matters shall be final. Nominal refusal shall be taken as equivalent to 25 mm total penetration for the final 20 blows using a hammer of driving energy as specified and shall be used as the criterion for acceptance for piles founded on rock. Severe driving which results in an average set per blow less than 0.5 mm will not be permitted.

Where hard drilling is encountered because of dense strata or obstructions located above the predetermined pile tip level, nominal refusal shall not be considered to have been achieved unless the Engineer is satisfied that the total number of blows, as the average driving resistance specified for nominal refusal, indicates that further driving will not advance the pile through dense strata or obstructions.

The pile shall be driven as accurately as possible to the vertical or to specified batter. Straining the pile into position can damage it and the driving equipment should be adjusted as much as possible to follow the position of the pile. Any deviation from the proper alignment shall be noted and promptly reported to the Engineer. If the deviation is to such an extent that the resulting eccentricity cannot be taken care of by strengthening the pile cap or pile tips, such a pile shall, at the discretion of the Engineer, be replaced or supplemented by an additional pile. Unless otherwise specified, the permissible positional deviation for piles shall be limited to those indicated in Clause 1116.

Care shall be taken not to damage the pile by over-driving. Any sudden change in the rate of penetration which cannot be ascribed in the nature of the ground shall be noted and its cause ascertained, if possible, before driving is continued.

While withdrawing a casing used in the construction of cast in-situ pile, consideration shall be given to the possibility of damaging any other nearby pile. The danger of damaging is greater

in compact soils than in loose soils. No pile shall be bored or driven within 3 m of a newly cast pile until at least 24 hours after completion of its installation.

Driving piles in loose sand tends to compact the sand which in turn increases the skin friction. Therefore, driving a number of friction piles in a group shall proceed outward from the centre as otherwise it will be difficult to drive the inner piles to the same depth as the others.

In the case of stiff clay also, the driving for a group of piles shall proceed outward from the centre. However, in case of very soft soil, the driving may proceed from outside to inside, so that the soil is restrained from flowing out during driving operations.

If there is a major variation between the depth at which adjacent foundation piles in a group meet refusal, a boring shall be made nearby to ascertain the cause of this difference. If the boring shows that the soil contains pockets of highly compressive material below the level of the shorter pile, it will be necessary to enforce penetration of all the piles to a level below the bottom of the zone which shows such pockets.

1111.2 Pre-boring and Jetting

Driving of the piles may be assisted by pre-boring holes or by the use of jets or both, subject to the approval of the Engineer. These may be used essentially to achieve the minimum penetration shown on the drawings where such penetration is not reached under normal conditions of driving indicated in Clause 1111.1.

The diameter of the hole shall not be greater than the diagonal dimension of the pile less 100 mm.

The maximum depth of the pre-boring shall be such that the specified set (or less) is obtained when the toe of the pile is at founding level. Pre-boring shall be as approved by the Engineer and shall be carried out only up to a level of one metre above the founding level. The pile shall be driven for at least one metre below the pre-bored hole. To ensure that the pile is properly supported laterally in the hole, any space remaining around the pile at the ground level after driving is completed, shall be backfilled with approved granular material.

When water jetting is used, at least two jets shall be attached to the pile symmetrically. The volume and pressure of water at the outlet nozzles shall be sufficient to freely erode material adjacent to the toe of the pile. The maximum depth up to which jetting is carried out, shall be such that the specified set (or less) is obtained when the toe of the pile is at founding level. Jetting shall cease as directed by the Engineer and shall proceed only up to 1 m above the founding level. The pile shall be driven at least 1 m below the pre-bored hole.

To avoid very hard driving and vibration in materials such as sand, jetting of piles by means of water may be carried out only with the express permission of the Engineer and in such a

manner as not to impair the bearing capacity of piles already in place, the stability of the soil or the safety of any adjoining buildings. Details of the arrangement for jetting shall be got approved from the Engineer in advance.

If large quantities of water are used for jetting, provision shall be made for collecting and draining away of water when it comes to the surface of the ground, so that the stability of the piling plant is not endangered by the softening of the ground.

Jetting shall be stopped before completing the driving which shall always be finished by ordinary methods. Jetting shall be stopped if there is any tendency for the pile tips to be drawn towards the pile already driven owing to the disturbance of the ground.

1112 RAKER (INCLINED) PILES

The maximum rake to be permitted in piles shall not exceed the following:

- i) 1 in 6 for all bored piles
- ii) 1 in 6 for cast in-situ piles
- iii) 1 in 4 for precast driven piles

1113 PILE TESTS

1113.1 Initial Load Test

- i) The number of initial tests shall be determined by the Engineer taking into consideration the bore log and soil profile, design length, pile diameter and design pile capacity. However, it shall not be less than two for each category.
- ii) Initial load test for axial load capacity, including uplift capacity if required, on trial piles of the same diameter as of the design pile, shall be carried out after 28 days design strength is achieved. The testing shall be done as per the procedure laid down in IS:2911, Part-IV. The load test shall be conducted for not less than 2½ times the design load. The initial load test shall be cyclic load test for piles deriving strength from end bearing and side friction. The maintained load test can be performed for end bearing piles which do not rely on friction and for piles socketed in rock;
- iii) If the initial load test gives a capacity greater than 25 percent of the capacity calculated by static formula and if it is desired to take benefit of the higher capacity, another two load tests shall be carried out to confirm the earlier value and minimum of the three shall be considered

as initial load test value. The number of initial tests shall be determined by the Engineer taking into consideration the bore log and soil profile.

- iv) Lateral load tests shall be carried out for estimating the lateral load capacity of the piles. The test procedure shall be carried out as per IS 2911 part IV. However the permissible deflection shall be as per IRC:78.
- v) In particular cases where upper part of pile is likely to be exposed later due to scour, then the capacity contributed by that portion of the pile during load test, shall be accounted for.

1113.2 Routine Load Tests

Routine load test shall be carried out at actual locations of foundations of bridges to re-confirm or modify the allowable loads. The lateral load test may be conducted on two adjacent piles. However, results of routine load tests shall not be used for upward revision of design capacity of piles. The minimum number of tests to be conducted for confirming the capacity shall be as per **Table 1100-3**.

Table 1100-3 : Minimum Number of Tests

Total Number of Piles for the Bridge	Minimum Number of Test Piles
Upto 50	2
50-150	3
Beyond 150	2% of total piles (fractional number rounded to next higher integer number)

Note: The number of tests may be judiciously increased depending upon the variability of foundation strata. For determining the number of piles to be tested for the routine test the total no. of piles under all structures of left and right carriageway and the service road shall be taken together provided length and diameters of the piles are the same.

1113.3 Permissible Overload

While conducting routine test on one of the piles belonging to a pile group, if the pile capacity is found to be deficient (based on the settlement criteria of 12 mm for piles of diameter up to and including 600 mm and 2 percent of the pile diameter for piles of diameter more than 600 mm at 1.5 times the design load) an overload up to 10 percent of the capacity may be allowed.

1113.4 For a quick assessment of pile capacity, strain dynamic tests may be conducted after establishing co-relation using the results of load tests. However, results of strain dynamic tests shall not be used for upward revision of design capacity of pile. Detailed guidelines and references are given in IRC:78. These methods can be followed.

To have a fairly good idea about the quality of concrete and construction defects like voids, discontinuities etc., pile integrity tests are extensively conducted. Detailed guidelines in this connection are given in IRC:78.

1114 PILE CAP

Casting of pile cap should be at a level higher than low water level unless functionally required to be below low water level. In such cases dewatering shall be resorted to allow concreting in dry conditions. Pile caps shall be of reinforced concrete. A minimum offset of 150 mm shall be provided beyond the outer faces of the outermost piles in the group. If the pile cap is in contact with earth at the bottom, a leveling course of minimum 80 mm thickness of M 15 nominal mix concrete shall be provided. In marine conditions or areas exposed to the action of harmful chemicals, the pile cap shall be protected with a coating such as bituminous based coaltar epoxy or epoxy based coating or with suitable anti corrosive paint. Concrete with high alumina cement, shall not be used in marine environment.

The attachment of the pile head to the cap shall be adequate for the transmission of loads and forces. A portion of pile top may be stripped of concrete and the reinforcement anchored into the cap. Manual chipping may be permitted three days after casting of pile, while pneumatic tools for chipping shall be permitted only seven days after casting of pile. The top of pile after stripping shall project at least 50 mm into the pile cap.

The top of concrete in a pile shall be brought above cut-off level to permit removal of all laitance and weak concrete before pile cap is laid. This will ensure good concrete at the cut-off level.

1115 IMPORTANT CONSIDERATIONS, INSPECTION/PRECAUTIONS FOR DIFFERENT TYPES OF PILES

1115.1 Driven Cast In-Situ Piles

1115.1.1 Specialist literature and the guidelines from the pile construction industry shall be consulted regarding the method of installation, equipment and accessories for pile driving and recording of data.

1115.1.2 During installation of piles, the final "set" of penetration of pile per blow of hammer shall be checked taking an average of last 10 blows.

1115.1.3 The pile shoes which may be of either cast iron conical type or mild steel flat type shall have double reams for proper seating of the removable casing tube inside the space between the reams.

1115.1.4 Before commencement of pouring of concrete, it shall be ensured that there is no ingress of water in the casing tube from the bottom. Further, adequate control during withdrawal of the casing tube is essential so as to maintain sufficient head of concrete inside the casing tube at all stages of withdrawal.

1115.1.5 Concrete in piles shall be cast up to a minimum height of 600 mm above the designed top level of pile, which shall be stripped off at the time of construction of pile cap.

1115.2 Bored Cast In-Situ Piles

1115.2.1 While concreting uncased piles, voids in concrete shall be avoided and sufficient head of concrete is to be maintained to prevent inflow of soil or water into the concrete. It is also necessary to take precautions during concreting to minimize the softening of the soil by excess water. Uncased cast in-situ piles shall not be allowed where mudflow conditions exist.

1115.2.2 The drilling mud such as bentonite suspension shall be maintained at a level sufficiently above the surrounding ground water level throughout the boring process, to ensure the stability of the strata which is being penetrated until the pile has been concreted.

1115.2.3 Where bentonite suspension is used to maintain the stability of the borehole, it is essential that the properties of the material be carefully controlled at stages of mixing, supply to the borehole and immediately before concrete is placed. It is usual to limit :

- i) The density of bentonite suspension to 1.05 g/cc
- ii) The marsh cone viscosity between 30 and 40
- iii) The pH value between 9.5 and 12
- iv) The silt content less than 1 percent
- v) The liquid limit of bentonite not less than 400 percent

These aspects shall act as controlling factors for preventing contamination of bentonite slurry for clay and silt.

1115.2.4 The bores shall be washed by bentonite flushing to ensure clean bottom at two stages viz. after completion of boring and prior to concreting after placing of reinforcement cage. Flushing of bentonite shall be done continuously with fresh bentonite slurry till the consistency of inflowing and outflowing slurry is similar.

1115.2.5 For concreting of piles using tremie, Clause 1107 of these Specifications may be referred.

1115.2.6 For very long or large diameter piles, use of retarding plasticizer in concrete is desirable.

1115.2.7 For large diameter piles, it may be essential to conduct non-destructive pile integrity tests to evaluate integrity of the pile.

1115.2.8 Where possible, it may be desirable to grout the base of pile with cement slurry under suitable pressure after concrete in the pile attains the desired strength. For this purpose, conduit pipes with easily removable plugs at the bottom end, should be placed in the bore along with reinforcement cage before concreting.

1116 TOLERANCES

1116.1 Permissible Tolerances for Piles

- i) Precast Concrete Piles:
 - a) Variation in cross-sectional dimensions : ± 5 mm
 - b) Variation in length : ± 25 mm
 - c) Surface irregularities measured with 3 m straight edge : 5 mm
 - d) Bow for total length of pile in mm : 1 mm/m length of pile limited to 20 mm
- ii) Driven Piles
 - a) Variation in cross-sectional dimensions : +50 mm, -10 mm
 - b) Variation from vertical for vertical piles : 1 in 150
 - c) For vertical piles deviation at piling platform level : 75 mm
 - d) Variation of level of top of piles : ± 25 mm
- iii) Bored Piles
 - a) Variation in cross-sectional dimensions : +50 mm, -10 mm
 - b) Variation from vertical for vertical piles : 1 in 150
 - c) For vertical piles deviation at piling platform level : 75 mm
 - d) Variation of level of top of piles : ± 25 mm
- iv) For raker piles from specified rake : 1 in 25

1116.2 Permissible Tolerances for Pile Caps

- a) Variation in dimensions : +50 mm, -10 mm
- b) Misplacement from specified position in plan : 15 mm
- c) Surface irregularities measured : 5 mm with 3 m straight edge
- d) Variation of level of top of piles : ± 25 mm

1117 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria and requirements.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1118 MEASUREMENTS FOR PAYMENT

For supply of precast concrete, timber or steel piles of specified cross-section, the measurement shall be in metres of the length of piles ordered in writing by the Engineer measured from the head to the butt of the shoe or the tapered point. Reinforcement in precast concrete piles shall not be measured for payment.

For cast in-situ driven and bored concrete piles of specified cross-section, the measurement shall be the length in metres of the accepted pile that remains in the finished structure complete in place. Reinforcement in cast in-situ driven and bored concrete piles shall be measured for payment as per Section 1600 of these Specifications.

Routine and Initial Pile Load Tests shall not be measured for payment.

For installation of the pile, i.e. by drilling in the case of precast concrete, timber, steel and cast in-situ driven piles, and by boring in the case of cast in-situ bored pile the measurement shall be the length in metres that remains in the finished structure complete in place, limited to that shown on drawings or ordered by the Engineer. No distinction shall be made for penetration through hard strata or rock and socketing into rock.

For steel liners/casing shown on the drawings to be permanently left in place, the measurement shall be by weight in tonnes that remains in the finished structure complete in place, limited to that shown on drawings or ordered by the Engineer.

For the pile cap, the quantity of concrete shall be measured in cubic metres as per Section 1700 of these Specifications and reinforcement in pile cap shall be measured in tonnes as per Section 1600 of these Specifications.

1119 RATE

The contract unit rate for supplying precast concrete, timber or steel piles shall include cost of all labour, materials, tools and equipment, and other work involved in making or fabricating the pile complete as shown on the drawing, and where required its loading, transport, delivery to site, unloading and stacking at the place indicated by the Engineer. The cost of reinforcement including treatment as per Section 1600 of these Specifications in precast

concrete shall be deemed to be included in the quoted rate for supply of piles. The contract unit rate shall also include costs of all labour, materials, equipments and all other incidentals involved in conducting routine and initial pile load tests, including installation of piles for initial load tests.

The contract unit rate for cast in-situ driven and bored piles shall include the cost of concrete and all other items as per Section 1700 of these Specifications. The contract unit rate shall also include costs of all labour, materials, equipments and all other incidentals involved in conducting routine and initial pile load tests, including installation of piles for initial load tests.

The contract unit rate for reinforcement in cast in-situ driven and bored piles shall be as per Section 1600 of these Specifications.

The contract unit rate for installation of piles shall include full compensation for furnishing all labour, materials, tools and equipment, and incidentals for doing all the works involved in driving timber, precast concrete and steel piles, driving or making bores for cast in-situ driven and bored concrete piles, cutting off pile heads, all complete in place to the specified penetration of piles. Providing temporary liner/casing and its withdrawal and placing reinforcement in position shall also be deemed to be included in the rate for installation of piles and no additional payment shall be made for the same.

The contract unit rate for permanent steel liners shall include cost of all labour, fabrication, treatment to the liner and placing the steel liner to the required depth as shown on the drawings and as ordered by the Engineer.

The contract unit rate for concrete in pile cap shall cover all costs of labour, materials, tools, plant and equipment, formwork and staging including placing in position, sampling and testing and all as per Section 1700 of these Specifications. Unit rate quoted shall also include the treatment to be given to the surfaces of the pile cap. Reinforcement in the pile cap shall be paid for separately as per Section 1600 of these Specifications.

1200

WELL FOUNDATIONS

1201 DESCRIPTION

The work shall consist of construction of well foundation, taking it down to the founding level by sinking through all kinds of substrata, plugging the bottom, filling the well with approved material, plugging the top and providing a well cap, in accordance with the details shown on the drawings and as per these specifications, or as directed by the Engineer.

1202 GENERAL

1202.1 Wells may have a circular, rectangular or D-shape in plan and may consist of one, two or more compartments in plan.

1202.2 In case of well foundations of size larger than 12 m diameter, supplemental construction specifications will be necessary.

1202.3 The subsurface geotechnical investigations to be carried out before commencement of work of well foundations shall be in accordance with relevant clauses of **Section 1900** of these Specifications.

1202.4 In case blasting is anticipated for facilitating sinking through difficult strata such as boulders and rock, special protective/strengthening measures for the curb and steining of the well will be required.

1202.5 Pneumatic sinking may have to be resorted to in cases where the well has to be sunk through rock/hard strata or where there are obstacles such as tree trunks, large sized boulders etc., which cannot be removed by open dredging. In such cases, the decision regarding adoption of pneumatic sinking shall be taken on the basis of results of confirmatory bores and as directed by the Engineer.

1203 SETTING OUT AND PREPARATIONS FOR SINKING

1203.1 Necessary reference points shall be accurately fixed to mark x-x axis along the direction of traffic and y-y axis normal to direction of traffic. Such reference points shall be away from the zone of blow-ups or possible settlements which may result from well sinking operations and shall be connected to the permanent stations with the base line on the banks. The centre of the individual wells shall be marked with reference to these stations. The distances between the wells shall be checked with the help of precision instruments.

1203.2 A temporary benchmark shall be established near the well foundation, away from the zone of blow-ups or possible settlement. The bench mark shall be checked regularly with respect to the permanent bench mark established at the bridge site.

1203.3 For wells located on the banks of the river or in dry area, the bed may be

prepared by excavating the soil up to 1.5 m, followed by levelling and dressing before placing the cutting edge.

1203.4 For wells which are to be located in water, a sand island shall be constructed for laying the cutting edge and well curb. Sand islands are practicable for water depths of up to 5 m under stable bed soil conditions. Where the depth of water is greater than 5 m or in fast flowing rivers or for locations where soil is too weak to sustain sand island, floating caissons may have to be adopted.

The plan dimensions of sand islands shall be such as to have a working space of at least 2 m all around the steining of the well. Sand islands shall be maintained to perform their functions, until the well is sunk to a depth below the original bed level at least equal to the depth of water at that location.

The sand island shall be held in position and protected against scour by means of wooden ballies properly braced or sheet piles. The top level of the sand island to be decided by the Engineer, shall be sufficiently above the prevailing water level so that it is not affected by wave action.

1203.5 Equipment shall be deployed for construction of well foundation as required and as directed by the Engineer. Generally, the following equipment may be required for the work:

- a) crane with grab buckets – capacity 0.5 cum to 2.0 cum
- b) submersible pumps
- c) air compressors, air locks and other accessories where pneumatic sinking of well is anticipated
- d) chisels of appropriate sizes
- e) aqua-header for cutting rocky strata
- f) diving helmets and accessories
- g) batching plants for concrete production
- h) equipment for transportation, placing and compaction of concrete

1204 CUTTING EDGE

1204.1 The cutting edge shall be made from structural steel sections conforming to Section 1900 of these Specifications and shall be strong enough to facilitate sinking of the well through the type of strata expected to be encountered. The weight of the cutting edge shall not be less than 40 kg per metre length. It shall be properly anchored into the well curb as shown on the drawing.

1204.2 When there are two or more compartments in a well, the bottom of the cutting edge of the inner walls shall be kept at about 300 mm above that of outer walls.

1204.3 In V shaped cutting edge, the inclined plate should meet the vertical plate in such a way that full strength connection by welding is feasible.

1204.4 The parts of cutting edge shall be erected on level firm ground about 300 mm above prevalent water level. Temporary supports shall be provided to facilitate fabrication and for maintaining the assembly in true shape. The fabrication may be carried out in the shop or at site. Steel sections shall not be heated and forced into shape. However, "V" cuts may be made in the horizontal portion, uniformly throughout the length, to facilitate cold bending. After bending, such "V" cuts should be closed by welding. Joints in the lengths of structural sections, unless otherwise specified, shall be fillet welded using single cover plate to ensure the requisite strength of the original section.

1205 WELL CURB

1205.1 The well curb shall be such that it will offer minimum resistance while sinking but will be strong enough to be able to transmit superimposed loads from the steining to the bottom plug. The shape and outline dimensions of the curb shall be as shown in IRC:78. The internal angle of the curb shall be about 30° to 37° depending upon geotechnical data of the strata through which the well is to be sunk.

1205.2 The well curb shall be in reinforced concrete having concrete mix in accordance with Table 1700-2 and Table 1700-3 and with minimum reinforcement of 72 kg/cum excluding bond rods. The steel shall be suitably detailed to prevent spreading and splitting of curb during sinking. The outer face of the curb shall be vertical. The bottom ends of vertical bond rods of steining shall be fixed securely to the cutting edge with check nuts or by welds. Concreting of the well curb shall be done in one continuous operation.

1205.3 Steel formwork for well curb shall be fabricated strictly in conformity with the drawing. The formwork on outer face of curb may be removed within 24 hours after concreting while that on inner face shall be removed only after 72 hours.

1205.4 In case blasting is anticipated, the inner face of the well curb shall be protected with steel plates of thickness not less than 10 mm up to the top of the well curb. If considered necessary, the inner face of steining may also be protected with steel plates of 6 mm thickness up to a height of 3 m above the top of the well curb or as specified by the Engineer. The curb as well as 3 m height of steining above the curb, shall be provided with additional hoop reinforcement of 10 mm diameter bars at 150 mm spacing. Additional hoop reinforcement shall be provided in the steining for a further height of up to two times the thickness of steining above the plates, so as to avoid cracking which may arise on account of sudden change in the effective section due to curtailment of plate.

1206 FLOATING CAISSONS

1206.1 Floating caissons are generally fabricated at or near the banks on dry land or in dry docks and then towed into position. For floating caissons, a detailed method statement covering fabrication, floating and sinking operations, shall be prepared and furnished to the Engineer. Such statement shall include the total tonnage of steel involved, fabrication and welding specifications, list of materials and plant and a description of operations and manpower required for the work.

1206.2 Floating caissons shall be of structural steel conforming to Section 1900 of these Specifications. The joints of the fabricated structure shall be absolutely leak-tight and shall be checked against leakage before floating and being towed to site. The reinforcement of the curb and steining of the well shall be fixed inside the shell by welding before the caisson is floated. Stability of floating caissons shall be ensured against overturning and capsizing under the action of water current, wave pressure and wind while being towed and kept in position. To maintain the stability of the shell while being floated, it may be provided with ballast in the form of water filling up to required level or filling with small amount of concrete. It shall be ensured that the draught of the floating caisson is always less than the depth of water available, so as to facilitate its smooth hindrance-free movement while being towed.

1206.3 Height of caisson shall be planned to ensure that at any given time, at least one metre of the shell shall be above water level. In case the location is affected by the action of waves, the height shall be suitably increased to avoid water spilling into the caisson. In case the bed has soft soil, the caisson shall be provided with 3 to 5 metres of additional height, as it may sink by itself after grounding in bed. Simultaneous sinking and concreting is required to prevent caisson from tilting. In sandy stratum especially with strong water current, appropriate additional height of caisson is necessary for accommodating local scour.

1206.4 The floating caisson shall be held in position against untoward movement by wire ropes/chains, using winches mounted on stationary suitable platforms/buoys or similar anchoring systems. Anchoring in minimum three directions, shall be provided to prevent unacceptable longitudinal and lateral movement. The anchoring system shall permit small movements in order to facilitate correct positioning of the caisson at the exact location of the well and until the stage when it is just getting grounded. Special care is necessary where variation in water level is frequent, e.g. in tidal zones.

1206.5 After being held in correct position, concreting of the floating caisson shall be commenced. The concrete mixed in batching plants, shall be carried to the floating caisson on barges and placed in position through concrete pumps or tremie. When large volumes of concreting are involved, the batching plant concrete pump, crane etc, may all be mounted on a barge kept in the vicinity of the caisson. As no vibration is possible inside the shell, it shall be ensured that the concrete has a slump of 150 to 200; alternatively, self-compacting concrete can be used. The concrete shall be carefully placed uniformly all around the caisson so that it settles vertically without any tendency to tilt.

1207 WELL STEINING

1207.1 The dimensions, shape, concrete strength and reinforcements of the well steining shall strictly conform to those shown on the drawings. The formwork shall preferably be of M.S. sheets shaped and stiffened suitably. In case timber forms are used, they shall be lined with plywood or M.S. sheets.

1207.2 The height of the first lift of steining to be cast above the well curb shall not be more than 2 m and subsequent lifts shall not exceed the diameter of the well or the depth of well to be sunk below the bed level at any time. For stability, the first lift of steining shall be cast only after sinking the curb at least partially. Concreting of steining may be carried out in subsequent lifts of about 2 to 2.5 m. Attempts should be made to minimize the number of construction joints. The concreting layers shall be limited to 450 mm restricting the free fall of concrete to not more than 1.5 m. Laitance formed at the top surface of a lift shall be removed to expose coarse aggregates before setting of concrete at the proposed construction joint. As far as possible, construction joints shall not be kept at the location of laps in the vertical steining bars.

1207.3 The steining of the well shall be built in one straight line from bottom to top such that if the well is tilted, the next lift of steining will be aligned in the direction of the tilt. The work will be checked carefully with the aid of straight edges of lengths approved by the Engineer. Plumb bob or spirit level shall not be used for alignment. After sinking of a stage is complete, damaged portions if any, of steining at top of the previous stage shall be properly repaired before constructing the next stage.

1207.4 For measuring the height of steining, it shall be marked with at least 4 gauges, two in traffic direction and two normal to traffic direction, distributed equally on the outer face of the well. The marking shall be in the form of a 100 mm wide strip painted on the steining, with every metre marked in black paint. Marking of the gauges shall be done carefully and accurately with a steel tape, starting with zero at the bottom of the cutting edge. The marking shall be continued upwards as each lift of steining is added.

1207.5 After reaching the founding level, the well steining shall be inspected to check for any damage or cracks. The Engineer will direct and the Contractor shall execute the remedial measures, if required, before acceptance of the well steining. In case the well is found to be unacceptable even after remedial measures are carried out, then it shall stand rejected.

1208 WELL SINKING**1208.1 General**

The well shall be sunk true and vertical through all types of strata. No well shall be permitted to be placed in a pre-dredged hole.

Sinking or loading of the well with kentledge shall be commenced only after the steining has been cured for at least 48 hours or as specified in the drawings.

The well shall be sunk by excavating the material uniformly from inside the dredge hole using cranes with grab buckets of appropriate capacity. Use of water jetting, explosives and divers may be adopted for sinking of wells through difficult strata, with prior approval of the Engineer. Well sinking can also be carried out by jack down method.

Normally dewatering of well should not be permitted as a means for sinking the well. It shall never be resorted to if there is any danger of sand blowing under the well. Dewatering shall however be done when well is to be founded in rock. Pneumatic sinking may have to be resorted to where obstacles such as tree trunks, large sized boulders etc. are met or when there is hard strata which cannot be removed by open dredging. The necessity for adopting pneumatic sinking shall be decided by the Engineer.

Complete history of sinking of each well giving details of concreting, sinking and problems met, if any, shall be maintained in the format given in Appendix 1200/I.

1208.2 Sand Blows in Wells

Dewatering of the well shall not be carried out if sand blows are expected. Any equipment or men working inside the well, shall be brought outside the well as soon as there are any indications of sand blow occurring. Sand blow can often be minimized by keeping the level of water inside the well higher than the water table and also by adding heavy kentledge.

1208.3 Use of Kentledge for Sinking of Well

Kentledge shall be placed in an orderly and safe manner on the loading platform and in such a way that it does not interfere with the excavation of the material from inside the dredge hole and also does not in any way damage the steining of the well.

Where tilt has occurred or there is a danger of well developing a tilt, the position of the load shall be regulated in such a manner as to provide greater sinking effort on the higher side of the well.

1208.4 Use of Water Jetting

Water jetting can be used to facilitate sinking of wells through clay/hard strata. The decision regarding use of water jetting shall be taken at the design stage itself, based on geotechnical investigations which may be indicating presence of hard, clayey strata. For carrying out water jetting, the required number of steel pipes of 40 to 50 mm diameter shall be embedded in the steining of the well, spaced evenly around its periphery. The bottom of the steel pipe shall taper down to a nozzle exiting in the sloping face of the well curb. The diameter of the nozzle

shall be 6 mm. The steel pipe shall be kept about 1m above the top of each lift of steining, so that it can be extended by means of suitable couplers before the next lift of steining is cast. When the well reaches the hard strata and the need for water jetting arises, the tops of the embedded pipes shall be connected to pumps of required capacity for pumping in water at high pressure. The water jet issuing from the nozzle of the pipe under high pressure, cuts through the hard material and loosens it, permitting the well to sink at a faster rate than would otherwise have been possible. When water jetting is to be adopted, the Contractor shall furnish a method statement for approval of the Engineer covering all aspects of the work including the number, capacity and location of the high pressure pumps and other ancillaries required for executing the work.

1208.5 Use of Jack Down Method

The jack down method of sinking shall be adopted as per requirement or as directed by the Engineer. The first step shall be to install ground anchors outside the periphery of the well. The number, location and depth of ground anchors are decided based on the properties of the surrounding soil to develop the necessary resisting force through skin friction. The drill holes of about 150 mm diameter along with casings shall be taken down to a depth of about 20 m or more below the founding level of the well, depending on requirements of design. After the holes have been drilled to the required depth, prestressing strands of adequate diameter and capacity are cut to the desired length and lowered into the holes. The holes shall then be grouted with cement slurry with non-shrink additive. Once the grouting is completed till the ground level, the casing is removed. The removal of the casing shall be done before the grout sets. In case rock is met with, the anchors shall be socketed into rock.

Heavy duty pressurization girders fabricated of steel, shall be placed over stools resting on the steining of the well, against which the hydraulic jacks connected to the ground anchors, can exert pressure to push the well down. The hydraulic jacks shall be of capacity 500 T or more as per requirement. Before applying pressure from the jacks, 1 m deep sump is created inside the well by dredging. Pressure on different jacks is exerted in such a manner as to neutralize any tendency of the well to tilt. With the use of the jacks and controlled dredging, high rates of sinking can be achieved and the chances of sand blowing can also be reduced.

For use of jack down method of sinking, the Contractor shall furnish a method statement for approval of the Engineer, giving full details of construction of ground anchors, fabrication of pressurizing girder, type, number and capacity of jacks to be used, method of dredging and application of jack down force and all other relevant aspects for proper execution of the work.

1208.6 Use of Explosives

Mild explosive charges may be used as an aid for sinking of the well. All prevalent laws

concerning handling, storing and using of explosives shall be strictly followed. All safety precautions shall be taken as per IS:4081 "Safety Code for Blasting and related Drilling Operations", to the extent applicable, whenever blasting is resorted to.

When the likelihood of resorting to blasting is predicted in advance, protection of the bottom portion of the well shall be done as per Clause 1205.4.

Blasting of any sort shall be done only with prior permission and in the presence of the Engineer. Blasting shall not be done before the concrete in the steining has hardened sufficiently and is more than 7 days old.

After blasting operations are completed, the well curb and steining should be examined for any cracks and remedial measures taken if required.

If blasting has been done after the well has reached the design foundation level, normally 24 hours shall be allowed to lapse before the bottom plug is laid.

The charges shall be exploded well below the cutting edge by making a sump so as to avoid chances of any damage to the curb or to the steining of the well. A minimum sump of 1 m depth should be made before resorting to blasting. Use of large charges, 0.7 kg or above, may not be allowed, except under expert direction and with the permission of the Engineer. The pattern of charges may be suitably arranged with delay detonators so as to reduce the number of charges fired at a time. The burden of the charge may be limited to 1 m and the spacing of holes may normally be kept as 0.5 m to 0.6 m.

There should be no equipment inside the well nor shall there be any worker in the close vicinity of the well at the time of exploding the charges.

If rock blasting is to be done for seating of the well, the damage caused by flying debris should be minimised by covering blasting holes with rubber mats before detonating the charge.

1208.7 Use of Divers

Divers may be used for removal of obstructions during sinking, carrying out rock blasting and for inspection. All safety precautions shall be taken as per any acceptable safety code or any statutory regulations in force, when divers carry out work under water in the well.

Only persons trained in diving operations shall be employed after being certified fit for diving by an approved doctor. They shall work under expert supervision. The raising of the diver from the bottom of wells shall be controlled so that decompression rate conforms to the rate as laid down in relevant regulations.

The diving and other equipment shall be of acceptable standard and certified to this effect by an approved independent agency. They shall be well maintained as per requirements for safe use.

Arrangement for ample supply of low pressure clean cool air shall be ensured through an armoured flexible hose pipe. Standby compressor shall be provided to cover the contingency of breakdown of the compressor.

Separate high pressure connection shall be made for use of pneumatic tools. Electric lights where provided shall be at 50 volts (maximum).

1208.8 Use of Pneumatic Sinking

1208.8.1 General

The Engineer shall familiarize himself with particular reference to 'caisson diseases' and working of the medical air-lock. A doctor competent to deal with cases of 'caisson diseases' or other complications arising as a result of working under high pressure, shall be stationed at the construction site when pneumatic sinking is under progress.

The Contractor shall provide complete facilities and ensure strict enforcement of the requirements outlined in these specifications.

Safely provisions as contained in IS:4138 and in these specifications shall be strictly followed.

Pneumatic sinking shall be limited to a depth of 30 m below ground level.

1208.8.2 Man Locks and Shafts

Locks, reducers, and shaft used in connection with caissons shall be of riveted construction throughout. The material used in their manufacture shall be steel plate with thickness not less than 6 mm.

Shafts shall be subjected to hydrostatic or air pressure test so as to ensure leak-tightness at a pressure of at least 0.5 MPa. The pressure at which testing has been done shall be clearly and visibly displayed.

The shaft shall be provided with safe, proper and suitable staircase for its entire length including landing platforms which shall be not more than 6 m apart. Where this is impracticable due to space constraints, suitable ladders along with landing platforms shall be installed. These shall be kept clear and in good condition at all times and shall be constructed, inspected and maintained to the entire satisfaction of the Engineer.

A 1 m wide platform with 1 m high railing shall be provided all round the caisson air locks.

Where 15 or more men are employed, caissons shall have two locks, one of which shall be used as a man-lock.

Locks shall be located so that the lowest part of the bottom door shall not be less than 1 m above the highest water level in the well.

The supply of fresh air to the working chamber shall at all times be sufficient to permit work to be done without any danger or excessive discomfort. All air supply lines shall be fitted with check valves.

A man lock shall be used solely for the compression or decompression of workers and not for the passage of plant and material and shall be maintained in a reasonably clean and sufficiently warm state. However, any hand tool or hand instruments used for the purpose of the work may be carried into the man lock.

Where it is not reasonably practicable to provide a separate man lock for use by workers only, the lock when it is in actual use for compression or decompression of a person, shall be in a reasonably clean and sufficiently warm state and shall not be put simultaneously to any other use.

1208.8.3 Valves

Exhaust valves shall be provided, having risers extending to the upper part of the chamber. These shall be operated, whenever necessary specially after a blast. Precautions shall be taken that men are not allowed to resume work after a blast, until the gas and smoke have cleared.

1208.8.4 Medical Supervision and Certification

Every employee absent from work for 10 or more consecutive days due to illness or any other disability, shall be required to pass the regular physical examination by the doctor before being permitted to return to work.

After a person has been employed continuously in compressed air for a period of 2 months, he shall be re-examined by the doctor and shall not be permitted to work until such re-examination has been made and the report is satisfactory.

No person known to be addicted to the excessive use of intoxicants shall be permitted to work in compressed air.

The doctor shall, at all times, keep a complete and full record of examination made by him, which shall contain dates of examinations, a clear and full description of the persons examined, his age and physical condition at the time of examination and a statement as to the period for which he has been engaged in such work. Records shall be kept at the place where the work is in progress and shall be subject to inspection by authorized officers.

Every man lock shall always have a doctor or a responsible person in attendance. In case the person in charge is not a doctor, he must have positive means of promptly communicating with and securing the services of a competent doctor in case of emergency. Such arrangements shall invariably be subject to the approval of the Engineer.

All cases of compressed-air illness shall be reported and copies of all such reports shall be kept in file at the place of work.

1208.8.5 Lighting

All lighting in compressed air chambers shall be operated only by electricity. Two independent electric lighting systems with independent sources of supply shall be used. These shall be so arranged that the emergency source shall become automatically operative in case of failure of the regularly used source.

The minimum intensity of light on any walkway ladder, stairway, or lower working level shall be one-quarter (1/4) candlepower. In all work places, the lighting shall always be such as to enable workmen to see their way about clearly. All external parts of lighting fixtures and electrical equipment lying within 2.5 m above the floor shall be constructed of non-combustible, non-absorbing insulating materials. If metal is used, it must be effectively earthed. Portable lamp shall have non-combustible, non-absorbing insulating sockets, approved handles, basket guards and approved cables. The use of worn out or defective portable and pendant conductors is prohibited.

1208.8.6 Safety Against Fire Hazard

No oil, gasoline, or other combustible material shall be stored within 30 m of any shaft, caisson or tunnel opening. It shall be positively ensured that leaking flammable liquids do not flow into such areas. Oil may be stored in suitable tanks in isolated fireproof buildings, which are not less than 15 m away from any shaft, caisson, or tunnel opening or any building directly connected thereto.

Where feasible, a fire hose connected to a suitable source of water shall be provided at the top of every caisson. Where fire mains are not accessible, water shall be stored in tanks near the top of every caisson, provided fire pails or suitable pumps are kept available. Approved fire extinguishers shall also be provided.

1208.8.7 Sanitation

Properly heated, lighted and ventilated dressing rooms shall be provided for all employees engaged in compressed air work. Such rooms shall contain lockers and benches and be open and accessible to person during intermissions between shifts. Adequate toilet accommodation of one for every twenty five employees shall be provided.

Care shall be taken to keep all parts of the caissons and other working compartments, including locker rooms, dry rooms, rest rooms and other equipment in good sanitary condition and free from refuse, decaying or other objectionable matter.

Smoking shall be strictly prohibited and matches and smoking materials shall not be allowed to be brought into the locker rooms.

A separate dry room shall be provided where working clothes may be dried in a reasonable time.

1208.8.8 Protection Against Gases

In all cases where release of gas is expected as in the case of sinking through alluvium impregnated with decayed vegetable matter, the use of Davy Safety Lamp shall be compulsory.

1208.8.9 Additional Safety Provisions

- a) The weight of the pneumatic platform and that of steining and kentledge, if any, shall be sufficient to resist the uplift from air inside, skin friction being neglected in this case. If at any section, the total weight acting downwards is less than the uplift pressure of air inside, additional kentledge shall be placed on the well.

If it is not possible to make the well heavy enough during excavation, "blowing down" may be used. The men should be withdrawn and air pressure reduced. The well should then begin to move with small reduction in air pressure. "Blowing down" should only be used when the ground is such that it will not heave up inside the chamber when the pressure is reduced. When the well does not move with the reduction in air pressure, kentledge should be added. "Blowing down" should be in short stages and the drop should not exceed, 0.5 m at any stage. To control sinking during blowing down, use of packing is recommended.

- b) The pneumatic sinking plant and other allied machinery shall not only be of proper design and make, but also shall be operated by competent and well trained personnel. Every part of the machinery and its fixtures shall be minutely examined before installation and use. Availability of appropriate spares, standbys, safety of personnel as recommended in IS:4138 for working in compressed air must be ensured at site. Codes for safety and for working in compressed air and other labour laws and practices prevalent in the country, as specified to provide safe, efficient and expeditious sinking shall be followed.

- c) Inflammable materials shall not be taken into air locks and smoking shall be prohibited. Wherever gases are suspected to be issuing out of dredge hole, the same shall be analysed by trained personnel and necessary precautions adopted to avoid hazard to life and equipment.
- d) Where blasting is resorted to, it shall be carefully controlled and all required precautions shall be observed. Workers shall be allowed inside after blasting only when a competent and qualified person has examined the chamber and steining thoroughly and found the same to be safe.

1208.9 Precautions During Sinking

- a) When wells have to be sunk close to each other and clear distance between them is less than the diameter of wells, sinking shall be taken up on all wells and they shall be sunk alternately so that the sinking proceeds uniformly. Simultaneous and even dredging shall be carried out in the wells in such a manner that the difference in the levels of the sump and cutting edge in the adjacent wells does not exceed half the clear gap between them. Plugging of all the wells shall be done together.
- b) During sinking of double D-shaped wells, the excavation in both the dredge holes should be carried out simultaneously and equally.
- c) Bore chart shall be referred to constantly during sinking for taking adequate care while piercing different types of strata. The type of soil as obtained during the well sinking should be compared with bore chart so as to take prompt decisions.
- d) Before seasonal floods, all wells on which sinking is in progress shall be sunk to sufficient depths below the designed scour level. Further, they shall be temporarily filled and plugged so that they do not suffer any tilt or shift during the floods.
- e) All necessary precautions shall be taken against any possible damage to the foundations of existing structures in the vicinity of the wells, prior to commencement of dredging from inside the well.
- f) The dredged material shall not be allowed to accumulate around the well. It shall be dumped and spread, as far away as possible, and then continuously and simultaneously removed, as directed by the Engineer. In case the river stream flows along one edge of the well being sunk, the dredged material shall not be dumped on the dry side of the bank but on the side on which the river current flows.
- g) Very deep sump shall not be made below the well curb, as it entails risk of jumping (sudden sinking) of the well. The depth of sump shall

be generally limited to one-sixth of the outer diameter/least lateral dimension of the well in plan. Normally the depth of sump shall not exceed 3.0 m below the level of the cutting edge unless otherwise specially permitted by the Engineer.

- h) In case a well sinks suddenly with a jerk, the steining of the well shall be examined to the satisfaction of the Engineer to see that no damage has occurred to it.
- i) In pneumatic sinking, the well shall not, at any time, be dropped to a depth greater than 500 mm by the method of "blowing down".
- j) Dewatering shall be avoided if sand blows are expected. Any equipment and men working inside the well shall be brought out of the well as soon as there are any indications of a sand-blow.
- k) Sand blowing in wells can often be minimized by keeping the level of water inside the well higher than the water table and also by adding heavy kentledge.
- l) In soft strata prone to settlement/creep, the construction of the abutment wells shall be taken up only after the approach embankment for a sufficient distance near the abutment, has been completed.

1208.10 Tilts and Shifts

Unless otherwise specified, the tilt of any well i.e. its inclination from the vertical, shall not exceed 1 (horizontal) in 80 (vertical). The shift of the well i.e. the horizontal displacement of the centre of the well at the founding level from its theoretical position, shall not be more than 150 mm in any resultant direction.

Tilts and shifts shall be carefully checked and recorded regularly during sinking operations in the format given in Appendix 1200/II. For the purpose of measuring the tilts along the two axes of the bridge, reduced level of the marks painted on the surface of the steining of the well shall be taken. For determination of shift, locations of the ends of the two diameters shall be precisely measured along the two axes, with reference to fixed reference points.

Whenever any tilt is noticed, adequate corrective measures like placing eccentric kentledge, pulling, strutting, anchoring or depositing more dredged material outside the tilted face, water/air jetting, shall be adopted before any further sinking. After correction, the dredged material shall be removed and disposed of sufficiently away from the affected well. In case of sinking by jack down method tilt can be controlled by suitably adjusting jack down pressure on one side.

A pair of wells close to each other have a tendency to come closer while sinking. Timber struts may be introduced in between the steining of these wells to prevent such movement.

Tilts occurring in a well during sinking in dipping rocky strata can be controlled by suitably supporting the curb.

In the event of a well developing tilt or shift beyond the specified permissible values, the Contractor shall have to carry out, at his own cost, suitable remedial measures to the satisfaction of the Engineer, to bring the tilt and shift within permissible values.

If the resultant tilt and shift of any well exceeds 1 in 80 or 150 mm respectively the well so sunk shall be regarded as not conforming to specification and classified as substandard work. The Engineer in his sole discretion, may consider accepting such a well, provided:

- i) Calculations for foundation pressures and steining stresses, accounting for the actual tilt and shift furnished by the Contractor show that the well is safe. remedial measures required to bring the stresses within permissible values (such as increase in the dimension of the well cap, provision of dummy weights on the well cap etc.), shall be carried out by the Contractor at his own cost.
- ii) The Contractor shall be subjected to reduction in rates as a penalty in accordance with Clause 1215(g).

In case the Engineer, in his discretion, rejects the well, the Contractor shall dismantle the rejected well to the extent directed by the Engineer and remove the debris. Further, the Contractor shall at his own risk and cost, complete the bridge with modified span arrangement acceptable to the Engineer.

1208.11 Seating of Wells

The well shall be uniformly seated on the founding strata. It shall be ensured by test borings that the properties of the soil encountered at the founding level and up to a depth of one and a half times the well diameter, is identical to that adopted in the design. The procedure for test boring shall be in accordance with the provisions of these Specifications. In case the soil encountered is inferior to that adopted in design, the well shall be re-designed by the Engineer adopting the soil properties actually encountered and the founding level intimated to the Contractor, who shall carry out the work accordingly.

In case of seating of wells in hard rocky strata, where the rock profile is steeply sloping, pneumatic methods of sinking may be adopted to seat the well evenly as directed by the Engineer. The decision of adopting pneumatic sinking shall be taken by the Engineer. The cutting edge may also be embedded for a suitable depth in the rocky strata, as decided by the Engineer keeping in view the quality of rock. A sump of depth 300 mm in hard rock or 600 mm in ordinary rock shall be made inside the well by chiselling or blasting as approved by Engineer. Diameter of sump shall be 1.5 m to 2 m less than that of the dredge hole. After

the well has been evenly seated on good hard rock, arrangements shall be made to facilitate proper inspection in dry and visible conditions before the bottom plug is laid.

1209 BOTTOM PLUG

A bottom plug of concrete shall be provided in all wells, the top level of which shall be kept a minimum of 300 mm above the top of the curb, as shown in IRC:78. A suitable sump shall be made below the level of the cutting edge. Before concreting the bottom plug, it shall be ensured that the inside faces of curb and steining have been cleaned thoroughly.

The concrete mix used in bottom plug shall have a minimum cement content of 330 kg per cu.m with a slump about 150 mm, to permit easy flow of concrete through tremie to fill up all cavities. Concrete shall be laid in one continuous operation till the dredge hole is filled to the required height. For under water concreting, the concrete shall be placed by tremie under still water condition and the minimum cement content shall not be less than 330 kg/m³ inclusive of all mineral admixtures, if added.

In case of grouted concrete, the grout mix shall not be leaner than 1:2. It shall be ensured that the grout fills up all interstices upto the top of the bottom plug by suitable means such as, controlling the rate of pumping etc.

Any dewatering required, shall only be done 7 days after casting of bottom plug.

The concrete production and placement equipment should be sufficient to enable under water concreting within stipulated time. Necessary standby equipment should be available for emergency situation.

Before commencing plugging, all loose material from the bottom of the well shall be removed. Concreting shall be done in one continuous operation till the dredge hole is filled up to the required height and thereafter soundings shall be taken to ensure that the concrete has been laid to the required height. Least disturbance shall be caused to the water inside the well while laying concrete in the bottom plug. The concrete after placing, shall not be disturbed in any way for at least 7 days.

In order to check whether there is any rise in the level of the bottom plug, soundings should be taken at the close of concreting and once every day for the next 3 days.

The soundness of the bottom plug may be tested by dewatering the well to a level 5 m below the surrounding water level and checking the rise of water. For foundation subjected to artesian pressure, the depth of dewatering by 5 m shall be measured from the still water level created inside the well by the construction of false steining. The rate of rise shall preferably be less than 10 cm per hour. In case the rate is higher, suitable remedial measures as directed by the Engineer, shall be taken by the Contractor at his own cost.

1210 SAND FILLING

Sand filling shall commence 7 days after laying of bottom plug. The level of the top of the bottom plug shall be verified before starting sand filling.

The sand shall be clean and free from earth, clay clods, roots, boulders, shingles, etc. and shall be compacted as directed. Sand filling shall be carried out up to the level shown on the drawing or as directed by the Engineer.

1211 TOP PLUG

After filling sand up to the required level, a top plug of 300 mm thick concrete of grade M 15, shall be provided over it as shown on the drawing or as directed by the Engineer.

1212 WELL CAP

A reinforced cement concrete well cap will be provided over the top of the steining in accordance with the drawing. Formwork will be prepared conforming to the shape of well cap. In case sand filling has been carried out up to the top of the well, the concrete of the well cap may be laid directly on it after it has been suitably levelled. Otherwise, suitable shuttering supported on the inside of the steining, shall be provided for carrying the weight of the green concrete of the well cap.

Concreting shall be carried out in dry condition. A properly designed false steining may be provided where required, to ensure that the well cap is laid in dry condition.

The bottom of the well cap shall be laid preferably as low as possible but above the LWL in the active channel. Where the bed level is higher than the LWL, the top of the well cap may be suitably raised and kept 1m below existing ground level.

Bond rods of steining shall be anchored into the well cap.

1213 TOLERANCES

The permissible tilt and shift shall not exceed 1 (horizontal) in 80 (vertical) and the shift at the well base shall not be more than 150 mm in any resultant direction.

For the well steining and well cap, the permissible tolerances shall be as follows:

- a) Variation in dimension : +50 mm, -10 mm

- b) Misplacement from specified position in plan : 15 mm
- c) Surface unevenness measured with 3 m straight edge : 5 mm
- d) Variation of level at the top : ± 25 mm

1214 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1215 MEASUREMENTS FOR PAYMENT

All quantities shall be measured from the drawing, or as ordered by the Engineer, excepting those required to be provided by the Contractor at his cost.

- a) The structural steel in cutting edge shall be measured in tonnes based on the net weight of metal used in it, as per Section 1900 of these Specifications.
- b) The concrete in curb, well steining and well cap shall be measured in cubic metres in each of the items as per Section 1700 of these Specifications.
- c) The steel reinforcement shall be measured in tonnes separately in each of the items, as per Section 1600 of these Specifications.
- d) The measurement for well sinking shall be made in running metres for different depths and in different types of strata (e.g. predominantly sand/clay soil, ordinary rock, hard rock etc.) as specified in the contract. The depth of sinking shall be measured from the level specified in the contract. If no level has been specified in the Contract, sinking shall be measured from the low water level or from the level at which the cutting edge was laid, whichever is higher.
- e) The quantity of concrete in bottom and top plug shall be measured in cubic metres as per Section 1700 of these Specifications.
- f) The quantity of sand filling shall be measured in cubic metres.

- g) Pneumatic sinking, where required, shall be paid as a separate item and shall be measured in cubic metres of material to be excavated.

1216**RATE**

- a) The contract unit rates of structural steel in cutting edge shall cover all costs of labour, material, tools, plant and equipment, including placing in position, sampling and testing, and, supervision, all as per Section 1900 of these Specifications.
- b) The contract unit rates for concrete in curb, steining, bottom plug, top plug and well cap, shall cover all costs of labour, material, tools, plant and equipment, formwork and staging including placing in position, sampling and testing, and, supervision, all as per Section 1700 of these Specifications and as described in this Section.
- c) The contract unit rates for reinforcement in curb, steining, and well cap, shall cover all costs of labour, material, tools, plant and equipment, including bending to shape, placing in position, sampling, testing and supervision, all as per respective Section 1600 of these Specifications and as described in this Section.
- d) The contract unit rates for sand filling shall cover all costs of labour, material, tools, plant and equipment, including placing in position and supervision.
- e) The contract unit rates for sinking of well shall cover the costs of labour, tools, and equipment and plant and for all operations and other incidentals for sinking of well including seating except pneumatic sinking as described in this Section. The unit rates shall specify the strata such as types of soil, rock, etc. The rate shall cover all testing and supervision required for the work.
- f) The contract unit rate of material to be excavated by pneumatic sinking shall cover all costs of labour, material, tools, plant and other equipment and other incidentals and safety provisions and supervision required for pneumatic sinking as per this Section.
- g) Reduction in contract unit rates for sinking as a penalty, as required under Clause 1208.10.

If any well with tilt and/or shift exceeding the permissible values is accepted by the Engineer, the Contractor shall be subjected to a reduction in the rates for the sinking of well as follows:

S. No.	Amount of Tilt and/or Shift	Percent Reduction on the Rate (s) for Sinking of Whole Well
1)	Tilt exceeding the specified permissible value but equal to or within 1 in 60	5 percent
2)	Tilt exceeding 1 in 60 but equal to or within 1 in 50	10 percent
3)	Tilt exceeding 1 in 50	20 percent
4)	Shift exceeding the specified permissible value but equal to or within 200 mm	2 percent
5)	Shift exceeding 200 mm but equal to or within 300 mm	5 percent
6)	Shift exceeding 300 mm	10 percent

For excessive tilt and shift, the reduction in rates shall be decided separately by the Engineer.

1300

BRICK MASONRY

1301 DESCRIPTION

This work shall consist of construction of structures with bricks jointed together by cement mortar, in accordance with the details shown on the drawings or as approved by the Engineer.

1302 MATERIALS

All materials to be used in the work shall conform to the requirements laid down in **Section 1000** of these specifications.

1303 PERSONNEL

Construction of brick work shall be carried out only by masons having sufficient experience/training in the work.

1304 CEMENT MORTAR**1304.1 Proportioning and Mixing of Mortar**

Cement and sand shall be mixed in specified proportions given on the drawings. Cement shall be proportioned by weight, taking the unit weight of cement as 1.44 tonne per cubic metre. Sand shall be proportioned by volume with due allowance for bulking. All mortar shall be mixed with a minimum quantity of water to produce desired workability consistent with required density. The mix shall be clean and free from soil, acid, alkali, organic matter or other deleterious substances.

The mixing shall be done in a mechanical mixer operated manually or by power. As an exception, hand mixing can also be resorted to as long as uniform density of the mix and its strength are assured. Hand mixing shall be permitted only for very small and isolated works like CD works, subject to the prior approval of the Engineer. Hand mixing shall be carried out on a clean watertight platform, where cement and sand shall be first mixed dry in the required proportion by being turned over and over, backwards and forwards, several times till the mixture is of uniform colour. Thereafter, minimum quantity of water shall be added to bring the mortar to the consistency of a stiff paste. The mortar shall be mixed for at least two minutes after addition of water.

Mortar shall be mixed only in such quantity as required for immediate use. The mix which has developed initial set shall not be used. Initial set of mortar with ordinary Portland Cement shall normally be considered to have taken place in 30 minutes after mixing. In case the mortar has stiffened during initial setting time because of evaporation of water, it can be re-tempered by adding water as frequently as needed to restore the requisite consistency, but such re-tempering shall not be permitted 30 minutes after mixing. Mortar remaining unused for more than 30 minutes after mixing, shall be rejected and removed from site of work.

1304.2 Testing of Mortar

Necessary tests to determine compressive strength of the mortar, its consistency and water resistivity shall be carried out in accordance with IS:2250. For compressive strength tests, the frequency of testing shall be 1 cube for every 2 cu.m of mortar, subject to a minimum of 3 cubes for a day's work.

1305 SOAKING OF BRICKS

All bricks shall be thoroughly soaked in a tank filled with water for a minimum period of one hour prior to being laid. Soaked bricks shall be removed from the tank sufficiently in advance so that they are skin dry at the time of actual laying. Such soaked bricks shall be stacked at a clean place where they are not contaminated with dirt, earth, etc.

1306 JOINTS

The thickness of joints shall not exceed 10 mm. All joints on exposed faces shall be tooled to give concave finish.

1307 LAYING

All brickwork shall be laid in an English bond, even and true to line, plumb and level and all joints accurately kept in accordance with the drawing or as directed by the Engineer. Half and cut bricks shall not be used except when necessary to complete the bond. Closer in such cases shall be cut to the required size and used near the ends of the walls. The bricks used at the face and also at all angles forming the junction of any two walls shall be selected whole bricks of uniform size, with true and rectangular faces.

All bricks shall be laid with frogs up on a full bed of mortar except in the case of tile bricks. Each brick shall be properly bedded and set in position by slightly pressing while laying, so that the mortar gets into all its surface pores to ensure proper adhesion. All head and side joints shall be completely filled by applying sufficient mortar to brick already placed and on brick to be placed. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left. No bats or cut bricks shall be used except to obtain dimensions of the different courses for specified bonds or wherever a desired shape so requires.

The brick work shall be built in uniform layers and for this purpose, wooden straight edge with graduations indicating thickness of each course including joint shall be used. Corners and other advanced work shall be raked back. Brickwork shall be done true to plumb or in specified batter. All courses shall be laid truly horizontal, and vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. During construction, no part of work shall rise more than one metre above the general construction level, to avoid unequal settlement and improper jointing. Where this is not possible, the work shall be raked back according to the bond (and not toothed) at an angle not steeper than 45 degree with prior approval of the Engineer. Tothing may also be permitted where future extension is contemplated.

Before laying bricks in foundation, the foundation slab shall be thoroughly hacked, swept clean and wetted. A layer of mortar not less than 12 mm thick shall be spread on the surface of the foundation slab before the first course of bricks is laid.

1308 JOINTING OLD AND NEW WORK

Where fresh masonry is to join with masonry that is partially/entirely set, the exposed jointing surface of the set masonry shall be cleaned, roughened and wetted, so as to achieve the best possible bond with the new work. All loose bricks and mortar or other material shall be removed.

In the case of vertical or inclined joints, it shall be further ensured that proper bond between the old and new masonry is obtained by interlocking the bricks. Any portion of the brickwork that has been completed, shall remain undisturbed until thoroughly set.

In case of sharp corners specially in skew bridges, a flat cutback of 100 mm shall be provided so as to have proper and bonded laying of bricks.

1309 CURING

Green work shall be protected from rain by suitable covering and shall be kept constantly moist on all faces for a minimum period of seven days. Brick work carried out during the day shall be suitably marked indicating the date on which the work was done, so as to keep a watch on the curing period. The top of the masonry work shall be left flooded with water at the close of the day. Watering shall be done carefully so as not to disturb or wash out the green mortar.

During hot weather, all finished or partly completed work shall be covered or wetted in such a manner as to prevent rapid drying of the brickwork.

During the period of curing, the brick work shall be suitably protected from all damages. At the close of day's work or for other period of cessation, watering and curing shall have to be maintained. Should the mortar perish i.e. become dry, white or powdery through neglect of curing, work shall be pulled down to the extent required and rebuilt as directed by the Engineer. If any stains appear during watering, the same shall be removed from the surface.

1310 SCAFFOLDING

The scaffolding shall be sound, strong and safe to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good. Scaffolding shall be got approved by the Engineer, but its safety shall be the responsibility of the Contractor.

1311 EQUIPMENT

All tools and equipment used for mixing, transporting and laying of mortar and bricks shall be clean and free from set mortar, dirt or other injurious foreign substances.

1312 FINISHING OF SURFACES**1312.1 General**

All brickwork shall be finished in a workmanlike manner with the thickness of joints, manner of striking or tooling as described in these specifications.

The surfaces can be finished by jointing, pointing or plastering, as shown on the drawings.

For a surface which is to be subsequently plastered or pointed, the joints shall be squarely raked out to a depth of 15 mm, while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly cleaned and wetted.

The mortar for finishing shall be prepared as per Clause 1304.

1312.2 Jointing

In jointing, the face of the mortar shall be worked out while still green to give a finished surface flush with the face of the brick work. The faces of brick work shall be cleaned to remove any splashes of mortar during the course of raising the brick work.

1312.3 Pointing

Pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown on the drawing. The mortar shall be filled and pressed into the raked joints before giving the required finish. The pointing shall be ruled type for which it shall, while still green, be ruled along the centre with half round tools of such width as may be specified by the Engineer. The superfluous mortar shall then be taken off from the edges of the lines and the surface of the masonry shall be cleaned of all mortar. The work shall conform to IS:2212. Raised pointing which projects beyond the face of stone, brick or block shall be avoided.

1312.4 Plastering

Plastering shall be done where shown on the drawing. Superficial plastering may be done, if necessary, only in structures situated in fast flowing rivers or in severely aggressive environment.

Plastering shall be started from top and worked down. All holes shall be properly filled in advance of the plastering, while the scaffolding is being taken down. Wooden screeds 75 mm wide and of the thickness of the plaster shall be fixed vertically 2.5 m to 4 m apart,

to act as gauges and guides in applying the plaster. The mortar shall be laid on the wall between the screeds using the plasterer's float and pressing the mortar so that the raked joints are properly filled. The plaster shall then be finished off with a wooden straight edge reaching across the screeds. The straight edge shall be worked on the screeds with a small upward and sideways motion 50 mm to 75 mm at a time. Finally, the surface shall be finished off with a plasterer's wooden float. Metal floats shall not be used.

When re-commencing plastering beyond the work suspended earlier, the edges of the old plaster shall be scraped, cleaned and wetted before plaster is applied to the adjacent areas.

No portion of the surface shall be left unfinished for patching up at a later period.

The plaster shall be finished true to plumb surface and to the proper degree of smoothness as directed by the Engineer.

The average thickness of plaster shall not be less than that specified. The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3 mm.

Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut in rectangular shape and re-done as directed by the Engineer.

1312.5 Curing of Finishes

Curing shall be commenced as soon as the mortar used for finishing has hardened sufficiently so as not to be damaged during curing. The curing shall be done for a period of at least 7 days, during which the finishing shall be suitably protected from all damages.

1312.6 Scaffolding for Finishes

Stage scaffolding independent of the structure, shall be provided for the work of finishing.

1313 COPING FOR WING/RETURN/PARAPET WALL

This work shall consist of providing an architectural coping for wing/return/parapet walls.

The material used shall be cement mortar 1:3 or as shown on the drawings prepared in accordance with Clause 1304.

The cement mortar shall be laid evenly to an average thickness of 15 mm to the full width of the top of the wall and in a band of 150 mm depth along the top outer face of the walls.

1314 ACCEPTANCE OF WORK

All work shall be true to lines and levels as indicated on the drawing or as directed by the Engineer, subject to tolerances as indicated in these specifications.

Mortar cubes shall be tested in accordance with IS:2250 for compressive strength, consistency of mortar and its water retentivity. The frequency of testing shall be one sample for every 2 cubic metres of mortar subject to a minimum 3 samples for a day's work.

In case of plaster finish, the minimum surface thickness shall not be less than the specified thickness by more than 3 mm.

1315 MEASUREMENTS FOR PAYMENT

1315.1 All brick work shall be measured in cubic metres. Any extra work done by the Contractor in excess of the specified dimensions, shall be ignored.

1315.2 In arches; the length of arch shall be measured as the average of the lengths along the extrados and the intrados.

1315.3 The work of plastering and pointing shall be measured in square metres of the surface treated.

1315.4 Coping shall be measured in linear metres.

1316 RATE

1316.1 The contract unit rate for brick work shall include the cost of all labour, materials, tools and plant, scaffolding and other expenses incidental to the satisfactory completion of the work, sampling, testing and supervision as described in these specifications and as shown on the drawings.

1316.2 The contract unit rate for plastering shall include the cost of all labour, materials, tools and plant, scaffolding and all incidental expenses, sampling, testing and supervision, as described in these specifications.

1316.3 The contract unit rate for pointing shall include erecting and removal of scaffolding, all labour, materials, and equipment incidental to completing the pointing, raking out joints, cleaning, wetting, filling with mortar, trowelling, pointing and watering, sampling and testing and supervision as described in these specifications.

1316.4 The contract unit rate for coping shall include cost of all labour, materials, tools and plant, sampling and testing and supervision as described in these specifications.

1400

**STONE AND CONCRETE
BLOCK MASONRY**

1401 DESCRIPTION

This work shall consist of construction of structures with stones or concrete blocks jointed together by cement mortar in accordance with the details shown on the drawings and these specifications or as approved by the Engineer.

1402 MATERIALS

All materials to be used in stone and concrete block masonry, shall conform to Section 1000 of these Specifications, except cement mortar which shall conform to Clause 1304 of these Specifications.

1403 PERSONNEL

Only trained personnel shall be employed for construction and supervision.

1404 TYPE OF MASONRY

The type of masonry used for structures shall be random rubble (coursed or uncoursed) or coursed rubble (first sort) or concrete block. For bridge work generally, coursed rubble masonry shall be used. The actual type of masonry used for different parts of structures shall be specified on the drawings. For facing work, ashlar masonry shall be used where indicated on the drawings.

1405 CONSTRUCTION**1405.1 Stone Masonry****1405.1.1 General**

The dressing of stone shall be as specified for individual type masonry work and it shall also conform to the general requirements of IS:1597 and requirement for dressing of stone covered in IS:1129. Other specific requirements are covered separately with respect to particular types of rubble stone work.

1405.1.2 Laying

1405.1.2.1 The masonry work shall be laid to lines, levels, curves and shapes as shown on the drawing. The height in each course shall be kept same and every stone shall be fine tooled on all beds, joints and faces, full and true. The exposed faces shall be gouged out, grooved, regulated and sunk or plain moulded as the case may be. The faces of each stone between the draft shall be left rough as the stone comes from the quarry, except where sacrificial layer is to be provided or plastering is resorted to in aggressive environment.

1405.1.2.2 Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar.

Stratified stones shall be laid on their natural beds. All bed joints shall be normal to the direction of pressure coming on them.

Stones in the hearting shall be laid on their broadest faces so as to give better facility to fill the spaces between them.

The courses of the masonry shall ordinarily be pre-determined. They shall generally be of the same height. When there is to be variation in the height of courses, the larger courses are to be placed at lower levels, heights of courses decreasing gradually towards the top of the wall. The height of course shall not be less than 160 mm. placing loose mortar on the course and pouring water on it to fill the gaps in stones is not acceptable. Mortar shall be mixed thoroughly and poured in the joints in fluid state. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar.

In tapered walls, the beds of the stones and the planes of course should be at right angles to the batter. In case of bridge piers with batter on both sides, the course shall be horizontal.

The bed which is to receive the stone, shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and vertical joints and settled carefully in place with a wooden mallet immediately on placement and solidly embedded in mortar before it has set. Clean chips and spalls shall be wedged into the mortar joints and bed wherever necessary to avoid thick beds or joints of mortar. When the foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into rock snugly, when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar. For masonry works over rock, a levelling course of 150 mm thick M15 concrete, shall be laid over rock and then stone masonry work shall be laid without foundation concrete block.

Face works and hearting shall be brought up evenly but the top of each course shall not be levelled by the use of flat chips.

For sharp corners specially in skew bridges, through stones shall be used in order to avoid spalling of corners.

In case any stone already set in mortar, is disturbed or the joints broken, it shall be taken out without disturbing the adjoining stones and joints. Dry mortar shall be thoroughly cleaned from the joints and stones and the stones reset in fresh mortar. When freshly laid, no attempt shall be made to slide one stone on top of another.

Shaping and dressing shall be done before the stone is laid in the work. No dressing or hammering, which will loosen the masonry, will be allowed after the stone is placed in position. All necessary chases for joggles, dowels and clamps, should be formed beforehand.

Sufficient transverse bonds shall be provided by the use of bond stone extending from the front to the back of the wall and in case of thick wall, from outside to the interior and vice versa. In the latter case, bond stones shall overlap each other in their arrangement.

In case headers are not available, precast headers of M15 concrete shall be used. Cast in-situ headers are not permitted.

Stones shall break joint on the face for at least half the height of the course and the bond shall be carefully maintained throughout.

In band work at all angle junctions of walls, the stones at each alternate course shall be carried into each of the respective walls so as to unite the work thoroughly.

Building up thin faces tied with occasional through stones and filling up the middle with small broken stones or even dry packing, is not acceptable.

All quoins and the angles of the opening shall be made from selected stones, carefully squared and bedded and arranged to bond alternately long and short in both directions.

All vertical joints shall be truly vertical. Vertical joints shall be staggered as far as possible. Distance between the vertical joints of upper layer and lower layer, shall not be less than half the height of the course.

Only rectangular shaped bond stones or headers shall be used. Bond stones shall overlap each other by 150 mm or more.

All connected masonry in a structure shall be carried up nearly at one uniform level throughout but when breaks are unavoidable, the masonry shall be raked in sufficiently long steps to facilitate jointing of old and new work. The stepping of raking shall not be more than 45 degree with the horizontal.

1405.1.3 Random Rubble Masonry (Uncoursed and Coursed)

1405.1.3.1 Dressing

The stone shall be hammer dressed on the face, the sides and beds to enable it to come in proximity with the neighbouring stone. The bushing on the exposed face shall not be more than 40 mm.

1405.1.3.2 Insertion of Chips

Chips and spalls of stone may be used wherever necessary to avoid thick mortar beds or joints and it shall be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stones to bring these upto the level of face stones. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

1405.1.3.3 Hearting Stones

The hearting or interior filling of the wall face shall consist of rubble stones not less than 150 mm long in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing.

1405.1.3.4 Bond Stones

Through bond stones shall be provided in masonry upto 600 mm thickness and in case

of masonry above 600 mm thickness, a set of two or more bond stones overlapping each other at least by 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.,) the bond stone shall extend only about two-thirds into the wall, as through stones in such cases may give rise to penetration of dampness and therefore, for all thicknesses of such masonry, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. One bond stone or a set of bond stones shall be provided for ever 0.50 sq.m of the masonry surface.

1405.1.3.5 Quoin Stone

Quoin stone specially selected and neatly dressed for forming an external angle in masonry work, shall not be less than 0.03 Cu.m in volume.

1405.1.3.6 Plum Stone

The plum stones are selected long stones embedded vertically in the interior of the masonry to form a bond between successive courses and shall be provided at about 900 mm intervals.

1405.1.3.7 Laying

The masonry shall be laid with or without courses as specified. The quoins shall be laid header and stretcher alternately. Every stone shall be fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints, as much as possible, and to avoid long vertical lines of joints.

1405.1.3.8 Joints

The face joints shall not be more than 20 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

1405.1.4 Coursed Rubble Masonry (First Sort)

1405.1.4.1 Dressing

Face stone shall be hammer dressed on all beds and joints so as to give them rectangular shape. These shall be square on all joints and beds. The bed joints shall be chisel drafted for at least 80 mm back from the face and for at least 40 mm for the side joints. No portion of the dressed surface shall show a depth of gap more than 6 mm from the straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints. The requirements regarding bushing shall be the same as for random rubble masonry.

1405.1.4.2 Hearting Stones

The hearting or interior filling of the wall face shall consist of flat bedded stone carefully laid, on prepared beds in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity

of masonry. While using chips it shall be ensured that no hollow spaces are left anywhere in the masonry.

1405.1.4.3 Bond Stones

The requirements regarding through or bond stone shall be the same as for random rubble masonry, but these, shall be provided at 1.5 to 1.8 metre apart clear in every course.

1405.1.4.4 Quoin Stone

The quoins shall be of the same height as the course in which they occur and shall be formed of header stones not less than 450 mm in length. They shall be laid lengthwise alternately along each face, square in their beds which shall be fairly dressed to a depth of a least 100 mm.

1405.1.4.5 Face Stone

Face stones shall tail into the work for not less than their heights and at least one-third of the stones shall tail into the work for a length not less than twice their height. These shall be laid as headers and stretchers alternately.

1405.1.4.6 Laying

The stones shall be laid on horizontal courses and all vertical joints should be truly vertical. The quoin stones should be laid header and stretcher alternately and shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100 mm.

1405.1.4.7 Joints

The face joints shall not be more than 10 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

1405.1.5 Ashlar Masonry (Plain Ashlar)

1405.1.5.1 Dressing

Every stone shall be cut to the required size and shape, chisel dressed on all beds and joints, so as to be free from all bushing. Dressed surface shall not show a depth of gap of more than 3 mm from straight edge placed on it. The exposed faces and joints, 6 mm from the face shall be fine tooled so that a straight edge can be laid along the face of the stone in contact with every point. All visible angles and edges shall be true and square and free from chippings. The corner stones (quoins) shall be dressed square and corner shall be straight and vertical.

1405.1.5.2 Bond Stones

Through bond stones shall be provided for masonry up to 600 mm thickness and for masonry above 600 mm thickness, a set of two or more bond stones overlapping each other at least by 150 mm, shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.) the bond stone shall extend only about two-thirds into the wall, as through stones in such cases may give rise to penetration of dampness. For masonry with such stones, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. One bond stone or a set of bond stones shall be 1.5 to 1.8 metre apart clear in every course.

1405.1.5.3 Laying

The face stone shall be laid header and stretcher alternately, the header being arranged to come as nearly as possible in the middle of stretchers above and below. Stones shall be laid in regular courses not less than 300 mm in height and all courses of the same height, unless otherwise specified. No stone shall be less in width than its height or less in length than twice its height, unless otherwise specified.

1405.1.5.4 Joints

All joints shall be full of mortar. These shall not be less than 3 mm thick. Face joints shall be uniform throughout, and a uniform recess of 20 mm depth from face shall be left with the help of a stone plate during the progress of work.

1405.2 Concrete Block Masonry**1405.2.1 Laying**

The bed, which is to receive the block, shall be cleaned, wetted and covered with a layer of fresh mortar. The masonry works shall be laid to lines, levels, curves and shapes as shown on the drawing. In battered sections, the beds of blocks and the plane of courses shall be horizontal. Face blocks for such sections shall be manufactured specially for the purpose.

The block shall be soaked in water for at least 15 minutes before laying, to prevent absorption of water from mortar.

Concrete block masonry shall be constructed generally like fine tooled ashlar masonry. Each block must be fitted into its place dry in order that discrepancy of figure may be discovered and corrected before it is finally laid in mortar and settled in bed. The block shall be laid full in thin mortar, the bed and side joints being not more than 15 mm in thickness. Each block shall be struck with a wooden mallet when laid in place in mortar to bring it to solid bearing as to bed and joints. All visible edges shall be free from chippings.

The course shall be horizontal and side joints vertical throughout unless otherwise indicated in plans. Joints shall be struck.

For bond, face blocks shall be laid header and stretcher alternately unless otherwise ordered by the Engineer, the header being arranged to come as nearly as possible in the middle of stretchers below. The blocks in the courses above and below shall break joints for about half the height of the course and bond shall be carefully maintained throughout section.

While carrying out masonry work, templates prepared to the correct shape and approved by the Engineer, shall be used to ensure correct batter as well as correct shape of masonry, specially cut and ease water in piers. The finished work shall be checked at every stage by the competent authority to ensure that it has the correct shape and batter as required by design.

In case of skew bridges and for cut and ease water, the acute angle at the corners shall not be less than 45 degree. In case a smaller angle cannot be avoided, then a flat face of 100 mm shall be provided.

1406 POINTING

Pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown on the drawing. The mortar shall be filled and pressed into the raked out joints before giving the required finish. The pointing shall conform to Clause 1312.3 of these specification. The work shall conform to IS:2212. The thickness of joints shall not be less than 3 mm for ashlar masonry. However, the maximum thickness of joints in different works shall be as follows:

Random Rubble	:	20 mm
Coursed Rubble	:	15 mm
Ashlar Masonry	:	5 mm

1407 CURING

Curing shall conform to Clauses 1309 and 1312.5 of these Specifications.

1408 SCAFFOLDING

For scaffolding, Clause 1310 of these Specifications, shall apply.

1409 WEEP HOLES

Weep holes shall conform to Clauses 2706 of these Specifications.

1410 JOINTING WITH EXISTING STRUCTURES

For jointing with existing structures, the specifications as given for brick masonry under Clause 1308 of these Specifications, shall apply for stone masonry also.

1411 COPING FOR WING/RETURN/PARAPET WALLS

Coping for wing/return/parapet walls shall conform to Clause 1313 of these Specifications.

1412 TESTS AND STANDARDS OF ACCEPTANCE

All work shall be done to the lines and levels as indicated on the drawing or as directed by the Engineer, subject to tolerances as specified in these specifications.

Mortar cubes shall be taken in accordance with IS:2250 for testing of compressive strength, consistency and water retentivity. The frequency of testing shall be one sample for every two cubic metres of mortar subject to a minimum of 3 samples for a day's work.

1413 MEASUREMENTS FOR PAYMENT

1413.1 Stone masonry shall be measured in cubic metres.

1413.2 In arches, the length of arch shall be measured as the average of the lengths along the extrados and the intrados.

1413.3 The work of pointing shall be measured in square metres.

1413.4 Architectural coping shall be measured in linear metres.

1414 RATE

1414.1 The contract unit rate for stone masonry shall include the cost of all labour, materials, tools and plant, scaffolding, sampling and testing, supervision and other expenses incidental to the satisfactory completion of the work as described in these Specifications.

1414.2 The contract unit rate for pointing shall include erecting and removal of scaffolding, all labour, materials and equipment incidental to completing the pointing, raking out joints, cleaning, wetting, filling with mortar, trowelling, pointing and watering, sampling and testing and supervision as described in these specifications.

1414.3 The contract unit rate for coping shall include the cost of all labour, materials, tools and plant, sampling and testing and supervision as described in these specifications.

1500

FORMWORK

1501 DESCRIPTION

Formwork shall include all temporary or permanent forms required for forming the concrete of the shape, dimensions and surface finish, as shown on the drawing or as directed by the Engineer, together with all props, staging, centering, scaffolding and temporary construction required for their support.

1502 MATERIALS

All materials shall comply with the requirements of IRC:87. Materials and components used for formwork shall be examined for damage or excessive deterioration before use/re-use and shall be used only if found suitable after necessary repairs. In case of timber formwork, the inspection shall not only cover physical damages but also signs of attacks by decay, rot or insect attack or the development of splits.

Forms shall be constructed with metal or timber. The metal used for forms shall be of such thickness that the forms remain true to shape. All bolts should be countersunk. The use of approved internal steel ties or steel or plastic spacers shall be permitted. Structural steel tubes used as support for forms shall have a minimum wall thickness of 4 mm. Other materials conforming to the requirements of IRC:87 may also be used if approved by the Engineer.

1503 DESIGN OF FORMWORK

1503.1 The design, erection and removal of formwork shall conform to IRC:87 "Guidelines for Formwork, Falsework and Temporary Structures" and these specifications. The forms shall be such as to ensure that they can be conveniently removed without disturbing the concrete. The design shall facilitate proper and safe access to all parts of formwork for inspection.

1503.2 The Contractor shall furnish the design and drawing of complete formwork (i.e. the forms as well as their supports) for approval of the Engineer before any erection is taken up. If proprietary system of formwork is used, the Contractor shall furnish detailed information as per Appendix 1500/I, to the Engineer for approval.

Notwithstanding any approval or review of drawing and design by the Engineer, the Contractor shall be entirely responsible for the adequacy and safety of formwork.

1503.3 In the case of prestressed concrete superstructure, careful consideration shall be given to redistribution of loads on props due to prestressing.

1504 WORKMANSHIP

1504.1 The formwork shall be robust and strong and the joints shall be leak-proof.

Ballies shall not be used as staging. Staging must have cross bracings and diagonal bracings in both directions. Staging shall be provided with an appropriately designed base plate resting on firm strata.

1504.2 The number of joints in the formwork shall be kept to a minimum by using large sized panels. The design shall provide for proper "soldiers" to facilitate alignment. All joints shall be leak proof and must be properly sealed. Use of PVC joint sealing tapes, foam rubber or PVC T-section, is essential to prevent leakage of grout.

1504.3 As far as practicable, clamps shall be used to hold the forms together. Where use of nails is unavoidable, minimum number of nails shall be used and these shall be of the double-headed type. Alternatively, if the nails are of the normal type, they shall be left partially projecting without being driven to their full length, so that they can be withdrawn easily.

1504.4 Use of ties shall be restricted, as far as practicable. Wherever ties are used they shall be used with HDPE sheathing so that they can easily be removed. No parts prone to corrosion shall be left projecting or near the surface. The sheathing shall be grouted with cement mortar of the same strength as that of the structure.

1504.5 Unless otherwise specified, or directed, chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of the formwork to avoid sharp corners. The chamfers, beveled edges and mouldings shall be made in the formwork itself. Opening for fixtures and other fittings shall be provided in the shuttering as directed by the Engineer.

1504.6 Shuttering for walls, sloping members and thin sections of considerable height shall be provided with temporary openings to permit inspection and cleaning out before placing of concrete.

1504.7 The formwork shall be constructed with pre-camber to the soffit to allow for deflection of the formwork. This shall be in addition to the pre-camber for the permanent structure as shown on the drawings.

1504.8 Where centering trusses or launching trusses are adopted for casting of superstructure, the joints of the centering trusses, whether welded, riveted or bolted shall be thoroughly checked periodically. Also, various members of the centering trusses should be periodically examined for proper alignment and unintended deformation before proceeding with the concreting. They shall also be periodically checked for any deterioration in quality due to steel corrosion. Launching truss, casting truss of span more than 40 m and travelling forms, shall be load tested before they are put to use.

1504.9 The formwork shall be so made as to produce a finished concrete true to shape, line and levels and dimensions as shown on the drawings, subject to the tolerances specified in respective Sections of these specifications, or as directed by the Engineer.

1504.10 Where metal forms are used, all bolts and rivets shall be countersunk and well ground to provide a smooth, plane surface. Where timber is used it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mar the surface of concrete.

1504.11 Forms shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration during and after placing the concrete. Screw

jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete.

1504.12 The formwork shall ensure the correct final shape of the structure, with the calculated amount of positive or negative camber. The deformation of falsework, scaffolding or propping and the instantaneous or deferred deformation due to various causes arising in prestressed structures, shall be properly accounted for.

1504.13 Suitable camber shall be provided to horizontal members of structure, specially in long spans, to counteract the effects of deflection. The formwork shall be so fixed as to provide for such camber.

1504.14 The formwork shall be coated with an approved release agent that will effectively prevent sticking and will not stain the concrete surface. Lubricating oils (machine oils) shall be prohibited for use as coating.

1505 LINING OF FORMWORK

The formwork shall be lined with material approved by the Engineer so as to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and shall be so fixed to its backing as not to impart any blemishes. It shall be of the same type and obtained from only one source throughout for the construction of any one structure. The contractor shall make good any imperfections in the resulting finish as required by the Engineer. Internal ties and embedded metal parts shall be carefully detailed and their use shall be subject to the approval of the Engineer.

1506 PRECAUTIONS

The following precautions shall be observed:

- i) It shall be ensured that any cut-outs or openings provided in any structural member to facilitate erection of formwork, are closed with the same grade of concrete as that of the structure, after formwork is removed.
- ii) Provision for safe access to the formwork shall be made at all levels as required.
- iii) Close watch shall be maintained to check for settlement of formwork during concreting and any settlement shall be promptly rectified.
- iv) Natural ground shall be checked for bearing capacity and likely settlement before erection of the staging.
- v) It shall be ensured that water used for curing or rain water does not stagnate near the base plate of the staging.
- vi) For shutters used for deep and narrow member, temporary openings in the sides shall be provided to facilitate pouring and compaction of concrete.

1507 PREPARATION OF FORMWORK BEFORE CONCRETING

The inside surfaces of forms shall, except in the case of permanent formwork or where otherwise agreed to by the Engineer, be coated with a release agent supplied by approved manufacturer or of an approved material to prevent adhesion of concrete to the formwork. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come in contact with any reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork for exposed concrete.

Before re-use of forms, the following actions shall be taken :

- i) The contact surfaces of the forms shall be cleaned carefully and dried before applying a release agent.
- ii) It should be ensured that the release agent is appropriate to the surface to be coated. The same type and make of release agent shall be used throughout on similar formwork materials and different types should not be mixed.
- iii) The form surfaces shall be evenly and thinly coated with release agent. The vertical surface shall be treated before horizontal surface and any excess wiped out.
- iv) It shall be ensured that the reinforcement or the surface of the hardened concrete shall not come in contact with the release agent.

All forms shall be thoroughly cleaned immediately before concreting.

The Contractor shall give the Engineer due notice before placing any concrete in the forms to permit him to inspect and approve the formwork. However, such inspection shall not relieve the contractor of his responsibility for safety of formwork, men, machinery, materials and finish or tolerances of concrete.

1508 REMOVAL OF FORMWORK

The scheme for removal of formwork (i.e. de-shuttering and de-centering) shall be planned in advance and furnished to the Engineer for scrutiny and approval. No formwork or any part thereof shall be removed without prior approval of the Engineer.

The formwork shall be so removed as not to cause any damage to concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually to avoid any shock or vibration.

Form work shall not be released unless the concrete has achieved strength of at least twice the stress the concrete may be subjected at the time of the removal of formwork. When no

test is conducted for determination of strength of concrete and where the time of removal of formwork is not specified, the same shall be as under :

a)	Walls, piers, abutments, columns and vertical faces of structural members	12 to 48 hours as may be decided by the Engineer
b)	Soffits of Slabs (with props left under)	3 days
c)	Props left under slabs	14 days
d)	Soffits of Girders (with props left under)	7 days
e)	Props (left under girders)	21 days

The above time schedule is applicable when ordinary Portland Cement is used without any admixtures at an ambient temperature exceeding 10°C.

For concrete made with Portland pozzolona cement, Portland slag cement or mineral admixtures, additional cube samples shall be taken for verifying the strength of concrete to decide the time of deshuttering.

Where there are re-entrant angles in the concrete sections, the formwork should be removed at these sections as soon as possible after the concrete has set, in order to avoid cracking due to shrinkage of concrete.

Additional precautions as given in Clause 8.17 of IRC: 87, shall also be followed.

1509 RE-USE OF FORMWORK

When the formwork is dismantled, its individual components shall be examined for damage and damaged pieces shall be removed for rectification. Such examination shall always be carried out before their use again. Before re-use all components shall be cleaned of deposits of soil, concrete or other unwanted materials. Threaded parts shall be oiled after cleaning.

All bent steel props shall be straightened before re-use. The maximum permissible deviation from straightness is 1/600 of the length. The maximum permissible axial loads in used props shall be suitably reduced depending upon their condition. The condition of the timber components, plywood and steel shuttering plates shall be examined closely for distortion and defects before re-use.

1510 SPECIALISED FORMWORK

Specialised formwork such as slipform, floating caisson and travelling form, wherever used shall be designed and detailed by competent agencies and a set of complete working drawings and installation instructions supplied to the Engineer. In case proprietary equipment is used, the supplier shall furnish drawings, details, installation instructions etc, in the form of manuals along with the formwork.

For slipform, the rate of climb of the formwork shall be designed for each individual case taking into account various parameters including the grade of concrete, concrete strength, concrete temperature, ambient temperature and concrete admixtures.

For floating caisson, the details of fabrication, floating to site and placing in position shall be as given in Clause 1203.5 of these Specifications.

In order to verify the time and sequence of striking/removal of specialised formwork, routine field tests for the consistency and strength development of concrete are mandatory.

For specialised formwork, the form lining material may be either plywood or steel sheet of appropriate thickness.

1511 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria. The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1512 MEASUREMENTS FOR PAYMENT

Unless stated otherwise, the rate for concrete in plain concrete or reinforced concrete or prestressed concrete, shall be deemed to include all formwork required in accordance with this Section, which shall not be measured separately.

Where it is specifically stipulated in the Contract that the formwork shall be paid for separately, measurement of formwork shall be taken in square metres of the surface area of concrete which is in contact with formwork.

1513 RATE

The unit rate of plain concrete or reinforced concrete or prestressed concrete as defined in respective Sections of these Specifications, shall be deemed to cover the costs of all formwork and staging, including cost of all materials, labour, tools and plant required for design, construction and removal of formwork and supervision as described in this Section including properly supporting the members until the concrete is cured, set and hardened as required.

Where the contract unit rate for formwork is specially provided as a separate item in the contract, it shall include the cost of all materials, labour, tools and plant required for design, construction and removal of formwork and supervision as described in this Section including properly supporting the members until the concrete is cured, set and hardened as required.

1600

STEEL REINFORCEMENT

1601 DESCRIPTION

This work shall consist of furnishing and placing coated or uncoated mild steel or high strength deformed reinforcement bars of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

1602 GENERAL

Steel for reinforcement shall meet the requirements of **Section 1000** of these Specifications.

Reinforcements may be either mild steel or high strength deformed bars. They may be uncoated or coated with epoxy.

1603 PROTECTION OF REINFORCEMENT

Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or by thoroughly cleaning it using any suitable method such as sand blasting, mechanical wire brushing etc., as directed by the Engineer. Reinforcements shall be stored above the ground in a clean and dry condition, on blocks, racks or platforms and shall be suitably marked to facilitate inspection and identification.

Portions of uncoated reinforcing steel and dowels projecting from concrete, shall be protected within one week after initial placing of concrete, with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

In case of fusion bonded epoxy coated reinforcement or hot dipped galvanized bars used, reference shall be made Clause 1010.3.2 of Section 1000 of these specifications.

1604 BENDING OF REINFORCEMENT

Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar Bending Schedules.

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer using a proper bar bender, operated by hand or power to obtain the correct shape and radii of bends.

Bars shall not be bent or straightened in a manner that will damage the parent material or the coating.

Bars bent during transport or handling shall be straightened before being used on work. They shall not be heated to facilitate straightening.

1605 PLACING OF REINFORCEMENT

- a) The reinforcement cage should generally be fabricated in the yard at ground level and then shifted and placed in position. The reinforcement shall be placed strictly in accordance with the drawings and shall be assembled in position only when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcement and casting of concrete, which may result in rust formation on the surface of the bars, shall not be permitted.
- b) Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS:280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.
- c) Bars shall be kept in position usually by the following methods:
 - i) In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover, shall be placed between the bars and formwork, subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.
 - ii) In case of dowels for columns and walls, the vertical reinforcement shall be kept in position by means of timber templates with slots cut in them accurately, or with cover blocks tied to the reinforcement. Timber templates shall be removed after the concreting has progressed upto a level just below their location.
 - iii) Layers of reinforcements shall be separated by spacer bars at approximately one metre intervals. The minimum diameter of

spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.

- iv) Necessary stays, blocks, metal chairs, spacers, metal hangers, supporting wires etc. or other subsidiary reinforcement shall be provided to fix the reinforcement firmly in its correct position.
- v) Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc., as devices for positioning reinforcement shall not be permitted.
- d) Bars coated with epoxy shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Refer Section 1000 of these Specifications for other requirements.
- e) Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concreting is commenced.

1606 BAR SPLICES

1606.1 Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, shall be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1.25 times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points along the span where stresses are low.

1606.2 Welding

1606.2.1 Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

1606.2.2 While welding may be permitted for mild steel reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS:1786 shall in general be prohibited. Welding may be permitted in case of bars of other than Fe 240 grade including special

welding grade of Fe 415 grade bars conforming to IS:1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula :

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mg+V}{5} + \frac{Ni+Cu}{15}$$

is 0.4 or less.

1606.2.3 The method of welding shall conform to IS:2751 and IS:9417, any supplemental specifications and Clause 1904.8 of these Specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxy-acetelene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on overheating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded. Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used.

Welded joints shall be located well away from bends and shall be not less than twice the bar diameter away from a bend.

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators and welding procedure, are adequate to produce and maintain uniform quality at par with that attainable in shop welding, to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall be qualified by tests prescribed in IS:2751. Inspection of welds shall conform to IS:822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection, shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in two or three stages, the surface shall be cleaned properly after each stage. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

M.S. electrodes used for welding shall conform to IS:814.

1606.2.4 Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 percent of the bars are welded.

1606.2.5 Specimens of welded pieces of reinforcement taken from the site, shall be tested. The number and frequency of tests shall be as directed by the Engineer.

1606.3 Mechanical Couplers and Anchorages

1606.3.1 Mechanical Couplers

Bars may be joined with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g. by special grade steel sleeves swaged on to bars in end to end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 percent of the characteristic strength of the reinforcement bar.

1606.3.2 Anchorages

Bars may be anchored with approved patented mechanical anchorages as indicated on the drawing or as approved by the Engineer. The anchorages shall be connected to the reinforcing bar by the use of taper thread system. The anchorage shall be capable of developing the characteristic strength of reinforcement without damage to concrete and shall have sufficient diameter and width to develop adequate shear cone strength. The connection shall develop 125% of the characteristic strength of reinforcement bar.

1607 TESTING AND ACCEPTANCE

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. Additional tests, if required, will be got carried out by the Contractor at his own cost.

The supply, fabrication and placing of reinforcement shall be in accordance with these Specifications and shall be as checked and accepted by the Engineer.

Manufacturer's test certificate regarding compliance with Indian Standards for each lot of steel, shall be obtained and submitted to the Engineer. If required by the Engineer, the Contractor shall carry out confirmatory tests in the presence of a person authorized by the Engineer. Cost of these tests shall be borne by the Contractor. The sampling and testing procedure shall be as laid down in IS:1786. If any test piece selected from a lot fails, no re-testing shall be done and the lot shall be rejected.

1608 MEASUREMENT FOR PAYMENT

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the

weight of reinforcement shall be calculated in tonnes on the basis of IS:1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing, shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

1609 RATE

The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, royalty, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings and as per these Specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision.

The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the coating work as well as sampling, testing and supervision required for the work.

1700

STRUCTURAL CONCRETE

1701 DESCRIPTION

The work shall consist of producing, transporting, placing and compacting of structural concrete including fixing formwork and temporary works etc. and incidental construction in accordance with these Specifications and in conformity with the lines, grades and dimensions, as shown on the drawings or as directed by the Engineer.

1702 MATERIALS

All materials shall conform to Section 1000 of these Specifications.

1703 GRADES OF CONCRETE

1703.1 The grades of concrete shall be designated by the characteristic strength as given in Table 1700-1, where the characteristic strength is defined as the strength of concrete below which not more than 5 percent of the test results are expected to fall.

Table 1700-1 : Grades of Concrete

Type of Concrete/Grade Designation			Characteristic Strength in MPa
Nominal Mix Concrete	Standard Concrete	High Performance Concrete	
M15	M15		15
M20	M20		20
	M25		25
	M30	M30	30
	M40	M35	35
	M45	M40	40
	M50	M45	45
		M50	50
		M55	55
		M60	60
		M65	65
		M70	70
		M75	75
		M80	80
		M85	85
		M90	90

- 1) Normal Mix Concrete is made on the basis of nominal mix proportioned by weight of its main ingredients – cement, coarse and fine aggregates and water.

- 2) Standard concrete is made on the basis of design mix proportioned by weight of its ingredients, which in addition to cement, aggregates and water, may contain chemical admixtures to achieve certain target values of various properties in fresh condition, achievement of which is monitored and controlled during production by suitable tests. Generally, concrete of grades up to M50 are included in this type.
- 3) High Performance Concrete is similar to standard concrete but contains additional one or more mineral admixtures providing binding characteristics and partly acting as inert filler material which increases its strength, reduces its porosity and modifies its other properties in fresh as well as hardened condition. Concrete of grades upto M90 are included in this type.
- 4) For concrete of grades higher than M90, the design parameters may be obtained from specialized literature and experimental results.

1703.2 The minimum grades of concrete and corresponding minimum cement content and maximum water/cement ratios for different exposure conditions shall be as indicated in Table 1700-2.

1703.3 For concrete subjected to sulphate attack the minimum grades of concrete, minimum cement content and maximum water/cement ratios and types of cement for different concentration of sulphate content shall be as indicated in Table 1700-3.

Table 1700-2 : Requirement of Concrete for Different Exposure Condition using 20 mm Aggregate

Exposure Condition	Maximum Water Cement Ratio	Minimum Cement Content, kg/m ³	Minimum Grade of Concrete
Moderate	0.45	340	M25
Severe	0.45	360	M30
Very Severe	0.40	380	M40

Note:

- i) All three provisions given in the above table for a particular exposure condition, shall be satisfied.
- ii) The term cement for maximum w/c ratio and minimum cement content shown in Table includes all cementitious materials mentioned in Clause 1715.2. The maximum limit of flyash and ground granulated blast furnace slag in the blended cement shall be as specified in IS:1489 (Part 1) and IS:455 respectively.
- iii) For plain cement concrete, with or without surface reinforcement, the minimum grade of concrete can be lowered by 5 MPa and maximum water/cement ratio exceeded by 0.05.

Cement content shown in the above table shall be increased by 40 kg/m³ for use of 12.50 mm nominal size aggregates and decreased by 30 kg/m³ for use of 40 mm nominal size aggregates.

Table 1700-3 : Requirement of Concrete Exposed to Sulphate Attack

Class	Concentration of Sulphates as SO ₃			Type of Cement (Note ii)	Minimum Cement Content, kg/m ³	Maximum Water / Cement Ratio	Minimum Grade of Concrete
	In Soils		In Ground Water, g/l				
	Total SO ₃ , %	SO ₃ in 2:1 Water: Soil Extract, g/l					
1)	Traces	< 1.0	< 0.3	-OPC, PPC or PSC	280	0.5	M25
2)	2.0 to 0.5	1.0 to 1.9	0.3 to 1.2	-OPC, PPC or PSC -SRPC	330	0.5	M25
3)	0.5 to 1.0	1.9 to 3.1	1.2 to 2.5	-SRPC, -PPC or PSC	330 350	0.5 0.45	M25 M30
4)	1.0 to 2.0	3.1 to 5.0	2.5 to 5.0	-SRPC	370	0.45	M35
5)	>2.0	>5.0	>5.0	-SRPC with protective coatings	400	0.4	M40

Note: If the requirements of maximum water/cement ratio, minimum grade of concrete and minimum cement content from other durability considerations as given in Table 1700-2 are more stringent than those given in this table, then the former will govern.

OPC: Ordinary Portland Cement, PPC: Portland Pozzolona Cement. PSC: Portland Slag Cement, SRPC: Sulphate Resisting Portland Cement.

The minimum cement content shall be as low as possible but not less than the quantities specified in Table 1700-2 and 1700-3.

The maximum cement content excluding any mineral admixtures (Portland cement component alone) shall not exceed 450 kg/cu.m.

1703.4 Concrete used in any component or structure shall be specified by designation along with prescribed method of design of mix i.e. 'Design Mix' or 'Nominal Mix'. For all items of concrete, only design mix shall be used, except where nominal mix concrete is permitted as per drawing or by the Engineer. Nominal mix may be permitted only for minor bridges and culverts or other incidental construction, where strength requirements are upto M 20 only. Nominal mix may also be permitted for non-structural concrete or for screed below open foundations.

1703.5 If the Contractor so proposes, the Engineer may permit the use of concrete of higher grade than that specified on the drawing, provided the higher grade concrete meets the specifications applicable. The additional cost of such higher grade concrete shall be borne by the Contractor.

1704 PROPORTIONING OF CONCRETE

Prior to the start of construction, the Contractor shall design the mix in case of design mix concrete or propose nominal mix in case of nominal mix concrete, and submit to the Engineer for approval, the proportions of materials, including admixtures to be used. Water-reducing admixtures (including plasticisers or super-plasticisers) may be used at the Contractor's option, subject to the approval of the Engineer.

1704.1 Requirements of Consistency

The mix shall have the consistency which will allow proper placement and compaction in the required position. Every attempt shall be made to obtain uniform consistency. Slump test shall be used to measure consistency of the concrete.

The optimum consistency for various types of structures shall be as indicated in Table 1700-4, or as directed by the Engineer. The slump of concrete shall be checked as per IS:516.

Table 1700-4 : Requirements of Consistency

Type		Slump (mm) (at the Time of Placing of Concrete)
1)	a) Structure with exposed inclined surface requiring low slump concrete to allow proper compaction	25
	b) Plain cement concrete	25
2)	RCC structure with widely spaced reinforcements; e.g. solid columns, piers, abutments, footings, well steining	40 – 50
3)	RCC structure with fair degree of congestion of reinforcement; e.g. pier and abutment caps, box culverts, well curb, well cap, walls with thickness greater than 300 mm	50 – 75
4)	RCC and PSC structure with highly congested reinforcements e.g. deck slab girders, box girders, walls with thickness less than 300 mm	75 – 125
5)	Underwater concreting through tremie e.g. bottom plug, cast in-situ piling	150 – 200

Notwithstanding the optimum consistency indicated against Sl. No. 1 to 3, the situation should be properly assessed to arrive at the desired workability with the adjustment of admixture in each case, where the concrete is to be transported through transit mixer and placed using concrete pump. Under these circumstances, the optimum consistency during placement for the items of work of Sl. No. 1 to 3, can be considered ranging from 75 mm to 150 mm. This is, however, subject to satisfying the other essential criteria of strength, durability etc. and approval of the Engineer.

1704.2 Requirements for Design Mixes**1704.2.1 Target Mean Strength**

The target mean strength of specimen shall exceed the specified characteristic compressive strength by at least the current margin.

- i) The current margin for a concrete mix shall be determined by the Contractor and shall be taken as 1.64 times the standard deviation of sample test results taken from at least 40 separate batches of concrete of nominally similar proportions produced at site by the same plant under similar supervision, over a period exceeding 5 days, but not exceeding 6 months.
- ii) Where there is insufficient data to satisfy the above, the current margin for the initial design mix shall be taken as given in Table 1700-5 :

Table 1700-5 : Current Margin for Initial Design Mix

Concrete Grade	Current Margin (MPa)	Target Mean Strength (MPa)
M 15	10	25
M 20	10	30
M 25	11	36
M 30	12	42
M 35	12	47
M 40	12	52
M 45	13	58
M 50	13	63
M 55	14	69
M60	14	74
M 65	15	80
M 70	15	85
M 75	15	90
M 80	15	95
M85	16	101
M90	16	106

The initial current margin given in Table 1700-5 shall be used till sufficient data is available to determine the current margin as per Sub-Clause 1704.2.1(i).

1704.2.2 Trial Mixes

The Contractor shall give notice to the Engineer to enable him to be present at the time of carrying out trial mixes and preliminary testing of the cubes. Prior to commencement of trial mix design, all materials forming constituents of proposed design mix should have been tested and approval obtained in writing from the Engineer. Based on test results of material, draft mix design calculation for all grades of concrete to be used in the works, shall be prepared after taking into account the provisions in the Contract Technical Specifications, Guidelines of IS:10262, IS:SP:23 and IRC:112 and submitted to the Engineer for approval. Prior to commencement of concreting, trial mix design shall be performed for all grades of concrete and trial mix which has been found successful, shall be submitted by the Contractor and approval obtained. During concreting with the approved trial mix design, if source of any constituents is changed, the mix design shall be revised and tested for satisfying the strength requirements.

The initial trial mixes shall be carried out in a laboratory approved by the Engineer. However, Engineer may permit the initial trial mixes to be prepared at the site laboratory of the Contractor, if a full fledged concrete laboratory has been established well before the start of construction, to his entire satisfaction. Sampling and testing procedures shall be in accordance with these Specifications.

When the site laboratory is utilized for preparing initial mix design, the concrete production plant and means of transport employed to make the trial mixes shall be similar to those proposed to be used in the works.

For each trial mix, a set of six cubes shall be made from each of three consecutive batches for purposes of testing. Three cubes from each set of six shall be tested at an age of 28 days and three at an earlier age approved by the Engineer. The cubes shall be made, cured, stored, transported and tested in accordance with these Specifications. The mean strength of the nine cubes at 28 days shall exceed the specified characteristic strength by the current margin minus 3.5 MPa.

1704.2.3 Control of Strength of Design Mixes**a) Adjustment to Mix Proportions**

Adjustment to mix proportions arrived at in the trial mixes, shall be made subject to the Engineer's approval, in order to minimize the variability of strength and to maintain the target mean strength. Such adjustments shall not be taken to imply any change in the current margin.

b) Change of Current Margin

When required by the Engineer, the Contractor shall recalculate the current margin in accordance with Clause 1704.2.1. The recalculated

value shall be adopted as directed by the Engineer, and it shall become the current margin for concrete produced thereafter.

c) **Additional Trial Mixes**

In case any changes are observed in the properties of fresh concrete and/or strength of hardened concrete on the basis of early age tests, additional mixes and tests shall be carried out during production, so as to control and bring the quality of concrete within acceptable limits. In case of any change in the source or properties of materials, the design of mix shall be established afresh.

1704.3 Requirements of Nominal Mix Concrete

Requirements for nominal mix concrete unless otherwise specified shall be as given in **Table 1700-6**.

Table 1700-6 : Requirements for Nominal Mix Concrete

Concrete Grade	Total Quantity of Dry Aggregate by Mass per 50 kg of Cement to be taken as the Sum of Individual Masses of Fine and Coarse Aggregates (kg)	Proportion of Fine to Coarse Aggregate (by Mass)	Maximum Quantity of Water for 50 kg of Cement (Litres)	
			PCC	RCC
M 15	350	Generally 1:2, subject to upper limit 1:1.5 and lower limit of 1:2.5	25	
M 20	250		25	22

1704.4 Additional Requirements

Concrete shall meet any other requirements as specified on the drawing or as directed by the Engineer. The overall limits of deleterious substances in concrete shall be as follows:

- a) Total acid soluble chloride content in the concrete mix expressed as chloride ions shall not exceed the following values by mass of cement.
- | | |
|--|--------------|
| Prestressed concrete | 0.10 percent |
| Reinforced concrete (in severe, very severe or extreme exposure condition) | 0.20 percent |
| Reinforced concrete in moderate exposure condition | 0.30 percent |

- b) The total water soluble sulphate content of the concrete mix expressed as SO_3 , shall not exceed 4 percent by mass of cement in the mix.

For concrete made with Portland pozzolona cement, Portland blast furnace slag cement or mineral admixtures, the setting time and rate of gain of strength are different from those for concrete made with OPC alone. Such modified properties shall be taken into account while deciding the de-shuttering time, curing period, early age loading and time of prestressing. Additional cube samples may be required to be taken for verifying the concrete properties.

1704.5 Suitability of Proposed Mix Proportions

The Contractor shall submit the following information for the Engineer's approval :

- a) Nature and source of each material
- b) Quantities of each material per cubic metre of fully compacted concrete
- c) Either of the following :
 - i) Appropriate existing data as evidence of satisfactory previous performance for the target mean strength, current margin, consistency and water/cement ratio and any other additional requirement (s) as specified.
 - ii) full details of tests on trial mixes.
- d) Statement giving the proposed mix proportions for nominal mix concrete

Any change in the source of material or in the mix proportions shall be subject to the Engineer's prior approval.

1704.6 Checking of Mix Proportions and Water/Cement Ratio

In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement per bag as given by the manufacturer is accepted, a reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighed from bulk stock at site and not by bag, it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

The specified water/cement ratio shall always be kept constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined as frequently as possible, the frequency for a given job being determined by the Engineer according to the weather conditions. The amount of water to be added shall then be adjusted to compensate

for variations in the moisture content. For the determination of moisture content in the aggregates IS:2386 (Part III) shall be referred. Suitable adjustments shall also be made in the weight of aggregates to allow for their variation in weight due to variation in their moisture content.

1704.7 Grading of Aggregates for Pumped Concrete

Materials for pumped concrete shall be batched consistently and uniformly. Maximum size of aggregate shall not exceed one-third of the internal diameter of the pipe.

The grading of aggregates shall be continuous and shall have sufficient ultra fine materials (material finer than 0.25 mm). Proportion of fine aggregates passing through 0.25 mm shall be between 15 and 30 percent and that passing through 0.125 mm sieve shall not be less than 5 percent of the total volume of aggregate. Admixtures to increase workability can be added. When pumping long distances and in hot weather, set-retarding admixtures can be used. Fluid mixes can be pumped satisfactorily after adding plasticisers and super plasticisers. Suitability of concrete shall be verified by trial mixes and by performing pumping test.

1705 ADMIXTURES

1705.1 Chemical Admixtures

Chemical admixtures such as superplasticisers, or air entraining, water reducing, accelerating and retarding agents for concrete, may be used with the approval of the Engineer.

As the selection of an appropriate concrete admixture is an integral part of the mix design, the manufacturers shall recommend the use of any one of their products only after obtaining complete information of all the actual constituents of concrete as well as methodologies of manufacture, transportation and compaction of concrete proposed to be used in the work. Admixtures/additives conforming to IS:9103 may be used subject to approval of the Engineer. However, admixtures/additives generating hydrogen or nitrogen and containing chlorides, nitrates, sulphides, sulphates or any other material likely to adversely affect the steel or concrete, shall not be permitted.

The general requirements for admixtures are given in Clause 1007 of these Specifications.

Compatibility of the admixtures with the cement and any other pozzolona or hydraulic addition shall be ensured by for avoiding the following problems

- i) Requirement of large dosage of superplasticiser for achieving the desired workability,
- ii) Excessive retardation of setting,

- iii) Excessive entrainment of large air bubbles,
- iv) Unusually rapid stiffening of concrete,
- v) Rapid loss of slump
- vi) Excessive segregation and bleeding.

1705.2 Mineral Admixtures

For use of mineral admixtures, refer Clauses 1714.1 and 1715.2.

1706 SIZE OF COARSE AGGREGATES

The size (maximum nominal) of coarse aggregates for concrete to be used in various components shall be as given in Table 1700-7.

Table 1700-7 : Maximum Nominal Size of Coarse Aggregates

Components	Maximum Nominal Size of Coarse Aggregate (mm)
i) RCC well curb	20
ii) RCC/PCC well steining	40
iii) Well cap or Pile Cap Solid type piers and abutments	40
iv) RCC work in girder, slabs wearing coat, kerb, approach slab, hollow piers and abutments, pier/abutment caps, piles	20
v) PSC Work	20
vi) Any other item	As specified by the Engineer

Maximum nominal size of aggregates shall also be restricted to the smaller of the following values :

- a) 10 mm less than the minimum lateral clear distance between individual reinforcements
- b) 10 mm less than the minimum clear cover to the reinforcement
- c) One quarter of minimum thickness of member

The proportions of the various individual sizes of aggregates shall be so adjusted that the grading produces the densest mix and the grading curve corresponds to the maximum nominal size adopted for the concrete mix.

1707 EQUIPMENT

Unless specified otherwise, equipment for production, transportation and compaction of concrete shall be as under :

- a) Production of Concrete :
 - i) For overall bridge length of less than 200 m – batch type concrete mixer, diesel or electric operated, with a minimum size of 200 litres automatic water measuring system and integral weigher (hydraulic/pneumatic type).
 - ii) For overall bridge length of 200 m or more – concrete batching and mixing plant fully automatic, with minimum capacity of 15 cum per hour.

All measuring devices of the equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be checked over the range in use, when set up at each site and thereafter, periodically as directed by the Engineer.

The accuracy of the measuring devices shall fall within the following limits :

Measurement of Cement	:	± 3 percent of the quantity of cement in each batch
Measurement of Water	:	± 3 percent of the quantity of water in each batch
Measurement of Aggregate	:	± 3 percent of the quantity of aggregate in each batch
Measurement of Admixture	:	± 3 percent of the quantity of admixture in each batch

- b) Transportation of Concrete:
 - i) Concrete dumpers minimum 2 tonnes capacity
 - ii) Powered hoists minimum 0.5 tonne capacity
 - iii) Chutes
 - iv) Buckets handled by cranes
 - v) Transit truck mixer
 - vi) Concrete pump
 - vii) Concrete distributor booms
 - viii) Belt conveyor
 - ix) Cranes with skips
 - x) Tremies

- c) For Compaction of Concrete :
- | | |
|-----------------------|---|
| i) Internal vibrators | size 25 mm to 70 mm |
| ii) Form vibrators | minimum 500 watts |
| iii) Screed vibrators | full width of carriageway
(upto two lanes) |

1708 BATCHING, MIXING, TRANSPORTING, PLACING AND COMPACTION

1708.1 General

Prior to start of concreting, the Contractor shall submit for approval of the Engineer, his programme along with list of equipment proposed to be used by him for batching, mixing, transporting and placing concrete.

1708.2 Batching of Concrete

In batching concrete:

- The quantity of cement, aggregate and mineral admixtures, if used, shall be determined by mass.
- Chemical admixtures, if solid, shall be determined by mass.
- Liquid admixtures may be measured in volume or mass, and
- Water shall be weighed or measured by volume in a calibrated tank.

The concrete shall be sourced from on-site or off-site batching and mixing plants, or from approved Ready Mixed Concrete plants, preferably having quality certification.

Except where supply of properly graded aggregate of uniform quality can be maintained over a period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, the different sizes being stocked in separate stock piles. The materials should be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible to ensure that the specified grading is maintained.

The water/cement ratio shall always be maintained constant at its correct value. To this end, determination of moisture content in both fine and coarse aggregates shall be made as frequently as possible, depending on weather conditions. The amount of added water shall be adjusted to compensate for any observed variations in the moisture content. To allow for the variation in mass of aggregate due to variation in moisture content, suitable adjustment in the mass of aggregate, shall also be made. Accurate control shall be kept on the quantity of mixing water, which when specified, shall not be changed without approval.

1708.3 Mixing Concrete**1708.3.1 Mixing at Site**

All concrete shall be machine mixed. In order to ensure uniformity and good quality of concrete the ingredients shall be mixed in a power driven batch mixer with hopper and suitable weigh batching arrangement or in a central mix plant. Hand mixing shall not be permitted. The mixer or the plant shall be at an approved location considering the properties of the mixes and the transportation arrangements available with the Contractor. The mixer or the plant shall be approved by the Engineer.

Mixing shall be continued till materials are uniformly distributed, a uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall mixing be done for less than 2 minutes. It shall be ensured that the mixers are not loaded above their rated capacities and are operated at a speed recommended by the manufacturer. When mineral admixtures are added at the mixing stage, their thorough and uniform blending with cement shall be ensured, if necessary by longer mixing time. The addition of water after the completion of the initial mixing operation, shall not be permitted.

Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch and also before changing from one type of cement to another.

1708.3.2 Ready Mix Concrete

Use of ready mix concrete proportioned and mixed off the project site and delivered to site in a freshly mixed and unhardened state conforming to IS:4926, shall be allowed with the approval of the Engineer.

1708.4 Transporting Concrete

Mixed concrete shall be transported from the place of mixing to the place of final deposit as rapidly as possible by methods which will prevent the segregation or loss of the ingredients. The method of transporting or placing of concrete shall be approved by the Engineer. Concrete shall be transported and placed as near as practicable to its final position so that no contamination, segregation or loss of its constituents materials take place.

Concrete may be transported by transit mixers or properly designed buckets or by pumping. Transit mixers or other hauling equipment when used should be equipped with the means of discharge of concrete without segregation. During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to be reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

When concrete is conveyed by chute, the plant shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flows without excessive quantity of water and without any segregation of its ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork.

In case concrete is to be transported by pumping, the fresh concrete should have adequate fluidity and cohesiveness to be pumpable. Proper concrete mix proportioning and initial trials should ensure this. The conduit shall be primed by pumping a batch of mortar through the line to lubricate it. Once the pumping is started, it shall not be interrupted, as concrete standing idle in the line is liable to cause plug. The operator shall ensure that some concrete is always there in the pump's receiving hopper during operation. The lines shall always be maintained clean and free of dents.

Pipelines from the pump to the placing area shall be laid with minimum bends. For large quantity placements, standby pumps shall be available. Suitable air release valves, shutoff valves etc. shall be provided as per site requirements. The pumping of priming mix i.e. rich mix of creamy consistency, to lubricate the concrete pump and pipelines, shall precede the pumping of concrete. Continuous pumping shall be done to the extent possible. After concreting, the pipelines and accessories shall be cleaned immediately. The pipes for pumping shall not be made of material which has adverse effect on concrete. Aluminium alloy pipelines shall not be used.

1708.5 Placing of Concrete

All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete.

No concrete shall be placed in any part of the structure until the approval of the Engineer has been obtained. If concreting is not started within 24 hours of the approval being given, the approval shall have to be obtained again from the Engineer. Concreting shall proceed continuously over the area between the construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes, unless a proper construction joint is formed.

The concrete shall be deposited as nearly as practicable in its original position to avoid re-handling. Methods of placing should be such as to preclude segregation. Care should be taken to avoid displacement of reinforcement or movement of formwork. To achieve this, concrete should be lowered vertically in the form and horizontal movement of concrete inside the forms should, as far as practicable, be minimised.

The concrete shall be placed and compacted before its initial setting so that it is amenable to compaction by vibration. The workability of concrete at the time of placement shall be adequate for the compaction equipment to be used. If there is considerable time gap between mixing and placing of concrete, as in the case of ready mixed concrete plants or off-site batching and mixing plants, concrete mix shall be designed to have appropriately higher workability at the time of discharge from the mixer, in order to compensate the loss of workability during transit. This is generally achieved by suitable chemical admixtures. Keeping these considerations in view, the general requirement for ready mixed concrete plants or off-site batching and mixing plants, is that concrete shall be discharged from the truck mixer within two hours of the time of loading. A longer period may be permitted if suitable retarding admixtures are used.

In wall forms, drop chutes attached to hoppers at the top should preferably be used to lower concrete to the bottom of the form. As a general guidance, the permissible free fall of concrete may not exceed 1.5 metres and under no circumstances shall it be more than 2 metres. When free fall of larger height is involved, self compacting concrete having adequate fluidity, cohesiveness and viscosity and which uniformly and completely fills every corner of the formwork by its own weight without segregation, shall be used.

Except where otherwise agreed to by the Engineer, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450 mm when internal vibrators are used and not more than 300 mm in all other cases.

Concrete when deposited shall have temperature of not less than 5°C and preferably not more than 30°C and in no case more than 40°C. In case of site mixing, fresh concrete shall be placed and compacted in its final position within 30 minutes of its discharge from the mixer. When the concrete is carried in properly designed agitator operating continuously, the concrete shall be placed and compacted within 1 hour of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. It may be necessary to add retarding admixtures to concrete, if trials show that the periods indicated above are unacceptable. In all such matters, the Engineer's decision shall be final.

1708.6 Compaction of Concrete

Concrete shall be thoroughly compacted by vibration or other means during placing and worked around the reinforcement, tendons or duct formers, embedded fixtures and into corners of the formwork to produce a dense homogeneous void-free mass having the required surface finish. When vibrators are used, vibration shall be done continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that does not promote segregation. Over-vibration shall be avoided to minimize the risk of forming a weak surface layer. When external vibrators are used, the design of formwork and disposition of vibrator shall be such as to ensure efficient compaction and to avoid surface blemishes. Vibrations shall not be applied through reinforcement and where

vibrators of immersion type are used, contact with reinforcement and all inserts like ducts etc., shall be avoided.

When internal vibrators are used, they shall be inserted vertically to the full depth of the layer being placed and ordinarily shall penetrate the layer below for a few centimetres. The vibrator should be kept in place until air bubbles cease escaping from the surface and then withdrawn slowly to ensure that no hole is left in the concrete, care being taken to see that it remains in continued operation while being withdrawn. The internal vibrators shall be inserted in an orderly manner and the distance between insertions should be about one and half times the radius of the area visibly affected by vibration. Additional vibrators in serviceable condition shall be kept at site so that they can be used in the event of breakdown.

Mechanical vibrators used shall comply with IS:2502, IS:2506, IS:2514 and IS:4656.

1709 CONSTRUCTION JOINTS

Construction joints shall be avoided as far as possible. In no case shall the locations of such joints be changed or increased from those shown on the drawings except with the express approval of the Engineer.

Joints should be positioned where they are readily accessible for preparation and concreting. Construction joints should be positioned to minimize the effects of the discontinuity of the durability, structural integrity and appearance of the structure. As far as possible, joints should be provided in non-aggressive zones, but if joints in aggressive zones cannot be avoided, they should be sealed. Joints should be located away from the regions of maximum stress caused by loading; particularly where shear and bond stresses are high.

In beams and slabs joints should not be near the supports. Construction joints between slabs and ribs in composite beams, shall be avoided. For box girders, there shall be no construction joint between the soffit and webs.

Joints should be either vertical or horizontal. For a vertical construction joint, the lifts of concrete shall finish level or at right angles to the axis of the member. Concreting shall be continued right up to the joint.

Before resuming work at a construction joint when concrete has not yet fully hardened, all laitance shall be removed thoroughly. The surface shall be roughened, taking care to avoid dislodgement of coarse aggregates. Concrete shall be brushed with a stiff brush soon after casting, while the concrete has only slightly stiffened. If the concrete has partially hardened, it may be treated by wire brushing or with a high pressure water jet, followed by drying with an air jet, immediately before the new concrete is placed. Fully hardened concrete shall be treated with mechanical hand tools or grit blasting, taking care not to split or crack aggregate particles. The practice of first placing a layer of mortar or grout when concreting joints, shall

be avoided. The old surface shall be soaked with water, without leaving puddles, immediately before starting concreting. The new concrete shall be thoroughly compacted against it.

Where there is likely to be a delay before placing the next concrete lift, protruding reinforcement shall be protected. In all cases, where construction joints are made, the joint surface shall not be contaminated with release agents, dust, or sprayed curing membrane and reinforcement shall be firmly fixed in position at the correct cover.

The sequence of concreting, striking of forms and positioning of construction joints for every individual structure, shall be decided well in advance of the commencement of work.

1710 CONCRETING UNDER WATER

When it is necessary to deposit concrete under water, the methods, equipment, materials and proportions of mix to be used, shall be got approved from the Engineer before any work is started.

Concrete shall not be placed in water having a temperature below 5°C. The temperature of the concrete, when deposited, shall not be less than 16°C, nor more than 30°C.

Coffer dams or forms shall be sufficiently tight to ensure still water conditions, if practicable, and in any case to reduce the flow of water to less than 3 m per minute through the space into which concrete is to be deposited. Coffer dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the walls. Pumping shall not be done while concrete is being placed, or until 24 hours thereafter. To minimise the formation of laitance, care shall be exercised not to disturb the concrete as far as possible while it is being deposited.

All under water concreting shall be carried out by tremie method only. The number and spacing of the tremies should be worked out to ensure proper concreting. However, it is necessary to have a minimum number of 2 tremies for any concreting operation, so that even if one of the tremies goes out of commission during concreting, the other one can be used to complete the work. The tremie concreting when started, should continue without interruption for the full height of the member being concreted. The capacity of the concrete production and placement equipment should be sufficient to enable the underwater concreting to be completed uninterrupted within the stipulated time.

The top section of the tremie shall have a hopper large enough to hold one full batch of the mix or the entire contents of the transporting bucket, as the case may be. The tremie pipe shall not be less than 200 mm in diameter and shall be large enough to allow a free flow of concrete and strong enough to withstand the external pressure of the water in which it is suspended, even if a partial vacuum develops inside the pipe. Preferably, flanged steel pipe of adequate strength shall be used. A separate lifting device shall be provided for each

tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check valve, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering the concrete to the tremie pipe through the hopper, so that when the concrete is forced down from the hopper to the pipe, it will force the plug (and along with it any water in the pipe) down the pipe and out of the bottom end, thus establishing a continuous stream of concrete. It will be necessary to raise the tremie slowly in order to allow a uniform flow of concrete. At all times after placing of concrete is started and until all the required quantity has been placed, the lower end of the tremie pipe shall be kept below the surface of the plastic concrete and shall not be taken out of concrete. This will cause the concrete to build up from below instead of flowing out over the surface and thus avoid formation of layers of laitance. It is advisable to use retarders or suitable superplasticizers to retard the setting time of concrete, which shall be established before the commencement of work.

1711 CONCRETING IN EXTREME WEATHER

1711.1 Concreting in Cold Weather

Where concrete is to be deposited at or near freezing temperature, precautions shall be taken to ensure that at the time of placing, it has a temperature of not less than 5°C and that the temperature shall be maintained above 4°C until the concrete has hardened. When necessary, concrete ingredients shall be heated before mixing but cement shall not be heated artificially other than by the heat transmitted to it from other ingredients of the concrete. Stock-piled aggregate may be heated by the use of dry heat or steam. Aggregates shall not be heated directly by gas or on sheet metal over fire. In general, the temperature of aggregates or water shall not exceed 65°C. Salt or other chemicals shall not be used for the prevention of freezing. No frozen material or materials containing ice shall be used. All concrete damaged by frost shall be removed. Concrete exposed to freezing weather shall have entrained air and the water content of the mix shall not exceed 30 litres per 50 kg of cement. To counter slower setting of concrete, accelerators can be used with the approval of the Engineer. However, accelerators containing chloride shall not be used.

1711.2 Concreting in Hot Weather

When depositing concrete in hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 30°C while placing. This shall be achieved by using chilled mixing water, using crushed ice as a part of mixing water, shading stock piles of aggregates from direct rays of the sun, sprinkling the stock piles of coarse aggregate with water to keep them moist, limiting temperature of cement below 30°C at the time of use, starting curing before concrete dries out and restricting time of concreting as far as possible to early mornings and late evenings. When ice is used to cool mixing water, it will be considered as part of the water in design mix. Under no circumstances shall the mixing operation be considered complete until all ice in the mixing drum has melted. The Contractor will be required to state

his methodology for the Engineer's approval when temperatures of concrete are likely to exceed 30°C during the work.

1712 PROTECTION AND CURING

1712.1 General

Concreting operations shall not commence until adequate arrangements for concrete curing have been made by the Contractor. Curing and protection of concrete shall start immediately after compaction of the concrete.

The concrete shall be protected from:

- a) Premature drying out particularly by solar radiation and wind
- b) High internal thermal gradients
- c) Leaching out by rain and flowing water
- d) Rapid cooling during the first few days after placing
- e) Low temperature or frost
- f) Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.
- g) Vibration caused by traffic including construction traffic.

Concrete shall be protected, without allowing ingress of external water, by means of wet (not dripping) gunny bags, hessian etc. Once the concrete has attained some degree of hardening (approximate 12 hrs after mixing), moist curing shall commence and be continued through the requisite period. Where members are of considerable size and length, with high cement content, accelerated curing methods may be applied, as approved by the Engineer.

1712.2 Water Curing

Water for curing shall be as specified in **Section 1000** of these specifications.

Sea water shall not be used for curing. Sea water shall not come into contact with concrete members before they have attained adequate strength.

The concrete should be kept constantly wet by ponding or covering or use of sprinklers/perforated pipes for a minimum period of 14 days after concreting, except in the case of concrete with rapid hardening cement, where it can be reduced to 5 days. Water should be applied on surfaces after the final set. Curing through watering shall not be done on green concrete. On formed surfaces, curing shall start immediately after the forms are stripped. The concrete shall be kept constantly wet with a layer of sacking, canvas, hessian or similar absorbent material.

1712.3 Steam Curing

Where steam curing is adopted, it shall be ensured that it is done in suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be after about four hours of placement of concrete to allow the initial set of the concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased to about six hours.

The steam shall be at 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete. Steam curing is applied in enclosures or tunnels through which concrete members are transported on a conveying system. Alternatively, portable enclosures or plastic covers are placed over precast members and steam is supplied to the enclosures. The rate of increase or decrease of temperature should not be more than 10°C to 20°C per hour and the maximum temperature shall be about 70°C. The maximum temperature shall be maintained until the concrete has attained the desired strength required at the end of steam curing period and shall be decided by prior trials. When steam curing is discontinued, the air temperature shall not drop at a rate exceeding 10°C per hour, until a temperature of about 10°C above the ambient temperature outside has been reached. Steam curing of concrete shall be followed by water curing for at least 7 days. The concrete shall not be exposed to temperatures below freezing for at least six days after curing.

1712.4 Curing Compound

Membrane forming curing compounds consisting of waxes, resins, chlorinated rubbers etc. may be permitted by the Engineer in special circumstances. Curing compounds shall not be used on any surface which requires further finishing to be applied. All construction joints shall be moist cured and no curing compound shall be permitted in locations where concrete surfaces are required to be bonded together.

Liquid membrane forming compounds shall conform to ASTM C 309 and the curing efficiency shall be as per ASTM C 156.

Curing compounds shall be continuously agitated during use. All concrete cured by this method shall receive two applications of the curing compound. The first coat shall be applied immediately after acceptance of concrete finish. If the surface is dry, the concrete shall be saturated with water and curing compound applied as soon as the surface film of water disappears. The second application shall be made after the first application has set. Placement in more than two coats may be required to prevent streaking. The membrane formed shall be stripped off after 14 days, when curing is complete. Impermeable membranes, such as sheet materials for curing concrete conforming to ASTM C 171 or polyethylene sheeting

covering closely the concrete surface, may also be used to provide effective barrier against evaporation.

1713 FINISHING

Immediately after the removal of forms, exposed bars or bolts, if any, shall be cut inside the concrete member to a depth of at least 50 mm below the surface of the concrete and the resulting holes filled with cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners, and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar. The mortar shall be of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as possible. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. Special pre-packaged proprietary mortars shall be used where appropriate or where specified in the drawing.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filler shall be left exposed for its full length with clean and true edges.

Immediately on removal of forms, the concrete work shall be examined by the Engineer before any defects are made good. The work that has sagged or contains honeycombing to an extent detrimental to structural safety or architectural appearance of the member, shall be rejected. Surface defects of a minor nature may be accepted. On acceptance of such work, the same shall be rectified as directed by the Engineer.

1714 CONCRETE WITH BLENDED CEMENTS OR MINERAL ADMIXTURES

1714.1 Production of Concrete

In order to improve the durability of the concrete, use of blended cement or blending of mineral admixtures, is permitted. The maximum limit of flyash and ground granulated blast furnace slag in concrete, shall be as specified in Clause 1715.2. Blending at site shall be permitted only through a specific facility with complete automated process control to achieve the specified design quality or through RMC plants with similar facility.

1714.2 Modified Properties

For concrete made with Portland Pozzolona Cement, Portland Blast furnace slag cement or mineral admixtures, the setting time and rate of gain of strength are different from those of concrete made with OPC alone. Cognizance of such modified properties shall be taken

in deciding de-shuttering time, initial time of prestressing, curing period and for early age loading.

1714.3 Compatibility of Chemical Admixtures

Compatibility of chemical admixtures and superplasticizers with Portland Pozzolona cement, Portland blast furnace slag cement and mineral admixtures shall be ensured by trials outlined in **Clause 1705**.

1714.4 Additional Tests

In addition to the strength tests prescribed in other Sections of these Specifications, the following additional tests are required to be carried out from considerations of durability.

i) **Rapid Chloride Ion Permissibility Test**

Rapid Chloride Ion permeability test on as per ASTM C 1202 at 56 days for extreme, very severe and severe conditions of exposure. The permissible value of Chloride-Ion permeability for extreme condition 800 Coulombs very severe condition 1200 coulombs and severe exposure condition 1500 coulombs.

ii) **Water Permeability Test**

Water permeability test as per DIN: 1048 Part 5-1991 shall be carried out as described in Clause 1717.2.5.5.

1715 HIGH PERFORMANCE CONCRETE

1715.1 General

High Performance Concrete shall be used where special performance requirements of high strength, high early strength, high workability, low permeability and high durability for severe service environments, are required. Production and use of such concrete in the field shall be carried out with high degree of uniformity between batches and very stringent quality control.

1715.2 Materials

Cement, mineral admixtures, chemical admixtures, aggregates and water shall conform to **Section 1000** of these Specifications and this Section.

Flyash when used, shall neither be less than 20 percent nor shall be greater than 35 percent of the total by mass of ordinary Portland cement and flyash and shall conform to grade-1 of IS:3812.

Ground granulated blast furnace (GGBS) slag when used, shall neither be less than 50 percent nor greater than 70 percent of the total mass of ordinary Portland cement and GGBS and shall conform to IS:12089.

Silica fume conforming to IS:15388 shall be used.

The cement content of concrete inclusive of any mineral admixtures shall not be less than 380 kg/m³. The cement content excluding any mineral admixtures (Portland cement content alone) shall not exceed 450 kg/m³. The water/cement (cement plus all cementitious materials) ratio should generally not exceed 0.33 but in no case shall be more than 0.40.

1715.3 Compatibility of Admixtures

Compatibility of the superplasticiser and admixtures with the cement and any other Pozzolanic or hydraulic dilutes shall be ensured by trials as outlined under Clause 1705.

1715.4 Characteristic Strength and Target Mean Strength

Characteristic strength and the initial target mean strength of concrete, shall be as given in **Table 1700-8**.

The target mean strength shall be calculated as per Clause 1704.2 after obtaining data on standard deviation from sufficient samples.

Table 1700-8 : Characteristic Compressive Strength and Target Mean Strength

Grade Designation	Specified Characteristic Compressive Strength at 28 days (MPa)	Target Mean Strength (MPa)
M 40	40	52
M 45	45	58
M 50	50	63
M 55	55	69
M 60	60	74
M 65	65	80
M 70	70	85
M 75	75	90
M 80	80	95
M85	85	101
M90	90	106

1715.5 Workability and Other Requirements

Workability, concrete mix design, field trial mixes, chloride and sulphate contents shall be as laid down in other Sections of these Specifications.

1715.6 Mixing of Concrete

The concreting plant and means of transportation employed to make trial mixes and to transport them to representative distances shall be similar to the corresponding plant and transport to be used in the works. The optimum sequence of mixing of ingredients shall be established by trials. Mixing time may be longer than in normal grade concrete mixes.

The temperature of concrete at the time of placement shall not exceed 25°C. The temperature of concrete at the mixing stage should be lower, to allow for rise in temperature during transport. When considerable distance of transport is involved, particular attention should be paid to ensure retention of slump as targeted for placement.

1715.7 Prototype Testing

Mock-up trials or prototype testing may be carried out to ensure that the concrete can be satisfactorily placed and compacted, taking into account the location of placement and provision of reinforcement, and required adjustments made in concrete mix design and/or detailing of reinforcement.

1715.8 Curing of Concrete

High performance concrete containing silica fume is more cohesive than normal mixes hence, there is a little or no bleeding and no bleed water to rise to the surface to offset water loss due to evaporation. Plastic shrinkage cracking is possible, if curing is not proper. Initial curing should commence soon after initial setting of concrete. Concrete should be covered with moist covers, opaque colour plastic sheets or suitable curing compound. Final moist curing should commence after final setting of concrete and continue for at least 14 days.

1715.9 Additional Tests for Concrete

Apart from the strength tests prescribed in other Sections of these Specifications, the additional tests as specified under Clause 1714.3, shall also be carried out.

1716 TOLERANCES

Tolerances for dimensions/shape of various components shall be as indicated in these Specifications or shown on the drawings or as directed by the Engineer.

1717 TESTS AND STANDARDS OF ACCEPTANCE

1717.1 Concrete shall conform to the surface finish and tolerance as prescribed in these Specifications for respective components.

1717.2 Random sampling and lot by lot acceptance inspection, shall be made for the 28 days cube strength of concrete.

1717.3 Concrete under acceptance, shall be notionally divided into lots for the purpose of sampling before commencement of work. The basis of delimitation of lots shall be as follows:

- i) No individual lot shall be more than 30 cu.m in volume
- ii) Different grades of mixes of concrete shall be divided into separate lots.
- iii) Concrete of a lot shall be used in the same identifiable component of the bridge.

1717.4 Sampling and Testing

Concrete for preparing 3 test cubes shall be taken from a batch of concrete at point of delivery for construction, according to procedure laid down in IS:1199.

A random sampling procedure shall be adopted which ensures that each of the concrete batches forming the lot under acceptance inspection has equal chance of being chosen for taking cubes.

150 mm cubes shall be made, cured and tested at the age of 28 days for compressive strength in accordance with IS:516. The 28 day test strength result for each cube shall form an item of the sample. Tests at other age shall also be performed, if specified.

Where automated batching plant/Ready Mixed Concrete Plant is located away from the place of use and the time gap between production and placement is more than the initial setting time or where any ingredients are added subsequent to mixing, separate sets of samples shall be collected and tested at batching plant and at location of placement. The results shall be compared and used to make suitable adjustment at batching plants so that properties of concrete at placement are as per the requirements.

1717.5 Test Specimen and Sample Strength

Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or for any other purpose.

The test strength of the sample shall be the average of the strength of 3 cubes. The individual variation should not be more than ± 15 percent of the average. If variation is more, the test results of the sample are invalid.

1717.6 Frequency

The minimum frequency of sampling of concrete of each grade shall be in accordance with Table 1700-9.

Table 1700-9 : Minimum Frequency of Sampling

Quantity of Concrete in Work, m ³	No. of Samples
1 – 5	1
6 – 15	2
16 – 30	3
31 – 50	4
51 and above	4 plus one additional sample for each additional 50 m ³ or part thereof

At least one sample shall be taken from each shift of work.

1717.7 Acceptance criteria

1717.7.1 Compressive Strength

1) Cubes

The concrete shall be taken as having the specified compressive strength when both the following conditions are met:

- a) The mean strength determined from any group of four consecutive non-overlapping samples exceeds the specified characteristic compressive strength by 3 MPa.
- b) Strength of any sample is not less than the specified characteristic compressive strength minus 3 MPa.

The quantity of concrete represented by the test results include the batches from which the first and last samples were taken, together with all intervening batches.

2) Cores

When the concrete does not satisfy both the conditions given in (1) above, representative cores shall be extracted from the hardened concrete for compression test in accordance with the method described in IS:1199 and tested to establish whether the concrete satisfies the requirement of compressive strength.

Evaluation of compressive strength by taking cores may also be done in case of doubt regarding the grade of concrete used either due to poor workmanship or based on results of cube strength tests.

The locations from which core samples are to be taken and their number shall be decided so as to be representative of the whole of the concrete under consideration. However, in no case shall fewer than three cores be tested. Cores shall be prepared and tested as described in

IS:516. Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has strength less than 75 percent of the specified strength.

1717.7.2 Chloride and Sulphate Content

The total chloride and sulphuric anhydride (SO_3) content of all the constituents of concrete as a percentage of mass of cement in the mix, shall not exceed the values given in this Section.

1717.7.3 Density of Fresh Concrete

Where minimum density of fresh concrete is specified, the mean of any four consecutive non-overlapping samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 percent of the specified value.

1717.7.4 Density of Hardened Concrete

Where minimum density of hardened concrete is specified, the mean of any four consecutive non-overlapping samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 percent of the specified value.

1717.7.5 Permeability Test

Water permeability test as per DIN:1048 Part 5–1991 shall be carried out as described below :

- i) A cylindrical test specimen 150 mm dia and 160 mm high shall be prepared.
- ii) After 28 days of curing, the test will be conducted between 28 and 35 days. The test specimen shall be fitted in a machine such that specimen can be subjected to a water pressure of up to 7 bars. A typical machine is shown in Appendix-1700/1.
- iii) The concrete specimen shall be subjected to a water pressure of 0.5 N/mm^2 from the top for a period of 3 days. The pressure shall be maintained constant throughout the test period. If the water penetrates through to the underside of the specimen, the test may be terminated and the specimen rejected as failed.
- iv) After 3 days, the pressure shall be released and the sample shall be taken out. The specimen shall be split in the middle by compression applied on two round bars on opposite sides above and below.

- v) When the split faces show signs of drying (after 5 to 10 minutes), the maximum depth of penetration in the direction of height shall be measured with the scale and extent of water penetration established.
- vi) The mean of maximum depth of penetration obtained from three specimens thus tested, shall be taken as the test result and it shall not exceed 25 mm.

1717.7.6 If the concrete is not able to meet any of the standards of acceptance as prescribed, the effect of such deficiency on the structure shall be investigated by the Contractor as directed by the Engineer. The Engineer may accept the concrete as sub-standard work. Any additional work required by the Engineer for such acceptance, shall be carried out by the Contractor at his cost. In case the concrete is not found to be acceptable even after investigation, the Contractor shall remove the rejected concrete forthwith.

1717.7.7 When durability of concrete is desired the rapid chloride ion permeability test as stated under Clause 1714.3.1 shall also be performed in addition to above tests.

1718 MEASUREMENTS FOR PAYMENT

Structural concrete shall be measured in cubic metres. In reinforced or prestressed concrete, the volume occupied by reinforcement or prestressing cables and sheathing shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

1719 RATE

The contract unit rate for structural concrete shall cover costs of all materials, labour, tools, plant and equipment required for mixing, transporting and placing in position, vibrating and compacting, finishing and curing as per this Section or as directed by the Engineer, including all incidental expenses, sampling and testing, quality assurance and supervision. Unless mentioned separately as an item in the contract, the contract unit rate for concrete shall also include the cost of providing, fixing and removing formwork required for concrete work as per **Section 1500** of these Specifications.

If the concrete is found to be acceptable by the Engineer as sub-standard work, the Contractor shall be subjected to reduction in his contract unit rate. For deficiency in compressive strength of concrete when accepted by the Engineer, the reduction in rate shall be applied as under:

$$\text{Percentage reduction in rate} = \frac{\text{Design Strength} - \text{Observed Strength}}{\text{Design Strength}} \times 100$$

1800

PRESTRESSING

1801 DESCRIPTION

The work shall consist of imparting prestress to structural concrete members by stressing of wires/strands/tendons/cables with jacks of required capacity and holding them between appropriately designed anchorages fixed internally or externally to the members.

1802 GENERAL

The work shall be carried out in accordance with the drawings and these Specifications or as approved by the Engineer.

Structural concrete and untensioned steel for the production of prestressed concrete members shall conform to the requirements of Section 1700 and Section 1600 respectively, of these Specifications, unless specifically modified by requirements set forth in this Section.

1803 MATERIALS

1803.1 All materials shall conform to **Section 1000** of these Specifications.

1803.2 Sheathing**1803.2.1 General**

The sheathing ducts shall be of the spiral corrugated type either in mild steel or HDPE or in PP for internal tendons. They shall be in as long lengths as practicable from considerations of handling and transportation without getting damaged.

External tendons shall be housed in either High Density Poly-Ethylene (HDPE) sheaths or metallic steel sheaths (plain or with protective coatings), which have smooth internal surfaces.

1803.2.2 M.S. Sheathing Ducts

The material shall be Cold Rolled Cold Annealed (CRCA) Mild Steel conforming to IS:513 intended for mechanical treatment and surface refining but not for quench hardening or tempering.

The material shall be clean and free from rust and normally be bright finished. However, where specified, as in case of use in aggressive environment, galvanized or lead-coated mild steel strips shall be used.

The sheathing shall conform to the requirements specified in Table 1800-1 and Appendix 1800/1. All the joints of sheathing shall be water tight and conform to provisions contained in Clause 1804.6.

Table 1800-1 : Details of Ducts

No. of Strands/ Dia in mm	Diameter of Duct in mm		Thickness of MS Sheathing in mm	Thickness of HDPE Duct in mm
	Metallic	HDPE		
6/13	50	50	0.3	2.0
12/13	75	75	0.4	2.5
19/13	85	85	0.4	2.5
27/13	100	100	0.5	3.0
12/15	85	85	0.4	2.5
19/15	100	100	0.5	3.0
27/15	125	130	0.5	4.0

1803.2.3 Corrugated HDPE Sheathing Ducts

The material for the ducts shall be high density polyethylene or polypropylene with more than 2 percent carbon black to provide resistance to ultraviolet degradation. The ducts shall be corrugated on both sides. All tests on raw materials and tests to be conducted on the finished product, shall be in accordance with *fib* Technical Report Bulletin 7 "Corrugated plastic ducts for internal bonded post tensioning".

Each batch of the HDPE ducts supplied to the site shall be accompanied by the supplier's certificate for properties of the raw materials which shall comply with the Technical report Bulletin 7. In addition the shore hardness for D-3 sec value shall be 60 ± 5 . For the approval of the finished product, the tests mentioned in the Appendix A1 to A9 of *fib* Technical Report Bulletin 7, shall be conducted at the reputed institutions or at the manufacturer's laboratories. Results shall comply with the provisions of the *fib* Technical report Bulletin 7, except for the wear resistance, minimum bending radius and bond length test which are modified as follows:

- a) Wear resistance test: The wear resistance of the duct i.e. the minimum residual wall thickness after loss, shall not be less than 1.5 mm for ducts up to 85 mm in diameter and not less than 2 mm for ducts greater than 85 mm in diameter.
- b) Minimum bending resistance: The test apparatus shall be identical to the wear test apparatus with the same clamping force. However sample shall not be moved but shall be as held in position for a period of 7 days. The residual wall thickness shall be as mentioned in (a) above.

- c) Bond length test: The ducts shall transmit full tendon strength from the tendon to the surrounding concrete over a length of not greater than 40 times duct diameter.

Each supply of the ducts shall be accompanied by test report of the finished product also. The test certificates issued by the institutes will be valid for a period of two years.

1803.2.4 Diameter and Thickness of Sheathing Ducts

The internal diameter and thickness of sheathing shall be as shown in the drawing or as indicated in Table 1800-1, whichever is greater:

Where prestressing tendons are required to be threaded after concreting, the internal diameter of sheathing shall be about 5 mm larger than required above for spans more than 30 m. In severe environment, cables shall be threaded after concreting. In such cases a temporary tendon shall be inserted in the sheathing or the sheathing shall be stiffened by other suitable method during concreting.

1803.3 Anchorages

1803.3.1 Prestressing accessories like jacks, anchorages, wedges, block plates, etc. shall be procured from authorized manufacturers only. Anchorages shall conform to "Recommendations for acceptance and application of prestressing systems" published by FIB. The prestressing accessories shall be subjected to an acceptance test prior to their actual use on the work. Test certificates from a laboratory fully equipped to carry out the tests shall be furnished to the Engineer. Such test certificates shall not be more than 12 months old at the time of making the proposal for adoption of a particular system for the project.

No damaged anchorages shall be used. Steel parts shall be protected from corrosion at all times. Threaded parts shall be protected by greased wrappings and tapped holes shall be protected by suitable plugs until used. The anchorage components shall be kept free from mortar and loose rust and any other deleterious coating.

1802.3.2 Swages of prestressing strand and button-heads of prestressing wire, where provided shall develop a strength of at least 95 percent of the specified breaking load of the strand or wire as the case may be. Where swaging/button-heading is envisaged, the Contractor shall furnish details of his methodology and obtain approval of the Engineer, prior to taking up the work.

1802.3.3 Untensioned steel reinforcements, around anchorages shall conform to the details of prestressing system and as shown on the drawing.

1803.4 Couplers

Couplers or other similar fixtures used in conjunction with the prestressing strands or bars, shall have an ultimate tensile strength of not less than the strengths of the individual strands or bars being joined and shall also meet the requirements of individual anchorages.

1804 TESTING OF PRESTRESSING STEEL AND ANCHORAGES

All materials specified for testing shall be furnished free of cost by the Contractor and shall be delivered in time for tests to be made, well in advance of anticipated time of use.

All wires, strands or bars to be shipped to the site, shall be assigned a lot number and tagged for identification purposes. Anchorage assemblies to be shipped shall also be similarly identified.

All samples submitted shall be representative of the lot to be furnished and in the case of wire or strand, shall be taken from the same master roll. The Contractor shall furnish samples of at least 5 m length selected from each lot for testing. Also, two anchorage assemblies, complete with distribution plates of each size or type to be used, shall be furnished along with short lengths of strands as required.

1805 WORKMANSHIP**1805.1 Cleaning**

Tendons shall be free from loose rust, oil, grease, tar, paint, mud or any other deleterious substance.

Cleaning of the steel may be carried out by immersing in suitable solvent solutions, wire brushing or passing through a pressure box containing carborundum powder. However, the tendons shall not be brought to a polished condition.

1805.2 Straightening

High tensile steel wire and strand shall be supplied in coils of sufficiently large diameter, such that tendons shall retain their physical properties and shall be straight as they unwind from the coil. Tendons of any type that are damaged, kinked or bent shall not be used.

The packing of prestressing wire/strand shall be removed only just prior to forming of cable for placement. Suitable stands shall be provided to facilitate uncoiling of wires/strands without damage to steel. Care shall be taken to avoid the possibility of steel coming into contact with the ground.

1805.3 Positioning**1805.3.1 Post Tensioning**

Prestressing tendons shall be accurately located and maintained in position, both vertically and horizontally, as per drawings.

Tendons shall be so arranged that they have a smooth profile without sudden bends or kinks.

The location of prestressed cables shall be such as to facilitate easy placement and vibration of concrete in between the tendons. High capacity tendons shall be used to reduce the number of cables thereby eliminating the necessity of grouping. The selected profiles of the tendons shall be such that their anchorages are not located in the top deck surface. Where two or more rows of cables have to be used, the cables shall be vertically in line to enable easy flow of concrete. The clear vertical and horizontal distance between any two cable ducts shall in no case be less than 50 mm or diameter of duct, whichever is greater, when grouping of cable is not involved. Where precast segments are used, the clear distance between cables shall be at least 150 mm.

Sheathing shall be placed in correct position and profile by providing suitable ladders and spacers. Such ladders may be provided at intervals of approximately 1.0 m. Sheathing shall be tied rigidly with such ladders/spacer bars, so that they do not get disturbed during concreting.

The method of supporting and fixing shall be such that profile of cables is not disturbed during vibrations, by pressure of wet concrete, by workmen or by construction traffic.

Sheathing in which the permanent tendon will not be in place during concreting shall have a temporary tendon inserted or shall be stiffened by some other method to the approval of the Engineer. The temporary tendon shall be pulled out by a special threading machine or other contrivance, before threading the permanent tendon.

Where possible, tendons shall be placed prior to stressing. Tendons shall be handled with care to avoid damage or contamination, to either the tendon or the sheathing. Any tendons which are damaged or contaminated shall be cleaned or replaced.

1805.3.2 Pre-tensioning

Prestressing steel shall be accurately located and maintained in position, both vertically and horizontally, as per drawings.

1805.3.3 Each anchorage device shall be set square to the line of action of the corresponding prestressing tendon and shall be positioned securely to prevent movement during concreting.

The anchorage devices shall be cleaned to the satisfaction of the Engineer, prior to the placing of concrete. After concreting, any mortar or concrete which adheres to bearing or wedging surfaces, shall be removed immediately.

1805.4 Cutting

Cutting and trimming of wires or strands shall be done by suitable mechanical or flame cutters. When a flame cutter is used, care shall be taken to ensure that the flame does not come in contact with other stressed steel. The flame cutting of wire or strand shall be carried out at least 75 mm beyond the point where the tendon will be gripped by the anchorage or jacks.

In post tensioned members, the ends of prestressing steel projecting beyond the anchorages, shall be cut after the grout has set.

1805.5 Protection of Prestressing Steel

Prestressing steel shall be continuously protected against corrosion, until grouted. The corrosion protector shall have no deleterious effect on the steel or concrete or on the bond strength of steel to concrete. Grouting shall conform to these Specifications or as directed by the Engineer.

In the case of external prestressing, steel shall be encased in suitable polyethelene pipes before grouting.

1805.6 Sheathing Duct Joints

1805.6.1 General

The sheathing and all joints shall be water tight and shall withstand a pressure of 1.1 times the grouting pressure and maximum grouting head due to grout. Any temporary opening in the sheathing shall be satisfactorily plugged and all joints between sheathing and any other part of the prestressing system, shall be effectively sealed to prevent entry of mortar, dust, water or other deleterious matter. Sheathing shall be neatly fitted at joints without internal projection or reduction of diameter.

Enlarged portions of the sheathing at couplings or anchorages shall be of sufficient length to provide for the extension of the tendons.

Special attention shall be paid to the junction at the anchorage end, where the sheathing must be tightly fitted on the protruding trumpet end of anchorage and thereafter sealed preferably with tape, to make it water-proof.

1805.6.2 Coupling of MS Sheathing Ducts

For major projects, the sheathing duct should preferably be manufactured at the project site utilizing appropriate machines. With such an arrangement, long lengths of sheathing ducts may be used with consequent reduction in the number of joints and couplers.

Where sheathing duct joints are unavoidable, they shall be made cement slurry tight by the use of corrugated threaded sleeve couplers, which can be tightly screwed on to the outer side of the sheathing ducts.

The length of the coupler should not be less than 150 mm but should be increased upto 200 mm wherever practicable. The joints between the end of coupler and duct shall be sealed with tape to prevent penetration of slurry during concreting. The couplers of adjacent ducts shall be staggered wherever practicable. As far as possible, couplers should not be located in curved zones. The corrugated sleeve couplers can be conveniently manufactured using the sheath making machine with the next higher size of die set.

For typical details of coupling refer Appendix 1800/1.

1805.6.3 Coupling of HDPE Sheathing Ducts

The HDPE sheathing can be joined by any one of the following three methods.

- a) Use of threaded sleeve couplers in the same manner as given for metallic sheathing.
- b) Welding of two ends of HDPE sheathing using appropriate machine such as Roaster Machine or Mirror Machine.
- c) Use of heat shrink couplers made of HDPE sleeves. The sleeves are integrated with the parent sheathing by hot process by using heating torch.

For typical details of coupling, refer Appendix 1800/1.

1805.7 Grout Vents

Grout vents of at least 20 mm diameter shall be provided at both ends of the sheathing and at all valleys and crests along its length. For cables longer than 50 m grout vents or drains may be provided at or near the lowest points. Additional vents shall also be provided along the length of sheathing such that the spacing of consecutive vents do not exceed 20 m. Each

of the grout vents shall be provided with a plug or similar device capable of withstanding a pressure of 1.0 MPa without leakage of water, air pressure or grout.

1805.8 Anchorages

All bearing surfaces of the anchorages shall be cleaned prior to concreting and tensioning.

Anchor cones, blocks and plates shall be securely positioned and maintained during concreting such that the centre line of the duct passes axially through the anchorage assembly.

The anchorages shall be recessed from the concrete surface by a minimum of 100 mm.

After the prestressing operations are completed and prestressing wires/strands are cut, the surface shall be painted with two coats of epoxy of suitable formulation having a dry film thickness of 80 micron per coat and entire recess shall be filled with concrete or non-shirk/ pre-packaged mortar of epoxy concrete.

1806 SUPERVISION

Prestressing operation and grouting shall be entrusted only to specially trained and qualified personnel. All prestressing accessories shall be procured from authorized manufacturers with in-house testing facilities. The Contractor shall be required to engage specialized agencies who should also be entrusted with the total service contract for fabrication of cables, protection of cables during concreting, prestressing and grouting. Necessary certificates shall be accorded by such specialized agencies that the work has been carried out in accordance with prescribed specifications. In exceptional cases, the prestressing and grouting operations could be entrusted to the bridge Contractor himself, if the Employer is convinced that he is well experienced and has qualified personnel and sufficient track record to substantiate his performance in the particular system of prestressing being adopted,.

1807 TENSIONING EQUIPMENT

All tensioning equipment shall be procured from authorized manufacturers only and be approved by the Engineer prior to use. Where hydraulic jacks are used, they shall be power-driven unless otherwise approved by the Engineer. The tensioning equipment shall satisfy the following requirements :

- i) The means of attachments of the prestressing steel to the jack or any other tensioning apparatus shall be safe and secure.
- ii) Where two or more wires/strands constitute a tendon, a single multi-pull stressing jack shall be used, which is capable of tensioning simultaneously all the wires/strands of the tendon. Suitable facilities for handling and attaching the multi-pull jack to the tendons shall be provided.

- iii) The tensioning equipment shall be such that it can apply controlled total force gradually on the concrete without inducing dangerous secondary stresses in steel, anchorage or concrete.
- iv) Means shall be provided for direct measurement of the force by use of dynamometers or pressure gauges fitted in the hydraulic system itself to determine the pressure in the jacks. Facilities shall also be provided for the liner measurement of the extension of prestressing steel to the nearest mm and of any slip of the gripping devices at transfer.

All dynamometers and pressure gauges including a master gauge shall be calibrated by an approved laboratory immediately prior to use and then at intervals not exceeding 3 months and the true force determined from the calibration curve.

Pressure gauges shall be concentric scale type gauges accurate to within two percent of their full capacity. The minimum nominal size of gauge shall be 100 mm. The gauge shall be so selected that when the tendon is stressed to 75 percent of its breaking load, the gauge is reading between 50 percent and 80 percent of its full capacity. Suitable safety devices shall be fitted to protect pressure gauges against sudden release of pressure.

Provision shall be made for the attachment of the master gauge to be used as a check, whenever requested for by the Engineer.

Jack and pump shall be calibrated from an approved laboratory prior to use and then at intervals not exceeding three months.

1808 POST TENSIONING

Tensioning force shall be applied in gradual and steady steps, in such a manner that the applied tensions and elongations can be measured at all times. The sequence of stressing, applied tensions and elongations shall be in accordance with the approved drawing or as directed by the Engineer.

It shall be ensured that in no case, the load is applied to the concrete before it attains the strength specified on the drawing or as stipulated by the prestressing system supplier, whichever is more.

After prestressing steel has been anchored, the force exerted by the tensioning equipment shall be decreased gradually and steadily so as to avoid shock to the prestressing steel or anchorage.

The tensioning force applied to any tendon shall be determined by direct reading of the pressure gauges or dynamometers and by comparison of the measured elongation with the calculated elongation. The calculated elongation shall be invariably adjusted with respect to the modulus of elasticity of steel for the particular lot as given by the manufacturer.

The difference between calculated and observed tension and elongation during prestressing operations shall be regulated as follows :

- a) If the calculated elongation is reached before the specified gauge pressure, continue tensioning till the specified gauge pressure is attained, provided the elongation does not exceed 1.05 times the calculated elongation. If 1.05 times the calculated elongation is reached before the specified gauge pressure is attained, stop stressing and inform the Engineer.
- b) If the calculated elongation has not been reached at the specified gauge pressure, continue tensioning by intervals of 5 kg/sq. cm until the calculated elongation is reached, provided the gauge pressure does not exceed 1.05 times the specified gauge pressure.
- c) If the elongation at 1.05 times the specified gauge pressure is less than 0.95 times the calculated elongation, the following measures must be taken, in succession, to determine the cause of this discrepancy:
 - i) Check the correct functioning of the jack, pump and leads.
 - ii) De-tension the cable. Slide it in its duct to check that it is not blocked by mortar which has entered through holes in the sheath. Re-tension the cable, if free.
 - iii) Re-establish the modulus of elasticity of steel for the particular lot from an approved laboratory.

If the required elongation is still not obtained, further finishing operations such as cutting or sealing, should not be undertaken without the approval of the Engineer.
- d) When stressing from one end only, the slip at the end remote from the jack, shall be accurately measured and an appropriate allowance made in the measured extension at the jacking end.

A complete record of prestressing operations along with elongation and jack pressure data shall be maintained in the format given in Appendix 1800/II.

The number of stages of prestressing and grouting shall be kept to a minimum, preferably two in the case of simply supported girders.

1809 GROUTING OF PRESTRESSED TENDONS

Grouting of prestressed tendons shall be carried out in accordance with provisions given in Appendix 1800/III. A record of grouting operations shall be maintained in the format given in Appendix 1800/IV.

1810 PRE-TENSIONING**1810.1 General**

The planning and construction aspects of the tensioning bed, tensioning bench, abutments at location of anchorage, steam curing system, formwork of the concrete elements and arrangements for de-moulding, lifting, stacking and transportation of the pre-tensioned concrete elements are all specialised items of work and shall be entrusted to engineers specifically experienced in this type of work.

1810.2 Concrete Mix Requirements

Minimum cement content, maximum water cement ratio and other durability requirement shall be same as indicated in Table 1700-2 and Table 1700-3 of these Specifications except that minimum grade of concrete shall be M40.

1810.3 Form Work

All sides, bottoms and header forms shall be of steel or any other suitable material. Forms shall be of sufficient thickness, with adequate external bracing and shall be stiffened and adequately anchored to withstand the forces due to placement and vibration of concrete. All joints of form work shall be leak proof. The bottom shutter shall have arrangement to permit longitudinal movement of girder concrete, which occurs while imparting prestress. Identifying marks shall be placed on the girders to indicate the correct orientation to ensure correct debonding locations, which may not be symmetrical, longitudinally.

1810.4 Laying of Deflected Tendons

For long span pre-tensioned girders, deflected tendons shall be used instead of the conventional straight tendons. This requires the use of hold-up/hold-down devices at each deflected location, in order to hold the tendons in the desired profile and location. A hold-down device normally consists of rollers attached to a vertical rod, which passes through the bottom form and is anchored to the form substructure or foundation to resist the prestress force. The force which must be resisted by the hold-up/hold-down device, and therefore its size, depends on the number of deflected strands and the trajectory angles of the strands. The strand can be either tensioned after it is held in its deflected profile by means of hold-up/hold-down devices or it can be tensioned first and then brought into its deflected profile. The number of deflected strands and their angle directly influence the size and cost of the hold-up/hold-down devices.

1810.5 Production and Testing of Concrete

A fully automated, computer-controlled batching plant shall be used. The batching plant shall

be provided with moisture measuring and compensating devices and automatic pump for dispensing admixtures.

Sampling and testing of concrete shall be as per Section 1700 of these Specifications. Additional cubes shall be prepared to determine the concrete strength at the time of removal of forms and transfer of prestress. Adequate number of samples shall be taken for this purpose, which shall be cured in identical conditions to those of the concrete of respective girders.

1810.6 Compaction, Removal of Form Work and Curing

Compaction of concrete may be achieved through needle vibrators or form vibrators along with needle vibrators. For casting of precast beams, any of the two commonly known techniques of precasting viz. (i) Long Line method or (ii) Short Line method maybe used.

The girders shall not be moved from the casting location until stipulated strength requirements have been attained. The concrete shall have attained a minimum compressive strength of 20 MPa at the time of removal of forms. Curing of concrete may be achieved through water or steam followed by water curing. Approved curing compound may also be used.

Longitudinal movement of the girders that takes place while releasing the prestress shall be suitably catered for. In case of long line method of precasting, adequate longitudinal gap shall be provided between girder ends during precasting, to accommodate projecting reinforcement and required length of the projecting strands.

1810.7 Stressing Bed for Pre-tensioning

The abutments and bed for pre-tensioning of tendons shall be designed to withstand the total tensioning force.

A notice shall be displayed adjacent to the stressing bed showing the maximum tensioning force permitted.

Where concrete elements are cast and prestressed individually, the stressing bench or moulds shall be rigid enough to sustain the reaction of the prestressing force without distortion.

In the long line method of prestressing, sufficient locator plates should be distributed throughout the length of the bed to ensure that the wires are maintained in their proper position during concreting. The moulds shall be free to slide in the direction of their length and thus permit the transfer of the prestressing force to all the concrete elements along the whole line.

Sufficient space shall be left in between the ends of concrete elements to permit access for cutting the strands/wires after transfer. Hold-downs or deflectors shall be used for holding

or deflecting the tendons in required position firmly. Deflectors which are in contact with the tendon shall have a diameter not less than the tendon or 15 mm, whichever is more.

The tensioning force required to be applied as stated on the drawings shall be the force remaining in the strands/wires after all strands/wires have been anchored to the abutments of the stressing bed and after the anchorage slip has already taken place. The tensioning force shall be determined by direct reading of the pressure gauges or dynamo-meters and by the measured elongation after slip.

The Contractor shall submit method of tensioning the tendons including the arrangement and layout of prestressing beds and all tendon deflection points, to the Engineer for approval before manufacture commences. The Contractor shall carry out trial stressing operations to establish the frictional resistance offered by the hold-downs and the slip during anchoring.

Debonding of strands, wherever required, shall be carried out using HDPE debonding tubes. PVC tubes shall not be permitted for this purpose. After pre-tensioning the strands and before concreting, a recheck shall be made to ensure that the debonding tubes are placed at the intended locations. Both ends of debonding tubes shall be effectively sealed against ingress of any cement slurry using epoxy putty or any other suitable material.

The Contractor shall also submit calculation showing that the hold-downs have been designed and constructed to withstand concentrated loads resulting from the application of the tensioning force.

1810.8 Pre-tensioning and De-tensioning Operations

1810.8.1 Pre-tensioning of Strands

Pretensioning of strands may be carried out either using single-pull jack or multi-pull jack. In case of the former, it shall be ensured at each stage, that the strands are stressed symmetrically, so that the supporting system of the strands does not rotate or distort. This may be achieved through suitably designed moving trolley engaging the strands or any other suitable arrangement. Prestressing force shall be transferred to metallic spacer, trolley, etc. so that the force does not remain on the hydraulic system for long.

It is necessary to apply a small prestressing force, through hydraulic jacks to remove slackness of the strands. After removal of the slackness, the strands must be thoroughly examined to ensure correct alignment, including that of the debonding tubes. Reference marks for measuring elongation shall then be established and the full strand load is applied thereafter. Loads indicated by the gauging system shall control the tensioning, with elongation checked on every strand.

It shall be ensured that the entire length of each strand between the grips is free of any defects. This is of particular importance while precasting girders using long line method entailing, longer pieces of strands between the grips.

Transfer of prestress shall not proceed until the Engineer has approved the proposed method. Strands and deflection devices shall be released in such a pre-determined order that unacceptable tensile stresses are not induced in the concrete.

Prior to transfer of the force to the units, all strands shall be tested for tightness and any loose strands shall be reported to the Engineer, who will decide whether the affected units should be rejected.

The Engineer may require that strands be marked at each end of any unit to allow measurement of the pull-in of the strands.

The sequence of transfer of prestressing force shall be done strictly as indicated in the drawings and ensuring that eccentricities of the prestressing force in the vertical and horizontal directions of the concrete element are minimum during the entire sequence.

The maximum slip of any tendon during transfer shall not exceed 3 mm for bottom strands and 5.5 mm for a top strands at any end of the concrete element. In case the slip exceeds above value, design of the member shall be got checked for the actual slip before acceptance.

1810.8.2 De-tensioning of Strands

Detensioning, in order to impart the prestress shall be effected gradually, so that there is no significant loss of bond due to slippage of strands and consequent increase in the transmission length. For detensioning, the trolley is pulled outward by a small distance, in order to release the metallic spacers, before releasing the prestressing force. Even when the pretensioning is carried out through single-pull jack, the release of the force in all the strands, while imparting the prestress to the concrete, shall be simultaneous. It shall be ensured that, during this process, prestressing forces at any stage does not exceed 90 percent of 0.1 percent proof stress.

1810.9 Cutting of Strands

Cutting of strands shall be carried out carefully so as not to affect the untensioned reinforcement which is in their close proximity. Diamond bit saw shall be used to cut the strands. Strands and untensioned reinforcement shall be so arranged that the untensioned reinforcement and those strands which are required to be extended into the adjoining cast in-situ concrete, do not get affected during cutting operation.

Under factory conditions, flame cutting may be resorted to. Yellow flame should be used first to heat the strand without introducing undue stresses and then blue flame for the

actual cutting. Heat cutting of strand shall be carried out symmetrically about the vertical axis of the members. One strand at a time on each side of the vertical axis for all girders in a long line shall be cut in the same manner. The above process shall be repeated till all the strands are cut. This will ensure gradual and uniform transfer of prestress to girders.

1811 PROTECTION OF ENDS

The exposed ends of the strands and the concrete surfaces of the ends of the units shall be wire brushed clean of all rust, loose mortar, grease and dirt.

The exposed ends of the strands and concrete surface within 50 mm of tendons shall be then abraded to provide a clean sound surface. An epoxy tar paint suitably formulated to give a dry film thickness of 80 micron per coat, shall then be immediately applied over the ends of the tendons unless otherwise directed.

A second coat of paint shall be applied prior to the drying out of the first coat.

1812 SAFETY PRECAUTIONS DURING TENSIONING

Care shall be taken during tensioning to ensure the safety of all persons in the vicinity.

Jacks shall be secured in such a manner that they will remain in position, even if their grip on the strand is lost.

No person shall be allowed to stand behind the jacks or close to the line of the tendons while tensioning is in progress.

The operations of the jacks and measurement of the elongation shall be carried out in such a manner and that the safety of all concerned is ensured.

A safety barrier shall be provided at both ends to prevent any tendon which might become loose, from recoiling unchecked.

During actual tensioning operation, warning signs shall be displayed at both ends of the tendon.

After prestressing, concrete shall not be drilled cut, chipped, or disturbed in anyway, without express approval of the Engineer.

No welding shall be permitted on or near strands nor shall any heat be applied to tendons. Any strand which has been affected by welding or weld spatter or heat shall be rejected.

1813 SURFACE PREPARATION

All surfaces, coming in contact with deck slab/ diaphragm shall be adequately prepared by green cutting, using surface retarders, by mechanical means to remove the laitance and

just expose the aggregates. Usually, precast girders join the cast in-situ concrete of end diaphragms at the points of high shear stress. Therefore, it is extremely important to adequately prepare the end faces of the girders for effective bonding of the new concrete. This shall be done using suitable mechanical means (such as 100% hacking) to ensure that the coarse aggregates are just exposed. Surface retarders, may also be used for this purpose.

1814 TRANSPORTATION STORAGE AND HANDLING OF PRECAST GIRDERS

Precast girders shall be transported in an upright position. Points of support and the direction of the reactions with respect to the girder shall approximately be the same during transportation, and storage as when the girder is placed in final position.

Method of transportation should be planned in such a way that the vehicle employed to transport the long girders can successfully negotiate the available road geometry. Adequate care shall be taken to ensure that the girder being transported does not topple due to unstable arrangement. For this purpose, height of the vehicle shall be kept as low as possible. This will also help in accommodating greater height of the system during transportation below existing bridges or through any other constraints. Girders should be transported only after 28 day concrete strength is achieved.

When members are to be stacked, they shall be firmly supported at such bearing positions as will ensure the stresses induced in them are always less than the permissible design stresses. Further, inclined side supports shall be provided at the ends and along the length of a precast girder to prevent lateral movements or instability.

Care shall be taken during storage, hoisting and handling of precast units to prevent them from being cracked or damaged. Units cracked or damaged by improper storing or handling, shall be replaced by the Contractor at his cost.

Handling of precast girders from precasting location to the bridge site requires careful operation. Lifting location shall be strictly as indicated on the construction drawings.

Lifting devices generally consist of loops of prestressing strand or mild steel bars or any other suitable arrangement. If it is anticipated that embedded material for lifting devices will be cast into the face of the member that will be exposed to view or to corrosive materials in the completed structure, the depth of removal of the embedded material and the method of filling the resulting cavities, shall be as shown on the construction drawings. The depth of removal shall not be less than the clear cover required to the reinforcing steel. The cavity so formed shall be suitably grouted for protecting the embedded metal. Also, the projecting reinforcement shall be suitably protected against corrosion.

1815 TOLERANCES**1815.1 Permissible Tolerances for Structural Unit**

The dimensional tolerances for precast girders shall be as under:

Length	± 10 mm
Flange width and thickness	± 5 mm
Depth	± 5 mm
Web thickness	± 5 mm
Minimum surface unevenness	1.5 mm on 3 m template

1815.2 Tolerances for Prestressing Strands

Permissible tolerances for positional deviation of prestressing strands shall be as under:

Variation from the specified horizontal profile	5 mm
Variation from the specified vertical Profile	5 mm
Variation from the specified position in member	3 mm

1816 TESTS AND STANDARDS OF ACCEPTANCE

The material shall be tested in accordance with these Specifications and shall meet the prescribed criteria and requirements

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

1817 MEASUREMENTS FOR PAYMENT

Prestressed concrete shall be measured in cubic metres. The volume occupied by mild steel reinforcement/HYSD bars, high tensile steel, sheathing and anchorages shall not be deducted.

High tensile (prestressing) steel shall be paid for separately. Its length, as actually incorporated in the finished work, shall be measured and weight calculated therefrom in tonnes on theoretical basis, for payment.

Anchorage devices, additional length of cables for attaching jack, ducts or sheathing, grouting, non-prestressed steel reinforcement fixed to the anchorage devices, making of recesses and filling the same, protection by painting with epoxy and furnishing samples for testing, shall all be deemed to be incidental to and included in the item of high tensile steel and shall not be measured separately.

1818 RATE

The contract unit rate for cast in-situ prestressed concrete shall cover the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per directions of the Engineer, curing and other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to specifications. The contract unit rate shall also include the cost of making, fixing and removing of all centering and formwork required for the work unless otherwise specified in the contract.

For precast prestressed concrete members, the unit rate, in addition to above, shall also include the cost of all materials, labour, tools and plant required, manufacturing in casting bed, transporting and placing the members in their final position as shown on the drawings and as directed by the Engineer.

The contract unit rate for high tensile steel shall cover the cost of material, labour, tools and plant required for procuring, placing, tensioning, anchoring and grouting the high tensile steel in the prestressed concrete as shown on the drawings and as per specifications or as directed by the Engineer.

The cost of anchorage devices, additional length of cables for attaching jack, ducts or sheathing, grout, non-prestressed steel reinforcement fixed to the anchorage devices, making of recesses and filling the same, protection by painting with epoxy and furnishing samples for testing, shall all be included in the unit rate. Rate shall also include payments, if any, to be made to the supplier of the prestressing system, who has to monitor, ensure and certify the correctness of all operations.

1900

STRUCTURAL STEEL

1901 DESCRIPTION

This work shall include furnishing, fabricating, transporting, erecting and painting structural steel, rivet steel, cast steel, steel forgings, cast iron and other incidental metal construction of the kind, size and quantity in conformity with the drawings and these Specifications or as directed by the Engineer.

1902 GENERAL

General requirements relating to the supply of material shall conform to the Specifications of IS:1387, for the purpose of which the supplier shall be the Contractor and the purchaser shall be the Engineer.

Finished rolled material shall be free from cracks, flaws, injurious seams, laps, blisters, ragged and imperfect edges and other defects. It shall have a smooth and uniform finish, and shall be straightened in the mill before shipment. It shall also be free from loose mill scale, rust, pits or other defects affecting its strength and durability.

The acceptance of any material on inspection at the rolling mill, foundry or fabricating plant where material for the work is manufactured, shall not be a bar to its subsequent rejection, if found defective.

Unless otherwise specified, high tensile steel rivets conforming to IS:1149 shall be used only for members of high tensile steel conforming to IS:961 and shall not be used for members of mild steel.

Unless otherwise specified, bolted connection of structural joints using high tensile friction grip bolts shall comply with requirements of IS:4000.

Cast iron shall not be used in any part of the bridge structure, except where it is subject to direct compression.

1903 MATERIALS

1903.1 All materials shall conform to Section 1000 of these Specifications. Special requirements are given below:

Mild steel for bolts and nuts shall conform to IS:226 but have a minimum tensile strength of 44 kg/sq.mm and minimum percentage elongation of 14.

High tensile steel for bolts and nuts shall conform to IS:961 but with a minimum tensile strength of 58 kg/sq.mm.

Use of high strength friction grip bolts shall be permitted only on satisfactory evidence of performance to the requirements (not covered by these Specifications) specified by the Engineer or as laid down in special provisions.

For cast steel, the yield stress shall be determined and shall not be less than 50 percent of the minimum tensile strength.

Plain washers shall be of steel. Tapered or other specially shaped washers shall be of steel or malleable cast iron.

Parallel barrel drifts shall have a tensile strength not less than 55 kg/sq.mm with elongation of not less than 20 percent measured on a gauge length of $4\sqrt{S_o}$.

(S_o = cross-sectional area).

1903.2 Materials for castings and forgings, fasteners, welding consumables and welding shall be as under :

1903.2.1 Castings and Forgings

Steel castings and forgings shall comply with the requirements of the following Indian Standards, as appropriate :

IS:1030	Carbon Steel Castings for General Engineering purposes
IS:1875	Carbon Steel Billets, blooms, slabs, bars for forgings
IS:2004	Carbon Steel Forgings for General Engineering purposes
IS:2644	High Tensile Steel Castings
IS:2708	1.5 Percent Manganese Steel Castings
IS:4367	Alloy and tool steel forgings for general industrial use

1903.2.2 Fasteners

Bolts, nuts washers and rivets shall comply with the following or relevant Indian Standards as appropriate :

IS:1148	Hot rolled rivet bars (up to 40 mm dia) for structural purposes
IS:1149	High tensile steel rivet bars for structural purposes
IS:1363	Hexagon head bolts, screw and nuts product grade C (Parts 1 to 3)
IS:1364	Hexagon head bolts, screw & nuts product grade A and B (Parts 1 to 3)

IS:1367	Technical supply conditions for threaded steel fastener (Parts 1 to 18)
IS:1929	Hot forged steel rivets for hot closing (12-36 mm dia)
IS:2155	Cold forged steel rivets for hot closing (6-16 mm dia)
IS:3640	Hexagon fit bolts
IS:3757	High strength structural bolts
IS:4000	High strength bolts in steel structures
IS:5369	Plain washers and lock washers – general requirements
IS:5370	Plain washers with outside dia = 3 X inside dia
IS:5372	Taper washers for channels (ISMC)
IS:5374	Taper Washers for I beams (ISMB)
IS:5624	Foundation bolts
IS:6610	Heavy washers for steel structures
IS:6623	High strength structural nuts
IS:6639	Hexagon bolts for steel structures
IS:6649	Hardened and tempered washers for high strength structural bolts and nuts.
IS:7002	Prevailing torque type steel hexagon nuts

1903.2.3 Welding Consumables

Welding consumables shall comply with the following Indian Standards as appropriate :

IS:814 (Part 1)	Covered Electrodes for Metal Arc Welding of Structural steel for welding other than sheets
IS:814 (Part 2)	For welding sheets
IS:1395	Low and medium alloy steel covered electrodes for manual Metal Arc Welding
IS:3613	Acceptance Tests for wire flux combinations for submerged arc welding of structural steel
IS:6419	Welding rods and bare electrodes for gas shielded arc welding of structural steel
IS:6560	Molybdenum and chromium-molybdenum low alloy steel welding rods and bare electrodes for gas shielded arc welding

IS:7280 Bare wire electrodes for gas shielded arc welding of structural steel

1903.2.4 Welding

IS:812 Glossary of terms relating to welding and cutting of metals

IS:816 Code of practice for use of metal arc welding for general construction in mild steel

IS:822 Code of procedure for inspection of welds

IS:1024 Code of practice for use of welding in bridges and structures subject to dynamic loading

IS:1182 Recommended practice for radiographic examination of fusion welded butt joints in steel plates

IS:4853 Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes

IS:5334 Code of practice for magnetic particle flaw detection of welds

IS:7307 Approval tests for welding procedures : Part 1 fusion welding of steel

IS:7310 Approval tests for welders working to approved welding procedures : Part 1 fusion welding of steel

IS:7318 Approval tests for welders when welding procedure is not required : Part 1 Fusion welding of steel

IS:9595 Recommendations for metal arc welding of carbon and carbon manganese steels

1903.3 Corrosion resistant steel to be used in aggressive environment shall be low alloy steels containing a total of 1 percent to 2 percent alloys, in particular copper, chromium, nickel and phosphorous.

1903.4 Paints

All materials for paints and enamels shall conform to the requirements specified on the drawings or other special provisions laid down by the Engineer.

The type of paints which can be used shall be as follows :

- a) Ordinary i.e. paints based on drying oils, alkyd resin, modified alkyd resin, phenolic varnish epoxy

- b) Chemical Resistant – one pack type (ready for use) or two pack type (mixed before use).
- c) Vinyl
- d) Chlorinated rubber
- e) Bituminous - (IS:9862)
- f) Epoxy - (IS:14925)
- g) Polyurethane - (IS:13759)
- h) Zinc rich - (IS:14589)

Unless otherwise specified, paints shall conform to the relevant Indian Standards. Paints shall be tested for the following qualities as per Specifications given in the relevant IS codes:

- Weight (for 10 litres of paint, thoroughly mixed)
- Drying time
- Consistency
- Dry thickness and rate of consumption

1904 FABRICATION

1904.1 General

All work shall be in accordance with the drawings and as per these Specifications. Fabrication work shall be taken up only after receipt of approved fabrication/working drawings. It shall be ensured that all parts of an assembly fit accurately together. All members shall carry mark number and item number and, if required, serial number. Method of marking shall be commensurate with the process of manufacture and such as to ensure retention of identity at all stages.

Unless specifically required under the contract, corresponding parts need not be interchangeable, but the parts shall be match marked as required under Clause 1904.9.

Templates, jigs and other appliances used for ensuring the accuracy of the work shall be of mild steel; where specially required, these shall be bushed with hard steel. All measurements shall be made by means of steel tape or other device properly calibrated. Where bridge materials have been used as templates for drilling, these shall be inspected and passed by the Engineer before they are used in the finished structure.

All structural steel members and parts shall have straight edges and plane surfaces. They shall also be free from twist. If necessary, they shall be straightened or flattened by pressure

unless they are required to be of curvilinear forms. Adjacent surfaces or edges shall be in close contact or at uniform distance throughout.

The Contractor shall submit his programme of work to the Engineer for his approval at least 15 days before the commencement of fabrication, which shall include the proposed system of identification and erection marks together with complete details of fabrication and welding procedures. He shall also submit for approval of Engineer, a Quality Assurance Plan according to the nature of fabrication work (whether welded or riveted) which should clearly define the points of checking and inspection during the stages of fabrication as well as supply of materials.

The Contractor shall prepare shop drawings for fabrication of any member and obtain approval of the Engineer before the start of work. Complete information regarding the location, type, size and extent of all welds shall be clearly shown on the shop drawings. These drawings shall distinguish between shop and field welds.

1904.2 Laminations in Plates

The following areas of plates shall not have laminations:

- a) Steel plates and sections in which tension stresses are transmitted through thickness of plate or in region in which lamination could affect the buckling behavior and bending compression.
- b) On each side of welded bearing diaphragm, strip of flange and web plate for a length equal to 25 times their thickness.
- c) The strip of web plate for a length of 25 times its thickness on each side of single sided bearing stiffener welded to web.
- d) For welded cruciform joints transmitting tensile stress through the plate thickness, for a length 4 times the thickness of plate on each side of attachment.
- e) For edges of plates where corner welds are provided on the surface of such plates.
- f) Other areas of plates or sections as may be specified by the Engineer.

1904.3 Straightening and Bending

1904.3.1 The straightening of plates, angles and other shapes shall be done by methods not likely to produce fracture or any injury to the metal. Hammering shall not be permitted. Heating, if permitted by the Engineer in special cases, shall be followed by as slow cooling as possible. Following the straightening of a bend or buckle, the surface shall be carefully inspected for evidence of fracture. Sharp kinks and bends may lead to rejection of material.

1904.3.2 Straightening by heating shall be done under controlled procedure. Temperature of the steel shall not be more than 650°C. Heating and cooling rate shall be appropriate to the particular type of steel and shall be as agreed and approved by the Engineer. Accelerated cooling shall not be carried out without the approval of the Engineer.

1904.3.3 Bending and Curving

Steel having yield stress more than 360 MPa shall not be heat curved. Rolled beams and girders may be curved by either continuous or V-type heating as approved by Engineer.

- a) For the continuous method, a strip of sufficient length along the edge of top and bottom flange shall be heated simultaneously to desired temperature to obtain required curve.
- b) For V-type of heating, the top and bottom flanges shall be heated in truncated triangular or wedge-shaped areas having their base along the flange edge and spaced at regular intervals along each flange. The truncate triangular pattern shall have an angle 15 to 30 with base not more than 250 mm long. The spacing and temperature shall be as required to obtain the required curvature and heating shall be at approximately the same rate along the top and bottom flanges.

For flange thickness of 32 mm or more, both inside and outside surfaces shall be heated concurrently.

The heat bending shall be conducted so that the temperature of steel does not exceed 620°C. The girder shall not be artificially cooled until temperature comes down to 315°C by natural cooling. The method of artificial cooling shall be as approved by Engineer.

Camber for rolled beams may be obtained by heat curving methods approved by Engineer. For camber in plate girders, the web shall be cut to prescribed camber with suitable allowance for shrinkage due to cutting, welding and heat curving.

1904.4 Preparation of Edges and Ends

1904.4.1 All structural steel parts, where required, shall be sheared, cropped, sawn or flame cut and ground accurately to the required dimension and shape. Material shall be cleaned and any burrs, scales or abnormal irregularities shall be removed.

1904.4.2 End/edge planing and cutting shall be done by any one of the following prescribed methods or left as rolled:

- a) Shearing, cropping, sawing, machining, machine flame cutting.
- b) Hand flame cutting with subsequent grinding to a smooth edge.

Sheared edges of plate not more than 16 mm thick, which are for secondary use such as stiffeners and gussets, shall be subsequently ground to smooth profile.

If ends of stiffeners are required to be fitted, they shall be ground, so that the maximum gap over 60 percent of the contact area does not exceed 0.25 mm.

1904.4.3 Where flame cutting or shearing is done, at least one of the following requirements shall be satisfied.

- a) The cut edge is not subjected to applied stress.
- b) The edge is incorporated in weld.
- c) The hardness of cut edge does not exceed 350 HV 30.
- d) The material is removed from edge to the extent of 2 mm or minimum necessary, so that the hardness is less than 350 HV 30.
- e) Edge is suitably heat treated by approved method to the satisfaction of the Engineer and it is shown by dye penetrant or magnetic particle test that cracks have not developed.
- f) Thickness of plate is less than 40 mm for machine flame cutting of materials conforming to IS:2062 up to Grade E250 (Fe 410w). The requirement of hardness below 350 HV 30 of flame cut edges shall be specified by the Engineer.

The flame cut edges shall be ground or machined over and above the requirements in (a) to (f), wherever specified by the Engineer.

1904.4.4 Where machining for edge preparation in butt joint is specified, the ends shall be machined after the members have been fabricated.

Outside edges of plate and section, which are prone to corrosion shall be smoothed by grinding or filing.

In the case of high tensile steel at least 6 mm of the material from the flame cut edge shall be removed by machining.

Longitudinal edges of all plates and cover plates in plate girders and built-up members shall be machined except in the following cases:

- a) Rolled edges of single universal plates or flats
- b) Covers to single flange plates.
- c) Edges of single plates in compression and edges of single plates of thickness 25 mm or less, in tension, where machine flame cutting is acceptable.

- d) Edges of single shaped plates over 2 mm thick not capable of being machined by ordinary method, which may be machine flame cut and the end surface ground.
- e) Edges of universal plates or flats of the same nominal width used in tiers, if so authorized by the Engineer.

All edges of splice and gusset plates 12 mm thick and over, shall be machined and those less than 12 mm thick shall be sheared and ground.

The ends of plates and sections forming the main components of plate girders or of built-up members shall be machined, machine flame cut, sawn or hand flame cut and ground.

Where ends of stiffeners are required to be fitted, they shall be machined, machine flame cut, sawn, sheared and ground or hand flame cut and ground.

The ends of lacing bar shall be rounded unless otherwise specified.

Other edges and ends of mild steel parts shall be sheared and any burrs at edges shall be removed.

1904.5 Preparation of Holes

1904.5.1 Drilling and Punching

Holes for rivets, black bolts, high strength bolts and countersunk bolts/rivets (excluding close tolerance and turn fitted bolts) shall be either punched or drilled. For bolts/rivets less than 25 mm dia, the diameter of holes shall be 1.5 mm larger while for those of 25 mm dia or more, the diameter of holes shall be 2 mm larger than the diameter of the bolt/rivet.

All holes shall be drilled except those for secondary members such as floor plates, hand rails etc. Members which do not carry the main load can be punched subject to the thickness of member not exceeding 12 mm for material conforming to IS:2062 up to Grade E250 (Fe 410w).

Holes through material of more than one thickness or through main material thickness exceeding 20 mm for steel conforming to IS:2062 up to Grade E250 (Fe 410w) or 16 mm for steel conforming to IS:2062 up to Grade E300 (Fe 440w) and above, shall either be sub-drilled or sub-punched to a diameter of 3 mm less than the required size and then reamed to the required size. The reaming of material more than one thickness shall be done after assembly.

Where several plates or sections form a compound member, they shall, where practicable, be firmly connected together by clamps or tacking bolts and the holes shall be drilled through

the group in one operation. Alternatively, and in the case of repetition work, the plates and sections may be drilled separately from jigs and templates. Jigs and templates shall be checked at least once after every 25 operations. All burrs shall be removed.

In the case of repetition of spans, the erection of every span shall not be insisted upon, except where close tolerance or turned bolts are used, provided that methods are adopted to ensure strict interchangeability. In such cases, one span in ten or any number less than ten of each type shall be erected from pieces selected at random by the Engineer and should there be any failure of the pieces to fit, all similar spans shall be erected complete. In the event of spans being proved completely interchangeable, all corresponding parts shall carry the same mark so that sorting of the materials at site is facilitated.

1904.5.2 Block Drilling

Where the number of plates to be riveted exceeds three or the total thickness is 90 mm or more, the rivet holes, unless they have been drilled through steel bushed jigs, shall be drilled out in place 3 mm all round after assembling. In such cases, the work shall be tightly bolted together.

1904.5.3 Size of Holes

The diameters of rivet holes in millimetres are given in Table 1900-1.

Table 1900-1 : Diameters of Holes for Rivets

Nominal dia of Rivets (mm)	Dia of Holes (mm)
12	13.5
14	15.5
16	17.5
18	19.5
20	21.5
22	23.5
24	25.5
27	29.0
30	32.0
33	35.0

1904.5.4 Close Tolerance Bolts and Barrel Bolts

For close tolerance or turn fitted bolts, the diameter of the holes shall be equal to the nominal diameter of the bolt shank + 0.15 mm to - 0.0 mm.

The members to be connected with close tolerance or turn fitted bolts shall be firmly held together by service bolts or clamped and drilled through all thicknesses in one operation and subsequently reamed to required size within specified limit of accuracy as specified in IS:919 tolerance grade H8.

The holes not drilled through all thicknesses in one operation shall be drilled to smaller size and reamed after assembly.

1904.5.5 Holes for High Strength Friction Grip Bolts

All holes shall be drilled after removal of burrs. Where the number of plies in the grip does not exceed three, the diameters of holes shall be 1.5 mm larger than those of bolts. Where the number of plies in the grip exceeds three, the diameters of holes shall be as follows, unless otherwise specified by the Engineer:

- in outer plies 1.5 mm larger than diameter of bolts
- in inner plies not less than 1.5 mm and not more than 3.0 mm larger than diameter of bolts

1904.5.6 Removal of Burrs

The work shall be taken apart after drilling and all burrs left by drilling and the sharp edges of all rivet holes completely removed.

1904.6 Rivets and Riveting

1904.6.1 The riveting shall be done by hydraulic or pneumatic machine unless otherwise specified by Engineer. The driving pressure shall be maintained on the rivets for a short time after the upsetting is completed.

1904.6.2 The diameter of rivets shown on the drawings shall be the size before heating. Each rivet shall be of sufficient length to form a head of the standard dimensions as given in IS handbook on Steel Sections, Part-I. The underside of the head shall be free from burrs.

1904.6.3 The tolerance on the diameter of rivets shall be in accordance with IS:1148 for mild steel rivets and IS:1149 for high tensile steel rivets. Unless otherwise specified, the tolerance shall be minus.

1904.6.4 When countersunk head is required, the head shall fill the countersunk hole and projection after countersinking shall be ground off wherever necessary. The included angle of the head shall be as follows:

- | | | |
|----|---|------------|
| a) | For plates over 14 mm thickness | 90 degree |
| b) | For plates upto and including 14 mm thickness | 120 degree |

1904.6.5 Mild steel rivets shall be heated uniformly to a light cherry red colour between 650°C to 700°C for hydraulic riveting and orange colour for pneumatic riveting. High tensile steel rivets shall be heated up to 1100°C. The rivets shall be red hot from head to the point when inserted and shall be upset in its entire length so as to fill the hole as completely as possible when hot. After being heated and before being inserted in the hole, the rivet shall be made free from scale by striking it on a hard surface. Any rivet whose point is heated more than the prescribed limit, shall not be driven.

Where flush surface is required, any projecting metal shall be chipped or ground off.

1904.6.6 Before riveting is commenced, the parts/members to be riveted shall be firmly drawn together with bolts, clamps or tack welds so that the various sections and plates are in close contact throughout. Every third hole of the joint shall have assembly bolts till riveted. Drifts shall only be used for drawing the work into position and shall not be used to such an extent as to distort the holes. Drifts of a larger size than the nominal diameter of the hole shall not be used.

1904.6.7 Driven rivets, when struck sharply on the head by a quarter pound rivet testing hammer, shall be free from movement and vibrations. Assembled riveted joint surfaces, including those adjacent to the rivet heads, shall be free from, dirt, loose scale, burrs, other foreign materials and defects that would prevent solid seating of parts.

1904.6.8 All loose or burnt rivets, rivets with cracked or badly formed defective heads or rivets with heads which are unduly eccentric with the shanks, shall be removed and replaced. In removing rivets, the head shall be sheared off and the rivet punched out so as not to damage the adjacent metal. If necessary, the rivets shall be drilled out. Re-cupping or re-caulking shall not be permitted. The parts not completely riveted in the shop shall be secured by bolts to prevent damage during transport and handling.

1904.7 Bolts, Nuts and Washers

1904.7.1 Black Bolts (Black All Over)

Black bolts are forged bolts in which the shanks, heads and nuts do not receive any further treatment except cutting of screw threads. They shall be true to shape and size and shall have the standard dimensions as shown on the drawings.

1904.7.2 Close Tolerance Bolts

Close tolerance bolts shall be faced under the head and turned on the shank.

1904.7.3 Turned Barrel Bolts

The diameter of the screwed portion of turned barrel bolts shall be 1.5 mm smaller than the diameter of the barrel unless otherwise specified by the Engineer. The diameter of the bolts as given on the drawing shall be the nominal diameter of the barrel. The length of the barrel shall be such that it bears fully on all the parts connected. The threaded portion of each bolt shall project through the nut by at least one thread. Faces of heads and nuts bearing on steel work shall be machined.

1904.7.4 High Strength Friction Bolts and Bolted Connections

The general requirement shall be as per relevant IS Specifications mentioned in **Clause 1903.2.2**. Unless otherwise specified by the Engineer, bolted connections of structural joints using high tensile friction grip bolts shall comply with requirements mentioned in IS:4000.

1904.7.5 Washers

In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a steel washer under the nut of sufficient thickness to avoid any threaded portion of the bolt being within the thickness of the parts bolted together and to prevent the nut when screwed up, from bearing on the bolt.

For close tolerance or turned barrel bolts, steel washers whose faces give a true bearing shall be provided under the nut. The washer shall have a hole diameter not less than 1.5 mm larger than the barrel and thickness not less than 6 mm so that the nut, when screwed up, will not bear on the shoulder of the bolt.

Taper washer, with correct angle of taper, shall be provided under all heads and nuts bearing on bevelled surfaces.

Spring washers may be used under nuts to prevent slackening of the nuts when excessive vibrations occur.

Where the heads or nuts bear on timber, square washers having a length of each side not less than three times the diameter of bolts or round washers having a diameter of 3½ times the diameter of bolts and with a thickness not less than one quarter of diameter, shall be provided.

1904.7.6 Studs

Ordinary studs may be used for holding parts together, the holes in one of the parts being tapped to take the thread of the stud. Countersunk studs may be used for making connections

where the surfaces are required to be clear of all obstruction, such as protruding heads of bolts or rivets. Studs may also be welded on the steel work in the positions required.

1904.7.7 Service Bolts

Service bolts shall have the same clearance as black bolts and where it is required that there should be no movement prior to final riveting, sufficient drifts or close tolerance bolts shall be used to locate the work.

1904.7.8 Tightening Bolts

Bolted connection joints with black bolts and high strength bolts shall be inspected for compliance of code requirements.

All joint surfaces for bolted connection including bolts, nuts and washers shall be free of scale, dirt, burrs, other foreign material and other defects that would prevent solid seating of parts. The slope of surface of bolted parts in contact with bolt head and nuts shall not exceed 1:20 plane normal to bolt axis; otherwise suitable tapered washer shall be used.

All fasteners shall have a washer under nut or bolt head, whichever is turned in tightening.

Each fastener of joint shall be tightened to specified value or to 70 percent of specified minimum tensile strength by hand wrenches (turn of nut method) or calibrated wrenches, manual torque wrenches, impact wrench or any other method specified by the Engineer.

When 'turn of nut' method is used for tightening the bolts in a joint, all bolts shall be first brought to snug-tight condition i.e. tightening by full manual effort using ordinary wrench or by a few impacts of any impact wrench. All bolts in the joint shall then be tightened additionally by applicable amount of nut rotation as specified in IS:4000.

The Engineer shall observe the installation and tightening of bolts to ensure that correct tightening procedure is used and all bolts are tightened. Regardless of tightening method used, tightening of bolts in a joint should commence at the most rigidly fixed or stiffest point and progress towards the free edges, both in initial snugging and in final tightening.

The tightness of bolts in connection shall be checked by inspection wrench, which can be torque wrench, power wrench or calibrated wrench.

Tightness of 10 percent bolts, but not less than two bolts, selected at random in each connection shall be checked by applying inspection torque. If no nut or bolt head is turned by this application, connection can be accepted as properly tightened, but if any nut or head has turned, all bolts shall be checked and, if necessary, re-tightened.

1904.7.9 Drifts

The barrel shall be drawn or machined to the required diameter for a length of not less than one diameter over the combined thickness of the metal through which the drifts have to pass. The diameter of the parallel barrel shall be equal to the nominal diameter of the hole subject to a tolerance of +0 mm and - 0.125 mm. Both ends of the drift for a length equal to 1½ times the diameter of the parallel portion of the bar, shall be turned down with a taper to a diameter at the end equal to one-half that of parallel portion.

1904.8 Pins and Pin Holes**1904.8.1 Pins**

The pins shall be parallel throughout and shall have a smooth surface free from flaws. They shall be of sufficient length to ensure that all parts that they connect, shall have a full bearing on them. Where the ends are threaded, they shall be turned to a smaller diameter at the ends for the thread and shall be provided with a pilot nut, where necessary, to protect the thread when being drawn to place. To facilitate insertion and extraction, pins may be chamfered beyond the required length and provided with suitable holes in the chamfered portion.

Pins more than 175 mm in length or diameter shall be forged and annealed.

1904.8.2 Pin Holes

Pin holes shall be bored smooth, straight and true to gauge at right angles to the axis of the member and parallel with each other, unless otherwise required. The tolerance in the length of tension members from outside to outside of pin holes and of compression members from inside to inside of pin holes shall be 1 mm. In built-up members, the boring shall be done only after the members have been finally riveted, welded or bolted unless otherwise approved by Engineer.

The specified diameter of the pin hole shall be its minimum diameter. The resulting clearance between the pin and the hole shall not be less than 0.5 mm and not more than 1 mm.

1904.9 Shop Erection and Match Marking

Before being dispatched, the steel work shall be temporarily erected in the fabrication shop for inspection by the Engineer either wholly or in such portion as the Engineer may require, so that he may be satisfied in respect of both the alignment and fit of all connections. For this purpose, sufficient number of parallel drifts and service bolts tightly screwed up, shall be employed. All parts shall fit accurately and be in accordance with drawings and specifications.

The steel work shall be temporarily assembled at place of fabrication. Assembly shall be of full truss or girder, unless progressive truss or girder assembly, full chord assembly, progressive chord assembly or special complete structure assembly, is specified by the Engineer.

The camber diagram showing camber at each panel point, method of shop assembly and any other relevant detail, shall be submitted to Engineer for approval.

The field connections of main members of trusses, arches, continuous beams, spans, bends, plate girders and rigid frame shall be assembled, aligned and accuracy of holes and camber checked by the Engineer. Only thereafter shall reaming of sub-sized holes to specified size, be taken up.

The assembly shall be dismantled only after final drilling of holes has been completed and the work has been passed by the Engineer. Before dismantling, each part shall be carefully marked for re-erection with distinguishing marks and stamped with durable markings. Drawings showing these markings correctly shall be supplied to the Engineer.

Unloading, handling and storage of steel work as per these Specifications shall be the responsibility of the Contractor. The cost of repairs, removal of rejected material, and transportation of replacement material to the site, shall be borne by the Contractor.

In cases where close tolerance or turned barrel bolts are used and interchangeability is not insisted upon, each span shall be erected and its members marked distinctly.

1904.10 Welding

1904.10.1 All welding shall be done with the prior approval of the Engineer and the workmanship shall conform to the specifications of the relevant Indian Standards as appropriate.

When material thickness is 20 mm or more, special precautions like pre-heating shall be taken as laid down in IS:9595. Surfaces and edges to be welded shall be smooth, uniform and free from fins, tears, cracks and other discontinuities. Surface shall also be free from loose or thick scale, slag rust, moisture, oil and other foreign materials. Surfaces within 50 mm of any weld location shall be free from any paint or other material that may prevent proper welding or cause objectionable fumes during welding.

The general welding procedures including particulars of the preparation of fusion faces for metal arc welding, shall be carried out in accordance with IS:9595.

The welding procedures for shop and site welds including edge preparation of fusion faces shall be as per details shown on the drawings and shall be submitted in writing for the approval of the Engineer, in accordance with Clause 22 of IS:9595, before commencing fabrication.

Any deviation from this procedure has to be approved by the Engineer. Preparation of edges shall, wherever practicable, be done by machine methods.

Machine flame cut edges shall be substantially as smooth and regular as those produced by edge planing and shall be left free of slag. Manual flame cutting shall be permitted by the Engineer only where machine cutting is not practicable.

Electrodes to be used for metal arc welding shall comply with relevant Indian Standards mentioned in Clause 1903.2.3. Procedure test shall be carried out as per IS:3613 to find out suitable wire-flux combination for welded joint.

Assembly of parts for welding shall be in accordance with provisions of Clauses 14 to 16 of IS:9595.

Welded temporary attachment should be avoided as far as possible. If unavoidable, the method of making any temporary attachment shall be as approved by the Engineer. Any scars from temporary attachment shall be removed by cutting and chipping and surface shall be finished smooth by grinding to the satisfaction of the Engineer.

Welding shall not be carried out when the air temperature is less than 10°C, when the surfaces are wet, during periods of strong winds and in snowy weather, unless the work and the welding operators are adequately protected.

1904.10.2 For welding of any particular type of joint, welders shall undergo the appropriate welders qualification test as prescribed in any of the relevant Indian Standards IS:817, IS:1966, IS:1393, IS:7307 (Part I), IS:7310 (Part I) and IS:7318 (Part I) to the satisfaction of the Engineer.

1904.10.3 In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as to avoid distortion and minimize shrinkage stress.

All requirements regarding pre-heating of parent material and interpass temperature shall be in accordance with provisions of IS:9595.

1904.10.4 Peening of weld shall be carried out wherever specified by the Engineer :

- a) If specified, peening may be employed to be effective on each weld layer except the first filling layer.
- b) After weld has cooled, the peening should be carried out by light blows from a power hammer using a round nosed tool. Care shall be taken to prevent scaling or flaking of weld and base metal from over peening.

1904.10.5 Where the Engineer has specified that the butt welds are to be ground flush, the loss of parent metal shall not be greater than that allowed for minor surface defects. The ends of butt joints shall be welded so as to provide full throat thickness. This may be done by use of extension pieces, cross runs or other means approved by the Engineer. Extension pieces shall be removed after the joint has cooled and the ends of the weld shall be finished smooth and flush with the faces of the abutting parts.

1904.10.6 The following joints and welds which do not perform well under cyclic loading, are prohibited.

- a) Butt joints not fully welded throughout their cross-section
- b) Groove welds made from one side only without any backing grip
- c) Intermittent groove welds
- d) Intermittent fillet welds
- e) Bevel-grooves and J-grooves in butt joints for other than horizontal position
- f) Plug and slot welds

1904.10.7 The run-on and run-off plate extension shall be used for providing full throat thickness at the end of butt welded joints. These plates shall comply with the following requirements.

- i) One pair of run-on and one pair of run-off plates prepared from same thickness and profile as the parent metal shall be attached to start and finish of all butt welds, preferably by clamps.
- ii) When run-on and run-off plates are removed by flame cutting, they shall be cut at more than 3 mm away from the parent metal and the remaining metal of the plates shall be removed by grinding or by any other method approved by the Engineer.

1904.10.8 Welding of Stud Shear Connectors

The stud shear connectors shall be welded in accordance with the manufacturer's instructions including those relating to pre-heating.

The stud and the surface to which it is to be welded shall be free from scale, moisture, rust and other foreign material. The stud base shall not be painted, galvanised or cadmium plated prior to welding.

The welds shall be visually free from cracks and shall be capable of developing at least the nominal ultimate strength of studs.

The procedural trial for welding the stud shall be carried out when specified by the Engineer.

1904.11 Tolerances

Tolerances in dimensions of components of fabricated structural steel work shall be specified on the drawings and shall be subject to the approval of the Engineer before fabrication. Unless otherwise specified, all parts of an assembly shall fit together accurately within tolerances specified in Table 1900-2.

A machined bearing surface, where specified by the Engineer, shall be machined within a deviation of 0.25 mm for surfaces that can be inscribed within a square of side 0.5 m.

Table 1900-2 : Fabrication Tolerances - Individual Components

1)	Length		
	a)	Member with both ends finished for contact bearing	± 1 mm
	b)	Individual components of members with end plate connection	+ 0 mm - 2 mm
	c)	Other members of length i) Upto and including 12 M ii) Over 12 M	± 2 mm ± 3.5 mm
2)	Width		
	a)	Width of built-up girders	± 3 mm
	b)	Deviation in the width of members required to be inserted in other members	+ 0 mm - 3 mm
3)	Depth		
	Deviation in the depths of solid web and open web girders		+ 3 mm - 2 mm
4)	Straightness		
	a)	Deviation from straightness of columns	L/3000 subject to maximum of 15 mm where L is length of member
		i) in elevation ii) In plan	+ 5 mm - 0 mm L/1000 subject to a maximum of 10 mm
5)	Deviation of centre line of web from centre line of flanges in built-up members at contact surface		3 mm
6)	Deviation from flatness of plate of webs of built-up members in a length equal to the depth of the members		0.005 d to a maximum of 2 mm where d is depth of the member

7)	Tilt of flange of plate girders		
	a)	At splices and stiffeners, at supports, at the top flanges of plate girders and at bearings	0.005 b to a minimum of 2 mm where b is width of the member
	b)	at other places	0.015 b to a maximum of 4 mm where b is width of the member
8)	Deviation from squareness of flange to web of columns and box girders		$L/1000$, where L is nominal length of the diagonal
9)	Deviation from squareness of fixed base plate (not machined) to axis of columns. This dimension shall be measured parallel to the longitudinal axis of the column at points where the outer surfaces of the column sections make contact with the base plate		$D/500$, where D is the distance from the column axis to the point under consideration on the base plate
10)	Deviation from squareness of machined ends to axes of columns		$D/1000$, where D is as defined in 9 above
11)	Deviation from squareness of machined ends to axes of beams		$D/1000$, where D is as defined in 9 above
12)	Ends of members abutting at joints through cleats or end plates, permissible deviation from squareness of ends		$1/600$ of depth of member subject to a maximum of 1.5 mm

1904.12 Annealing and Stress Relieving

The members to be annealed or stress relieved as indicated in the contract or specified by Engineer, shall have finish machining, boring, etc., done subsequent to heat treatment. The stress relief treatment shall conform to the following unless otherwise specified by Engineer:

- a) The temperature of the furnace shall not be more than 300°C at the time welded assembly is placed in it.
- b) The rate of heating shall not be more than 220°C per hour divided by maximum metal thickness, subject to maximum of 220°C per hour.
- c) After maximum temperature of 600°C is reached, the assembly shall be held within specified limit of time based on weld thickness. The temperature shall be maintained uniformly throughout the furnace during holding period such that temperature at no two points on the member will differ by more than 80°C.
- d) The cooling shall be done in closed furnace when temperature is 300°C, at the maximum rate of 260°C per hour divided by maximum metal thickness. The local stress relieving shall be carried out if specified and procedure approved by Engineer.

1904.13 Rectification of Surface Defects

The surface defects revealed during fabrication or cleaning shall be repaired as specified. The repair by welding on any surface defect or exposed edge lamination shall be carried out only with approval of Engineer.

1904.14 Alignment at Splice and Butt Joints

Bolted splice shall be provided with steel packing plates where necessary, to ensure that the sum of any unintended steps between adjacent surfaces does not exceed 1 mm for HSFG bolted joints and 2 mm for other joints.

In welded butt joints, misalignment of parts to be joined shall not exceed the lesser of 0.15 times the thickness of thinner part or 3 mm. However, if due either to different thicknesses arising from rolling tolerances or a combination of rolling tolerances with above permitted misalignment, this deviation is more than 3 mm, it shall be smoothed by a slope not steeper than 1:4.

1905 ERECTION**1905.1 General**

These provisions shall apply to erection of steel bridge superstructures or steel main members of bridge superstructures, which span between supports.

If the substructure and the superstructure are built under separate contracts, the Employer will provide the substructure, constructed to correct lines, dimensions and elevations properly finished and will establish the lines and the elevation required for erection purposes.

The Contractor shall erect the structural steel, remove the temporary construction and do all work required to complete the construction included in the contract, in accordance with the drawings and the specifications and to the entire satisfaction of the Engineer.

1905.2 Organisation and Equipment

The Contractor shall submit erection plans prepared by the fabricator showing the method and procedure of erection, compatible with the details of fabrication.

A detailed scheme shall be prepared showing stage-wise activities, with complete drawings and working instructions. This should be based on detailed stage-wise calculations taking into account specifications and capacity of erection equipment machinery, tools and tackles to be used and temporary working loads as per codal provisions.

The scheme shall also take into account site conditions such as hydrology, rainfall, flood timings and intensity, soil and subsoil conditions in the river bed and banks, maximum water depth, temperature and climatic conditions and available working space.

The scheme shall indicate details of materials required with specifications, quantities, type of storage, etc. It shall also indicate precisely the type of temporary fasteners to be used as also the minimum percentage of permanent fasteners to be fitted during the stage erection. The working drawings should indicate clearly the temporary jigs, fixtures, clamps, spacer supports, etc.

All components of the bridge shall be got checked for their adequacy to take care of temporary forces to which they are subjected during erection so as to ensure safety of the structure at all stages of erection.

Unless otherwise provided in the contract, the Contractor shall supply and erect all necessary falsework and staging and shall supply all labour, tools, erection plant and other materials necessary to carry out the work complete in all respects.

The Contractor shall supply all rivets, bolts, nuts, washers, etc. required to complete erection at site with an allowance for wastage of 12½ percent of the net number of field rivets, bolts, washers required, or a minimum of five numbers of each item.

Service bolts and nuts, washers and drifts for use in erection shall be supplied at 60 percent (45 percent bolts and 15 percent drifts) of the number of field rivets per span in each size (this includes wastage). A reduction in the numbers of service bolts, etc., may however, be specified by the Engineer if more than one span of each type is ordered.

Prior to actual commencement of erection, all equipment, machinery, tools, tackles, ropes, etc. need to be tested to ensure their efficient working. Frequent visual inspection of vulnerable areas is essential to detect displacements, distress, damages, etc.

Deflection and vibratory tests shall be conducted on supporting structures, launching truss and also the structure under erection. Any unusual deviation or looseness of fittings. is to be noted and reviewed.

For welded structures, welders' qualifications and skills are to be checked as per standard norms. Non-destructive tests of joints are to be carried out as per designer's directives.

Precision non-destructive testing instruments should be used for frequent checking of various important parameters of the structures and systematic records should be maintained.

Safety requirements shall conform to IS:7205, IS:7273 and IS:7269 as applicable and all aspects of safety commensurate with economy and speed of construction, shall be considered.

Erection work should start with complete resources mobilized as per latest approved drawings and after a thorough survey of foundations and other related structural work. For works of large magnitude, mechanization is to be adopted to the maximum extent possible.

The structure should be divided into erectable modules as per the scheme. The module should be pre-assembled in a suitable yard / platform and its matching with members of the adjacent module checked by trial assembly before erection.

The structure shall be set out to the required lines and levels. The steelwork should be erected, adjusted and completed in the required position to the specified lines and levels with sufficient drifts and bolts. Packing materials shall be available to maintain this condition. Quality surveillance checks need to be carried out frequently.

Before starting work, the Contractor shall obtain necessary approval of the Engineer for the methodology/procedure of erection, drawings of temporary works, use of erection equipments and the number and character of tools and plant. The approval of the Engineer shall not relieve the Contractor of his responsibility for the safety of his methodology and equipment or from carrying out the work fully in accordance with the drawings and specifications.

During execution, the Contractor shall have a competent engineer or foreman in charge of the work, who has adequate experience in steel erection and is acceptable to the Engineer.

1905.3 Handling and Storing of Materials

Suitable area for storage of structures and components shall be located near the site of work. The access road should be free from water logging during the working period and the storage area should be on firm levelled ground.

The store should be provided with adequate handling equipment viz. mobile crane, gantries, derricks, chain pulley blocks, winch etc., of capacity as required. Stacking area should be planned and have racks, stands sleepers, access tracks etc. and proper lighting.

Storage should be planned to suit erection work sequence and avoid damage or distortion of material. Excessively rusted, bent or damaged steel shall be rejected. Methods of storage and handling steel, whether fabricated or not, shall be subject to the approval of the Engineer.

Fabricated materials are to be stored with erection marks visible. They should not come into contact with earth surface or water and should be accessible to handling equipment.

All materials, consumables, including raw steel or fabricated material shall be stored specification-wise and size-wise above the ground upon platforms, skids or other supports. They shall be kept free from dirt and other foreign matter and shall be protected as far as possible from corrosion and distortion. Electrodes shall be stored specification-wise and shall

be kept in dry warm condition in properly designed racks. The bolts, nuts, washers and other fasteners shall be stored in gunny bags on racks above the ground with protective oil coating. Paint shall be stored under cover in air-tight containers. Small hand tools shall be kept in containers in covered stores.

IS:7293 and IS:7969 dealing with handling of materials and equipment for safe working should be followed. Safety nuts and bolts as directed are to be used while working. The Contractor shall be held responsible for loss or damage to any material paid for by the Employer while in his care or for any damage to such material resulting from his work.

1905.4 Formwork

The formwork shall be properly designed, substantially built and maintained for all anticipated loads. The Contractor, if required, shall submit plans for approval to the Engineer. Approval of the plans, however, shall not relieve the Contractor of his responsibility for adequacy and effective performance of the formwork.

1905.5 Assembling Steel

The parts shall be accurately assembled as shown on the drawings and match marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged.

Hammering which will injure or distort the members shall not be done. Bearing surface or surfaces to be in permanent contact shall be cleaned, before the members are assembled. The truss spans shall be erected on blocking, so placed as to give the proper camber. The blocking shall be left in place until the tendon chord splices are fully riveted and all other truss connections pinned and bolted. Rivets in splices of butt joints of compression members and rivets in railings, shall not be driven until the span has been swung.

All joint surface for bolted connections including bolts, nuts, washers shall be free from scale, dirt, burrs, other foreign materials and defects that would prevent solid seating of parts. The slope of surface of bolted parts in contact with bolt head and nut shall not exceed 1 in 20, in a plane normal to bolt axis; in case it does, suitable tapered washer shall be used.

All fasteners shall have a washer under nut or bolt head, whichever is turned in tightening.

Any connection to be riveted or bolted shall be secured in close contact with service bolts or with a sufficient number of permanent bolts before the rivets are driven or before the connections are finally bolted. Joints shall normally be made by filling not less than 50 percent of holes with service bolts and barrel drifts in the ratio 4:1. The service bolts are to be fully tightened as soon as the joint is assembled. Connections to be made by close tolerance or barrel bolts shall be completed as soon as practicable after assembly.

Any connection to be site welded shall be securely held in position by approved methods to ensure accurate alignment, camber and elevation before welding is commenced.

Field riveting, welding, bolting and pin connections shall conform to the requirements of Clause 1904 as appropriate.

The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents proper assembling and fitting up of parts by moderate use of drifts or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Engineer. In such cases, the method of correction shall be approved by the Engineer and carried out in his presence.

1905.6 Field Inspection

1905.6.1 General

All materials equipment and work of erection shall be subject to the inspection of the Engineer who shall be provided with all facilities required for this purpose, including labour and tools, at all reasonable times. Any work found defective is liable to be rejected.

1905.6.2 No protective treatment shall be applied to the work until the appropriate inspection and testing have been carried out. The stage inspection shall be carried out for all operations so as to ensure correctness of fabrication and good quality. Girder dimensions and camber shall not be finally checked until all welding and heating operations are completed and the member has cooled to a uniform temperature.

1905.6.3 Testing of Material

Structural steel shall be tested for mechanical and chemical properties as per appropriate Indian Standards as may be applicable and shall conform to requirements specified in IS:226, IS:2062, IS:11587, IS:1977, IS:8500 and IS:961.

Rivets, bolts, nuts, washers, welding consumables, steel forging, casting and stainless steel shall be tested for mechanical and chemical properties in accordance with the appropriate Indian Standards.

Rolling and cutting tolerance shall be as per IS:1852. The thickness tolerance check measurements for plates and rolled sections shall be taken at not less than 15 mm from edge.

Check for laminations in plates shall be carried out for areas specified in Clause 1904.2. by ultrasonic testing or any other specified method. Flame cut edges without visual signs of

laminations need not be tested for compliance with Clause 1904.2, unless otherwise specified by Engineer.

Steel work shall be inspected for surface defects and exposed edge laminations during fabrication and blast cleaning. Significant edge laminations found shall be reported to the Engineer for his decision.

Chipping, grinding, machining or ultrasonic testing shall be used to determine depth of imperfection.

1905.6.4 Testing of Connections

1905.6.4.1 Bolted Connections

Bolts and bolted connection joints with high strength friction grip bolts, shall be inspected and tested according to IS:4000.

Bolted connection joints with black bolts and high strength bolts shall be inspected and tested for compliance or requirements mentioned in Clause 1904.7.8.

1905.6.4.2 Riveted Connections

Rivets and riveted connection shall be inspected as per **Clause 1904.6** and tested for compliance of codal requirements.

The firmness of joint shall be checked by 0.2 mm filler gauge, which shall not go inside under the rivet head by more than 3 mm. There shall not be any gap between members to be riveted.

Driven rivets shall be checked with rivet testing hammer. When struck sharply on the head with the hammer, the rivet shall be free from movement and vibration. All loose rivets and rivets with cracks, badly formed or deficient heads or with heads which are eccentric with shanks, shall be cut out and replaced.

The alignment of plates at all bolted splice joints and welded butt joints shall be checked for compliance with codal requirements.

Testing of flame cut and sheared edges is to be done, where the hardness criteria given in the code are adopted. Hardness testing shall be carried out on six specimens.

1905.6.4.3 Welded Connections

Welding procedure, welded connections and testing shall be in compliance with codal requirements.

Welders qualification test shall be carried out as per requirements laid down in IS:7318 (Part 1). For approved welding procedures, the approval tests shall be as per requirements of IS:7310 (Part 1).

All facilities necessary for stage inspection during welding and on completion shall be provided to the Engineer or his inspecting authority by fabricator.

Adequate means of identification either by identification mark or other record shall be provided to enable each weld to be traced to the welder(s) by whom its welding was carried out.

All metal arc welding shall be in compliance with IS:9595 provisions.

The method of inspection shall be in accordance with IS:822 and extent of inspection and testing shall be in accordance with the relevant standards or as agreed with the Engineer.

1905.7 Procedure tests for Welds

The destructive and non-destructive test of weld shall be carried out according to IS:7307 (Part I).

1905.7.1 Non-Destructive Testing of Welds

One or more of the following methods may be applied for inspection or testing of weld :

- i) **Visual Inspection** : All welds shall be visually inspected, to cover all defects of weld such as size, porosity, crack in the weld or in the HAZ (Heat Affected Zone) etc. Suitable magnifying glass may be used for visual inspection. A weld shall be acceptable by visual inspection if it is seen that :
 - a) The weld has no cracks.
 - b) Thorough fusion exists between weld and base metal and between adjacent layers of weld metal.
 - c) Weld profiles are in accordance with relevant Clauses of IS:9595 or as agreed with the Engineer.
 - d) The weld is of full cross section, except for the ends of intermittent fillet welds outside their effective length.
 - e) When weld is transverse to the primary stress, undercut shall not be more than 0.25 mm deep in the part that is undercut. When the weld is parallel to the primary stress, undercut shall not be more than 0.8 mm deep in the part that is undercut.
 - f) The fillet weld in any single continuous weld shall be permitted to under run the nominal fillet weld size specified by 1.6 mm without

correction, provided that the undersized portion of the weld does not exceed 10 percent of the length of the weld. On the web-to-flange welds of girders, no under-run is permitted at the ends for a length equal to twice the width of the flange.

- g) The piping porosity in fillet welds shall not exceed one in each 100 mm of weld length and the maximum diameter shall not exceed 2.4 mm, except for fillet welds connecting stiffeners to web, where the sum of diameters of piping porosity shall not exceed 9.5 mm in any 25 mm length of weld and shall not exceed 19 mm in any 300 mm length of weld.
- h) The full penetration groove weld in butt joints transverse to the direction of computed tensile stress, shall have no piping porosity. For all other groove welds, the piping porosity shall not exceed one in 100 mm of length and the maximum diameter shall not exceed 2.4 mm.

- ii) **Magnetic Particle and Radiographic Inspection** : Welds that are subject to radiographic or magnetic particle testing in addition to visual inspection, shall have no crack.

Magnetic particle test shall be carried out according to IS:5334 for detection of crack and other discontinuity in the weld.

Radiographic test shall be carried out for detection of internal flaws in the weld such as crack, piping porosity inclusion, lack of fusion, incomplete penetration, etc. This test may be carried out as per IS:1182 and IS:4853.

- iii) **Ultrasonic Inspection** : Ultrasonic testing, in addition to visual inspection, shall be carried out for detection of internal flaws in the weld such as cracks, piping porosity inclusion, lack of fusion, incomplete penetration, etc. Acceptance criteria shall be as per IS:4260 or any other relevant IS Specification and as agreed to by the Engineer.

Bearing stiffeners or bearing diaphragms adjacent to welds, flange plates adjacent to web/flange welds, plates at cruciform welds, plates in box girder construction adjacent to corner welds or other details where specified by the Engineer, shall be ultrasonically tested after fabrication.

- iv) **Liquid Penetration Inspection** : The liquid penetrant test in addition to visual inspection, shall be carried out for detection of surface defect in the weld, as per IS:3658.
- v) Non-destructive testing of the following welds shall be carried out using any of the methods described at (ii), (iii) and (iv) above, as may be agreed to by the Engineer.

- a) All transverse butt welds in tension flanges
- b) 10 percent of the length of longitudinal and transverse butt welds in tension flanges.
- c) 5 percent of the length of longitudinal and transverse butt welds in compression flanges.
- d) All transverse butt welds in webs adjacent to tension flanges as specified by the Engineer.

The particular length of welds in webs to be tested shall be agreed with the Engineer, in case (b) or (c).

Any lamination, lamellar tearing or other defect found shall be recorded and reported to the Engineer for his decision.

1905.7.2 Testing of Welds for Cast Steel

The testing of weld for cast steel shall be carried out as agreed to and directed by the Engineer.

1905.7.3 Stud Shear Connectors

Stud shear connectors shall be subjected to the following tests:

- a) The fixing of studs after being welded in position shall be tested by striking the side of the head of the stud with a 2 kg hammer to the satisfaction of the Engineer.
- b) The selected stud head shall not show displacement of more than 0.25 times the height of the stud, from its original position, if struck once with a 6 kg hammer. The stud weld shall not show any sign of a crack or lack of fusion.

The studs whose welds have failed the tests given in (a) and (b) shall be replaced.

1905.7.4 Inspection of Members

1905.7.4.1 Inspection Requirement

The fabricated member/component made out of rolled and built-up section shall be checked for compliance of the tolerances given in Table 1900-2. Inspection of member/components for compliance with tolerances, and the check for deviations shall be made over the full length.

During checking, the inspection requirement shall be indicated in such a manner that local surface irregularities do not influence the results.

For plate, out-of-plane deviation shall be checked at right angle to the surface over the full area of plate.

The cross girder or cross frame deviation shall be checked over the middle third of its length between each pair of webs and at the end of member for cantilever.

The web of rolled beam or channel section shall be checked for out-of-plane deviation in a longitudinal direction over a length equal to the depth of the section.

During inspection, the component/member shall not have any load or external restraint.

1905.7.4.2 Inspection Stages

The stages of inspection to be carried out for compliance of tolerances shall include, but not be limited to, the following :

- a) For completed parts, component/members - on completion of fabrication and before any subsequent operation such as surface preparation, painting, transportation, erection.
- b) For webs of plate and box girder, longitudinal compression flange stiffeners in box girders and orthotropic decks and all web stiffeners at site joints - on completion of site joint.
- c) For cross girders and frames, cantilevers in orthotropic decks and other parts in which deviations have apparently increased - on completion of site assembly.

Where, on checking member/component for out-of-plane or out-of-straightness at right angles to the plate surface, and any other instances, the deviation exceeds the tolerance, the maximum deviation shall be measured and recorded. The record shall be submitted to the Engineer who will determine whether the component/member may be accepted without rectification, accepted with rectification or rejected.

1906 PAINTING

1906.1 General

Unless otherwise specified, all metal work shall be given approved shop coats as well as field coats of painting. The item of work shall include preparation of metal surfaces, application of protective covering and drying of the paint coatings along with all tools, scaffolding, labour and materials necessary.

Coatings shall be applied only to dry surfaces and the coated surfaces shall not be exposed to rain or frost before they are dry. The coatings shall be applied to all surfaces excluding shear connectors and inner surfaces of fully sealed hollow sections. While coating adjacent surfaces, care shall be taken to ensure that primer is not applied on the shear connectors.

1906.1.1 Types of Paints

i) Ordinary Paints

These include paints based on drying oils, alkyd resin, modified alkyd resin, phenolic varnish epoxy, etc.

Ordinary painting can generally be sub-divided into two types:

a) Primary Coats :

This shall be applied immediately after the surface preparation and should have the properties of adhesion, corrosion inhibition and imperviousness to water and air.

b) Finishing Coats :

This shall be applied over the primary coat and should have the properties of durability, abrasion resistance, aesthetic appearance and smooth finish.

ii) Chemical Resistant Paints

The more highly corrosion resistant paints can be divided into two main groups :

a) One pack paints (ready for use)

b) Two pack paints (mixed before use)

The two pack paints shall be mixed together just before use since they remain workable thereafter only for a restricted period of time.

iii) Other types of paints as mentioned in Clause 1903.4 of this Section may also be used, subject to approval by the Engineer.

All paints shall conform to relevant IS Standards as appropriate.

1906.1.2 Surfaces which are inaccessible for cleaning and painting after fabrication shall be painted as specified before being assembled for riveting.

All rivets, bolts, nuts, washers etc., are to be thoroughly cleaned and dipped into boiling linseed oil conforming to IS:77.

All machined surfaces are to be well coated with a mixture of white lead conforming to IS:34 and mutton tallow conforming to IS:887.

In site painting, the whole of the steel work shall be given the second cover coat after final passing and after touching up the primer and cover coats, if damaged in transit.

1906.1.3 Quality of Paint

Only paints which have been tested for the following qualities as per the specifications given in the relevant IS codes, should be used :

- Weight test (weight per 10 litre of paint thoroughly mixed)

- Drying time
- Flexibility and adhesion
- Consistency
- Dry thickness and rate of consumption

1906.1.4 Unless otherwise specified, all painting and protective coating work shall be done in accordance with IS:1477 (Part I).

1906.2 Surface Preparation

Steel surface to be painted either at the fabricating shop or at the site of work shall be prepared in a thorough manner with a view to ensuring complete removal of mill scale by one of the following processes as agreed to between the fabricator and the Engineer :

- a) Dry or wet grit/sand blasting
- b) Pickling which should be restricted to single plates, bars and sections
- c) Flame cleaning

Primary coat shall be applied as soon as practicable after cleaning and in case of flame cleaning, while the metal is still warm.

All slag from welds shall be removed before painting. Surfaces shall be maintained dry and free from dirt and oil. Work out of doors in frosty or humid weather shall be avoided.

1906.3 Coatings

Prime coat to be used shall conform to the specification of primers approved by the Engineer. Metal coatings shall be considered as prime coats. Primer shall be applied to the blast cleaned surface before any deterioration of the surface is visible. In any case, the surface shall receive one coat of primer within 4 hours of abrasive blast cleaning.

All coats shall be compatible with each other. When metal based coatings are used, the undercoat shall be compatible with the concerned metal base. The undercoat and finishing coat shall preferably be from the same manufacturer. Successive coats of paints shall be of different shades or colours and each shall be allowed to dry thoroughly before the next is applied. Particular care shall be taken with the priming and painting of edges, corners, welds and rivets. Typical guidelines for epoxy based paints and the conventional painting system for bridge girders as given below, may be complied with :

- a) **Epoxy Based Painting**
 - i) Surface preparation : Remove oil/grease by use of petroleum hydrocarbon solution (IS:1745) and grit blasting to near white metal surface.
 - ii) Paint system : 2 coats of epoxy zinc phosphate primer = 60 micron:
Total 5 coats = 200 micron

b) **Conventional Painting System for areas where corrosion is not severe Priming Coat :**

One coat of ready mixed, red lead primer conforming to IS:102

or

One coat of ready mixed zinc chrome primer conforming to IS:104 followed by one coat of ready mixed red oxide zinc chrome primer conforming to IS:2074

or

Two coats of red oxide zinc chrome primer conforming to IS:2074.

Finishing Coats :

Two cover coats of red oxide paint conforming to IS:123 or any other approved paint shall be applied over the primer coat. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site, the second coat shall be given after touching up the primer and the cover coats, if damaged in transit.

c) **Conventional Painting System for areas where corrosion is severe Priming Coat :**

Two coats of ready mixed red lead primer conforming to IS:102

or

One coat of ready mixed zinc chrome primer conforming to IS:104 followed by one coat of ready mixed zinc chrome primer conforming to IS:2074.

Finishing Coats :

Two coats of aluminium paint conforming to IS:2339 shall be applied over the primer coat. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site, the second coat shall be given after touching up the primer and the cover coats, if damaged in transit.

1906.4 Painting in the Shop

All fabricated steel shall be painted in the shop after inspection and acceptance with at least one priming coat, unless the exposed surfaces are subsequently to be cleaned at site or are metal coated. No primer shall be applied to galvanised surfaces.

Shop contact surfaces, if specifically required to be painted, shall be brought together while the paint is still wet.

Field contact surfaces and surfaces to be in contact with cement, shall be painted with primer only. No paint shall be applied within 50 mm of design location of field welds. Paint shall be completely dry before loading and transporting of the fabricated steel work to site.

Surfaces not in contact but inaccessible after shop assembly shall receive the full specified protective treatment before assembly.

Where surfaces are to be welded, the steel shall not be painted or metal coated within a suitable distance from any edges to be welded, if the specified paint or metal coating would be harmful to welders or is likely to impair the quality of site welds.

Exposed machined surfaces shall be adequately protected.

1906.5 Painting at Site

Surfaces which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

Surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while the paint is still wet.

Damaged or deteriorated paint surfaces shall be first made good with the same type of coat as the shop coat.

Where steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds, bolts and site rivets.

Specified protective treatment shall be completed after erection.

1906.6 Methods of Application

The methods of application of all paint coatings shall be in accordance with the manufacturer's written recommendation and shall be as approved by the Engineer. Spray painting may be permitted provided it will not cause inconvenience to the public and is appropriate to the type of structure being coated. Areas inaccessible for painting and areas shaded for spray application, shall be coated first by brushing.

Oil based red lead primers must be applied by brush only, taking care to work into all corners and crevices.

The primer, intermediate and finishing coats shall all be applied so as to provide smooth coatings of uniform thickness. Wrinkled or blistered coatings or coatings with pinholes, sags, lumps or other blemishes shall not be accepted. Where the Engineer so directs, the coating shall be removed by abrasive blast cleaning and replaced by the Contractor at his own cost.

1906.7 Protective Coatings in Different Environments

Since the severity of corrosion depends upon atmospheric conditions and these vary enormously, there is no single protective system or method of application that is suitable for every situation.

Table 1900-3 gives guidelines for various types of coatings to be used in various environmental conditions. Approximate life to first maintenance is also indicated.

1907 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with relevant IS Specifications and necessary

test certificates shall be furnished. Additional tests, if required, shall be got carried out by the Contractor at his own cost.

The fabrication, furnishing, erection and painting of structural steel work shall be in accordance with these Specifications and shall be checked and accepted by the Engineer.

Table 1900-3 : Guidelines for Selection of Types of Protective Coatings

	Type of Coating	Exposure Condition
i)	Wire brush to remove all loose rust and scale; 2 coats drying oil type primer, and 1 under coat alkyd type paint; 1 finishing coat alkyd type. Total dry thickness = 150 μm	Moderate
ii)	Wire brush to remove all loose rust and scale; 2 coats drying oil type primer; 2 under coats micaceous iron oxide (MXO) pigmented phenolic modified drying oil. Total dry film thickness = 170 μm (life up to 5 years)	Polluted inland environment
iii)	Blast clean the surface; 2 coats of quick drying primer; undercoat alkyd type paint; 1 finishing coat alkyd type. Total dry film thickness : 130 – 150 μm	Moderate
iv)	Blast clean the surface; 2 coats of drying type oil primer; 1 under coat micaceous iron oxide pigmented drying oil type paint. Total dry film thickness : 165–190 μm	Polluted inland environments
v)	Blast clean the surface; 2 coats of metallic lead pigmented chlorinated rubber primer, 1 undercoat of high build chlorinated rubber primer, 1 under coat of high build chlorinated rubber; 1 finishing coat of chlorinated rubber. Total dry film thickness : 200 μm	Severe coastal and non-coastal interior situations
vi)	Blast clean the surface; 350 – 450 μm thickness coal tar epoxy.	Severe
vii)	Pickle; hot dip galvanised (Zinc). Total thickness : 85 μm (life up to 15-20 years)	Moderate
viii)	Grit blast, hot dip galvanised. (Zinc). Total thickness = 140 μm (life more than 20 years)	Moderate
ix)	Grit blast; 1 coat of sprayed zinc/aluminum followed by suitable sealer Total thickness = 150 μm (life up to 15-20 years)	Severe

1908 MEASUREMENTS FOR PAYMENT

The measurements of this item shall be in tonnes based on the net weight of metal in the fabricated structure, computed on the basis of nominal weight of materials.

The weight of rolled and cast steel and cast iron shall be determined from the dimensions shown on the drawings on the following basis :

- Rolled or cast steel : 7.84×10^{-3} kg/cu.cm.
- Cast Iron : 7.21×10^{-3} kg/cu.cm.

Weight of structural sections shall be nominal weight.

Weight of castings shall be computed from the dimensions shown on the drawings with an addition of 5 percent for fillets and over-runs.

Weight of rivet heads shall be computed by taking the weight of 100 snap heads as given in Table 1900-4.

When specially agreed upon, allowance for snap heads may be taken as a flat 2.5 percent of the total weight.

Table 1900-4 : Weight of Rivet Heads

Dia of Rivet as Manufactured-mm	Weight of 100 Snap Heads - kg
12	1.3
14	2.1
16	3.4
18	4.45
20	6.1
22	8.1
24	10.5
27	15.0
30	20.5
33	27.2

The Contractor shall supply detailed calculation sheets for the weight of the metal in the fabricated structure.

No additions shall be made for the weight of protective coatings, weld fillets, bolts, nuts and washers.

Where computed weight forms the basis for payment, the weight shall be calculated for exact cut sizes of members used in the structure, deductions being made for all cuts, except for rivet holes. Additions shall be made for the rivet heads as mentioned above.

When specially agreed upon, the basis for payment may be the bridge weight complete, according to specifications included in special provisions of the contract.

1909 RATE

The contract unit rate for the completed structural steel work shall include the cost of all materials, labour, tools, plant and equipment required for fabrication, connections, oiling, painting, temporary erection, inspection, tests and complete final erection as shown on the drawings or as directed by the Engineer and as specified in these Specifications.

2000

BEARINGS

2001 DESCRIPTION

This work shall consist of furnishing and fixing bearings in position in accordance with the details shown on the drawings, to the requirements of these Specifications or as directed by the Engineer.

2002 GENERAL

- i) Bearing plates, bars, rockers, assemblies and other expansion or fixed devices shall be in accordance with the details shown on the drawings.
- ii) The bearings may either be supplied directly to the Engineer by the manufacturer to be installed by the Contractor or supplied and installed by the Contractor as part of the contract. In the former case, the manufacturer shall be associated with the installation of the bearings to the full satisfaction of the Engineer, whereas in the latter case, the Contractor shall be solely responsible for the satisfactory supply and installation of the bearing. In the detailed description of the specification, a general reference shall be made to the Contractor or manufacturer and the interpretation shall be as per terms of contract.
- iii) The Contractor shall exercise the utmost care in setting and fixing all bearings in their correct positions and ensuring that uniformity is obtained on all bearing surfaces.
- iv) Bearings shall be handled with care and stored under cover.
- v) When bearing assemblies or plates are shown on the drawings to be placed (not embedded) directly on concrete, the concrete bearing area shall be constructed slightly above grade (not exceeding 12 mm) and shall be finished by grinding.
- vi) It shall be ensured that the bearings are set truly level and in exact position as indicated on the drawings so as to have full and even bearing on the seats. Thin mortar pads (not exceeding 12 mm thickness) may be provided for this purpose.
- vii) It shall be ensured that the bottoms of girders to be seated on the bearings are plane at the locations of the bearings and that the bearings are not displaced while placing the girders.
- viii) M.S bearings sliding on M.S. plates shall not be permitted. For sliding plate bearings, stainless steel surface sliding on stainless steel plate with mild steel matrix shall be used. The other option shall be to provide PTFE surface sliding on stainless steel.

- ix) Segmental rollers are not permitted; only full cylindrical rollers shall be used. Adequate width of base plate shall be provided to cater for anticipated movements of the supporting structure.
- x) For seismic Zones IV and V, roller and rocker bearing components shall have guides to prevent them from being displaced during earthquakes.
- xi) For bridges with skew angle less than 20°, the bearings shall be placed at right angles to the longitudinal axis of the bridge. For bridges with skew angle greater than 20°, very wide bridges and curved bridges, the location of bearings shall be ensured as shown on the drawings.
- xii) Easy access to the bearing shall be made available for purposes of inspection and maintenance. Provision shall also be made for jacking up of the superstructure so as to allow repair/replacement of bearings.
- xiii) For types of bearings not covered in this Section, required specifications shall be as laid down in the contract.

2003 STEEL BEARINGS

2003.1 Materials

2003.1.1 Mild Steel

Mild steel to be used for components of bearings shall comply with IS:2062, Steel for General Structural Purposes.

For all components and plates exceeding 50 mm in thickness requiring welding, the carbon content shall be ascertained and suitable welding procedure like pre-heating, use of low hydrogen electrodes etc, shall be adopted after approval by the Engineer.

2003.1.2 Forged Steel

Forged steel to be used in components of bearings shall be in accordance with **Clause 1009.5** of these Specifications.

All slabs shall be normalised after forging. If welding is involved and if the slabs are more than 20 mm thick, pre-heating of the slab up to 200°C shall be done.

Railway axles (R 19) are also acceptable as forged steel for rollers.

2003.1.3 High Tensile Steel

High tensile steel shall comply with IS:961.

2003.1.4 Cast Steel

Cast steel shall be in accordance with Clause 1009.1 of these Specifications.

For the purpose of checking the soundness, castings shall be ultrasonically examined following procedures as per IS:7666, with acceptance standard as per IS:9565. The castings may also be checked by any other accepted method of non-destructive testing as specified in IS:1030.

Quality level of castings shall be Level 3 as per IS:9565.

2003.1.5 Stainless Steel

Stainless steel shall be in accordance with Clause 1009.7 of these Specifications.

2003.1.6 Welds

Welding of steel conforming to IS:2062 shall be as per IS:1024 using electrodes as per IS:814.

2003.1.7 Grease

The grease for bearings shall conform to the requirements of IS:503 (Grade 4).

2003.2 Construction Operations

- a) All work of steel bearings shall conform strictly to the drawings and shall be in accordance with the provisions of this Section. Care shall be taken to ensure that all parts of an assembly fit accurately together. The workmanship shall satisfy all relevant provisions laid down in Section 1900 of these Specifications.
- b) Knuckle pins, rolling surfaces of the rollers and bearing surface of the bearing plates shall be machined and all bolt holes shall be drilled. The whole bearing shall be fitted and finished as required for good quality machined work to the satisfaction of the Engineer. However, in case of bearings which are to be grouted or bedded on a suitable yielding material, any surface which is to be in permanent contact with the grout or the yielding material, may be left unmachined.
- c) In prestressed concrete construction involving launching of girders, slipping or jumping of rollers due to vibration or jolts, shall be avoided and adequate measures shall be taken to ensure that the roller assembly is not disturbed. It is normal practice to provide rocker bearings at the

launching end and place the beam on the rocker slightly in advance of placing on the roller.

- d) During concreting of girders, the bearings shall be held in position securely by providing temporary connection between the top and bottom plates in case of fixed bearings and between top plate, base plate and saddle plate in case of roller-cum-rocker bearings or by any other suitable arrangement which prevents the relative displacement of the components.
- e) In precast prestressed girders, where recesses are left on the underside of girders to receive the anchor bolts, grout holes extending to the sides or top of the beam shall be provided. The grout hole shall be filled with cement sand grout of mix 1:1 or with grout made of non-shrink high strength mortar. Alternatively, the precast girder may be fitted with a template screwed or bolted into sleeves already cast in the concrete, which can be removed and replaced by the top plate of the bearing at the time of erection of superstructure.

2003.3

Workmanship

- a) Fabrication shall be carried out by an organization sufficiently experienced and qualified to undertake precision engineering of this type as approved by the Engineer.
- b) Workmanship shall be of good quality such as to achieve neat finish and good appearance.
- c) Castings shall be true to the forms and dimensions shown on the drawings and shall be free from pouring faults, sponginess, cracks, blow holes and other defects, affecting their appearance or strength. Warped or distorted castings shall not be accepted. Exposed surfaces shall be smooth and dense.
- d) All castings shall be cleaned by sand or shot blasting to remove sand or scale and to present a clean uniform surface.
- e) All irregularities, fins or risers shall be ground off flush with the adjacent surface. Castings with visible cracks, blow holes or similar blemishes shall be rejected if the imperfections are located in bearing surfaces or cannot be remedied to the satisfaction of the Engineer.
- f) Imperfections which are not located in bearing surfaces shall be cleaned out, filled with weld metal of the appropriate composition and ground flush.
- g) All surfaces of major components like top plates, saddle plates, base plates and rollers of the bearings shall be machined all over for correct alignment, interchangeability and proper fitting.

2003.4 Tolerances

Tolerances for individual components or of the assembled bearings shall be as shown on the drawings and subject to the approval of the Engineer.

Unless otherwise specified, the following tolerances shall be maintained.

i) **Rollers and Curved Surfaces**

Tolerances on diameter of rollers and all convex surfaces shall conform to K7 of IS:919.

Tolerances on diameter of all concave surfaces shall conform to D8 of IS:919.

ii) **Height of Bearings**

Tolerances on height of any component shall not exceed +0.5 mm. No minus tolerance shall be allowed. The edges of all ribs shall be parallel throughout their length.

iii) **Plates**

Tolerance on length and width of the plates shall not exceed +1.0 mm; tolerance on the thickness of the plate shall not exceed +0.5 mm. No minus tolerance shall be allowed. All rocking, rolling and sliding surfaces shall have a machine smooth finish to 20 micron maximum mean deviation as per IS:3073.

iv) **Castings**

No minus tolerance shall be allowed in the thickness of any part of the castings. The edges of all ribs shall be parallel throughout their length.

2003.5 Installation

2003.5.1 General

- a) Bearings shall be placed in the position as shown on the drawings with all bearing surfaces in full contact and to the tolerances as specified.
- b) Roller and rocker bearings shall be placed so that their axes of rotations are horizontal and normal to the direction of movement of the members they support. Upper and lower bearing plates shall be set horizontal in both directions.
- c) During installation, the bearings shall be pre-set with respect to the bearing axis to account for the movement due to the following :
 - i) Temperature variation between the average temperature prevailing at the time of installation and the mean design temperature.

- ii) Shrinkage, creep and elastic shortening of prestressed girders.
- d) For bridges in gradient, the bearing plates shall be placed in a horizontal plane.

2003.5.2 Placing

- a) On supporting structures, pockets shall be provided to receive anchor bolts; one side of the pocket shall project beyond the bearing plate. The pocket shall be filled with mortar and the concrete bearing area also shall be finished level by a thin and stiff mortar pad (of thickness not exceeding 12 mm) just before placing of bearing assemblies or bottom plate on the concrete seat. The mortar shall be of mix 1:1 or of the non-shrink prepacked type.
- b) In case of precast girders a recess of 6 mm shall be provided on the underside with a level finish for housing the bearing plate. A thin and stiff mortar pad with thickness not exceeding 3 mm, shall be provided over the top plate before lowering the precast beam in position in order to ensure full and even pressure on the plate surface.
- c) It shall be ensured that while placing the girders, the bearings are in their exact positions as indicated on the approved drawing and not displaced therefrom.
- d) All concrete surfaces to be in contact with the mortar shall be thoroughly cleaned and wetted for a period not less than 24 hours before placing mortar. Operations are to be carried out when the surface temperatures of the exposed bearings are the minimum practicable.
- e) No mortar that is more than 30 minutes old after completion of mixing, shall be used.
- f) After placing and finishing the mortar, the bearing shall be checked for position and shims or other temporary supports removed and the mortar made good. If the bearing has moved, it shall be lifted, the mortar removed and the whole procedure repeated.
- g) Exposed faces of the mortar shall be cured under damp hessian for 7 days.
- h) Placing of the bearing and mortar shall only be carried out in the presence of the Engineer.

2003.5.3 Checking, Cleaning and Lubrication

- a) Before installation, each bearing shall be uncrated, dis-assembled and checked. Any damaged parts shall be made good for approval.

- b) All bearings with sliding surfaces shall be cleaned and lightly lubricated with an approved lubricant immediately before installation.

2003.6**Testing**

- i) The manufacturer has to produce test certificate from original producers of raw materials used in the manufacture of the bearings. Irrespective of the producers test certificates, the manufacturer will carry out the detailed tests on raw materials (both physical and chemical) for different types of raw materials used in the manufacture of the bearings as per relevant codes for such raw materials. For this purpose they will identify stock materials with certain batch number and draw samples from such stock materials and mark them with the same batch numbers. For each batch, 3 sets of samples will be drawn separately for tests of physical and chemical properties on samples. The manufacturer will carry out tests on chemical and physical properties on one set of samples and keep the remaining 2 sets of samples duly identified with the batch number for verification by the Engineer and/or his authorized representatives for confirmatory tests with respect to the results obtained by the manufacturer. Such tests can be carried out on a few samples selected at random at the discretion of the Engineer and/or his representatives. The following IS Codes may be referred for carrying out such tests (both physical and chemical):

IS:1030 for casting

IS:2062 for mild steel components

IS:2004 for forging

Other special materials shall be as per relevant IS/BS/AISI Codes.

- ii) All machined cast steel components shall be tested by ultrasonic testing to level III of IS:9565. Critical surface shall also be checked by Dye Penetration Test (DPT) and/or magnetic particle test for detecting presence of surface defects.
- iii) All forged steel components after machining will be subjected to ultrasonic testing. Guidelines given in Appendix 3 of IRC:83 (Part 1) may be referred. To ensure the reduction ratio, macro-etching test will be conducted on the integral test piece (per heat/batch) attached to anyone of the forgings.
- iv) All bearings shall be tested to 1.25 times the design load. Recovery should be 100 percent. Contact surfaces shall be examined by sufficient illumination and ultrasonic/DPT tests for detecting any defects/cracks.
- v) All welding shall be checked by Dye Penetration Test. If specifically required by Engineer, the X-ray test may also be done.

- vi) Engineer may carry out the destructive testing of any component/ components of bearings supplied in order to check their conformity with the test results submitted.
- vii) For large lots, (consisting of 12 sets or more), the bearings manufacturer shall, unless otherwise agreed by him and the Engineer, furnish a complete report on the process of quality control. The Engineer may appoint an authorized inspection agency for inspection on his behalf, which shall also submit reports to the Engineer regarding various tests performed on the bearing and certify the acceptance of the bearings.

The quality control report shall cover the following:

- a) A detailed system of quality control including stage by stage inspection, starting from raw materials up to the finished bearing.
 - b) Test certificates of all raw materials. If manufacturer's test certificates are not available for the raw materials, the bearings manufacturer shall perform the necessary confirmatory tests as per relevant codes of practice and furnish the test results.
 - c) A list of consumption of raw material for a period of at least preceding one year.
 - d) Test certificates of bearings manufactured during preceding one year at the manufacturer's works.
- viii) The Engineer shall reserve the right to witness inspection at manufacturer's works at any time. For this, the bearing manufacturer shall have in-house testing facilities as required.
 - ix) In case the lot size of similar bearings exceeds 12 sets as per the direction of the Engineer, one extra bearing for each set of 24 bearings or part thereof, shall be manufactured and the cost of such extra bearing shall be borne by the user.
 - x) The Engineer shall select the extra bearing(s) at random and shall perform various tests including destructive testing on it at his discretion, either at the manufacturer's works or at any other approved test laboratory, notwithstanding the test reports submitted.
 - xi) In case there is any major deficiency/discrepancy regarding material, the Engineer shall declare the whole lot of bearings as unacceptable.
 - xii) In case minor defects in fabrication, relating to welding or machining, are found in the test bearing before destructive testing and if the test bearing is found to be acceptable after destructive testing, the minor defects in the test bearings shall not be a bar to the acceptance of the entire lot.

- xiii) The opinion of the Engineer in cases xi) and xii) above shall be final and binding on the manufacturer.

2003.7 Inspection, Maintenance and Replacement

- i) Suitable easy access to the bearing shall be provided for inspection and maintenance.
- ii) Provision shall be made for jacking up of the superstructure so as to allow for adjustment/repair/replacement of the rollers of the bearings.
- iii) Each bridge bearing assembly and the adjacent members in contact with it, shall be inspected at least once a year to ascertain their actual condition. Suitable remedial measures shall be taken immediately if defects are noticed including replacement in the event of irreparable damage.
- iv) The bearings shall also be examined carefully after unusual occurrences such as passage of heavy traffic/oversized loads, earthquakes and battering by floating debris in high floods.

2004 SPECIAL BEARINGS

2004.1 Spherical Bearing

Spherical bearings which will permit uniaxial translatory movement along longitudinal axis of the bridge and rotation on all axes, shall consist of the following parts :

a) Bottom Plate

A bottom plate of circular/square shape is provided with a circular concave surface integrally cast with it. The bottom plate is connected to the substructure by means of tight fitted anchor bolts, which are embedded in concrete. The material of bottom plate shall be cast steel.

Pure unfilled quality dimpled PTFE of specified thickness shall be provided on top of concave surface of bottom plate in order to allow smooth rotation.

b) Saddle Plate

A saddle plate of square/circular/rectangular shape and circular convex surface at bottom shall be placed in the concave surface of bottom plate. The radius of the convex bottom of the saddle plate shall be slightly less than that of the concave top surface of the bottom plate, so as to ensure sufficient contact over a small area. Rotation along

all axes shall be permitted on the contact surface of the saddle plate and the bottom plate. Pure unfilled quality dimpled PTFE sheet shall be recessed to specified depth of recess over the top of saddle plate. Suitable elastomeric seal shall be provided on the saddle plate to prevent ingress of dirt and moisture. The material of saddle plate shall be cast steel.

c) **Top Plate**

The top plate shall have stainless steel plate welded to its bottom which shall slide over PTFE. The top plate shall be connected to the superstructure by tight fitted anchor bolts. Translatory movements along longitudinal axis of bridge shall be accommodated at the PTFE/ Stainless steel sliding surface. The material of top plate shall be cast steel.

d) **Guide Plate**

Guide plates shall be welded to saddle plate so as to permit only longitudinal movement. The material of guide plates shall be cast steel.

2004.2 Pin Bearing

2004.2.1 A pin bearing shall consist of a metal pin provided within a metal cylinder to bear and transmit horizontal force along any direction in the horizontal plane and accommodate rotational movement about any axis. Pin bearings shall not bear or transmit any vertical load.

2004.2.2 The sliding spherical and pin bearing shall conform to BS:5400, Parts 9.1 and 9.2 and all relevant clauses of these Specifications. The term bearing shall include the entire assembly covering all the accessories required for operation, erection and dismantling for replacement. All bearings shall be of replaceable type. The design of bearings shall be in accordance with the specifications mentioned/international specifications. The manufacturer shall get the design approved from Engineer and should be associated with installation of bearings.

2004.2.3 Materials

- i) The material of pin bearing including rocker plates shall be high tensile steel conforming to IS:961.
- ii) All materials shall be original, unused or non-recycled conforming to relevant specifications.
- iii) Cast steel, mild steel and stainless steel shall conform to Clause 2003.1.

- iv) Copolymer polytetrafluoroethylene (PTFE) unfilled quality shall have required properties as per BS:5400 and thickness as specified.
- v) Anchor bolts shall be as per relevant IS specifications.

2004.2.4 Seating of Pin Bearing

- i) Backing plate with studs welded on the face opposite to the seating face shall be delivered by the manufacturer.
- ii) This backing plate shall be accurately positioned on the reinforcement grid of the pedestal and levelled.
- iii) Studs shall be tack welded/tied to the reinforcement to keep the backing plate in proper location during casting.
- iv) Depth of embedment of the backing plate in the concrete shall be as per relevant drawing.
- v) The round base of the pot (bottom) of the pin bearing assembly shall be connected to the backing plates by anchor screws after concreting of pier cap/pedestal.
- vi) In order to ensure successful transfer of large horizontal forces to be resisted by the Pin bearing, great care shall be taken in detailing the reinforcement in the substructure and the superstructure adjacent to the studs in the backing plate.

2004.3 Acceptance Test on Spherical Bearings

- i) All bearings shall be checked for overall dimensions.
- ii) All bearings shall be load tested to 1.25 times design vertical load.
- iii) A pair of bearings selected at random shall be tested to determine coefficient of friction which shall be less than 0.05.
- iv) Two bearings selected at random shall be tested for permissible rotation.

2004.4 Acceptance Test on Pin Bearings

- i) All bearings shall be checked for overall dimensions
- ii) All bearings shall be load tested (if required, for design horizontal load only)

2005 ELASTOMERIC BEARINGS

Elastomeric bearings shall cater for translation and/or rotation of the superstructure by elastic deformation.

2005.1 Materials

- i) Chloroprene Rubber(CR) only shall be used.
- ii) Grades of raw elastomer of proven use in elastomeric bearings, with low crystallization rates and adequate shelf life viz. Neoprene WRT, Neoprene W, Bayprene 110, Bayprene 210, Skyprene B-5, Skyprene B-30, Denka S-40V and Denka M-40, shall be used.
- iii) No reclaimed rubber or vulcanized wastes or natural rubber shall be used.
- iv) The polychloropene content of the compound shall not be lower than 60 per cent. The ash content shall not exceed 5 per cent of its weight. Polychloropene content shall be determined in accordance with ASTM-D297 and ash content as per IS:3400-Part XXII.
- v) Use of synthetic rubber-like materials such as Ethyl Propylene Dimonomer (EPDM), Isobutane Isoprene Copolymer (IIR) and Chloro-Isoprene Copolymer (CIIR) shall not be permitted.

2005.1.2 Properties of Elastomer

The elastomer shall conform to the properties specified in Table 2000-1.

Table 2000-1 : Properties of Elastomer

Property	Unit	Value of the Characteristic Specified			Test Method IS Specification Reference
(1)	(2)	(3)			(4)
1. Physical properties					
1.1 Hardness	IRHD	50 ± 5	60 ± 5	70 ± 5	IS:3400 (Part II)
1.2 Minimum tensile strength					
- Moulded test piece	MPa	17	17	17	IS:3400 (Part I)
- Test piece from bearing		14	14	14	
1.3 Minimum elongation at break					
- Moulded test piece	%	450	400	300	IS:3400 (Part II)
- Test piece from bearing	%	400	350	250	IS:3400 (Part II)

Property	Unit	Value of the Characteristic Specified	Test Method IS Specification Reference
(1)	(2)	(3)	(4)
2. Maximum compression set (%) (24 h, 100 ± 1 °C)	%	< 35	IS:3400 (Part X)
3. Accelerated aging (72 h, 100 ± 1 °C) (Maximum change from un-aged value)			IS:3400 (Part IV)
3.1 Maximum change in hardness	IRHD	± 5	
3.2 Maximum change in tensile strength	%	± 15	
3.3 Maximum change in elongation	%	± 30	

2005.1.3 Shear modulus (G) is the apparent "conventional shear modulus" of the elastomer bearing determined by testing. At nominal temperature of 23 °C ± 2°C, the value of G shall comply with the values given in **Table 2000-2**.

Table 2000-2 : Shear Modulus at Nominal Temperature

Hardness (IRHD)	G (MPa)	Tolerances of G (MPa)
(1)	(2)	(3)
50 ± 5	0.7	± 0.15
60 ± 5	0.9	± 0.18
70 ± 5	1.15	± 0.20

2005.1.4 The adhesion strength of elastomer to steel plates determined according to IS:3400 (Part XIV) method A, shall not be less than 7 Kn/m.

2005.1.5 For elastomeric bearings (CR) used in adverse climatic conditions, the ozone resistance of elastomer shall be proved satisfactory when assessed by test according to IS:3400 (Part XX). The testing shall be carried out for a duration of 96 hours at a temperature of 40±1°C, strain of 30 per cent and ozone concentration of 100 pphm by volume.

If any cracking is detected by visual observation at the end of the test, the material shall be considered unsatisfactory. No specific tests for assessment of low temperature resistance are deemed necessary.

Note : For use of elastomer in extreme cold climates, the Engineer may specify special grade of low temperature resistant elastomer in conformity with operating ambient temperature conditions. The specifications for such special grade elastomer including the tests for low temperature resistance, shall be mutually agreed by the Engineer and the producer/supplier and are outside the purview of these Specifications.

2005.1.6 Laminates of mild steel conforming to IS:2062/IS:1079 or equivalent international grade, shall only be permitted. The yield stress of the material shall not be less than 250 MPa. Use of any other material like fibre glass or similar fabric as laminates, shall not be permitted.

2005.1.7 The manufacturers of elastomeric bearings shall satisfy the Engineer that they have in-house facilities for carrying out the following tests on elastomer in accordance with the relevant provisions of ASTM D-297.

- | | | | |
|----|----------------------------|---|--|
| a) | Identification of polymers | : | to confirm the usage of chloroprene (Appendix X-2) |
| b) | Ash content | : | to determine the percentage (sub-section 34) |
| c) | Specific gravity | : | (sub-section 15) |
| d) | Polymer content | : | (sub-section 10) |

The Engineer shall invariably get the test (a) performed in his presence or in the presence of his authorized representative. In case of any dispute regarding interpretation of results, the Engineer may carry out test as per ASTM S-3452-78 (chromatography test) at the manufacturer's cost in a recognized test house. The elastomer specimen to conduct the test shall be obtained from the bearing selected at random for destructive test. The remaining part of the test bearing shall be preserved by the Engineer for any test to be done later, if required.

2005.2 Manufacturing and Workmanship

- i) Plain pad and strip bearing shall be moulded in one piece, or comprise single pieces cut from previously moulded strips or slabs. Cutting shall produce a smooth surface without injurious heating of the elastomer.
- ii) Bearing with steel laminates shall be moulded as a single unit in a mould and vulcanised under heat and pressure. Moulding of elements

in separate units and subsequent bonding as well as cutting from large sized cast, shall not be permitted.

- iii) The moulds used shall have standard surface finish adequate to produce bearings free from any surface blemishes.
- iv) Steel plates for laminates shall be sand/grit blasted, clean of all mill scales and shall be free from all contaminants prior to bonding by vulcanization. Rusted plates with pitting shall not be used. The plates shall be rounded so as to be free of sharp edges.
- v) Bonding shall be carried out during vulcanisation using suitable bonding agent for bonding of elastomer to steel such that the bond peel strength is at least 7 N/mm width when tested in accordance with IS:3400 Part XIV method A.
- vi) Spacers used in mould to ensure cover and location of laminates shall be of minimum size and number practicable. Any hole at surface or in edge cover shall be filled in subsequently.
- vii) Care shall be taken to ensure uniform vulcanizing conditions and homogeneity of elastomer through the surface and body of bearings.
- viii) The vulcanizing equipment/press shall be such that between the platens of the press, the pressure and temperature are uniform and capable of being maintained at constant values as required for effecting a uniform vulcanization of the bearing.
- ix) The moulding dies utilized for manufacturing the bearings shall be so set inside the platen of the press that the pressure developed during vulcanization of the product is evenly distributed and the thickness maintained at all places are within acceptable tolerance limits taking into consideration the expansion/shrinkage allowance of vulcanizate (the product of vulcanization).
- x) The raw compound which is introduced inside the metal dies for vulcanization shall be accurately weighed each time and shall be of sufficient quantity to ensure proper flow of material to every part of the die so that a homogeneous and compact bearing is produced without any sign of sponginess or deficiency of material at any place.
- xi) Before the rubber mix of any batch is used for producing vulcanized bearings, test pieces in the form of standard slab and buttons shall be prepared in accordance with prescribed standards and salient properties tested and recorded regularly against each batch of production to monitor the quality of the products.

- xii) Bearings of similar size to be used in a particular bridge project shall be produced by identical process and in one lot as far as practicable. Phased production may be resorted to only when the total number of bearings is large.

2005.3 Manufacturing Tolerances

The bearings shall be fabricated/manufactured with the tolerances specified in Table 2000-3. Tolerances of thickness of individual layer of elastomer, dimension of laminates, and flatness of laminates are primarily meant for quality control during production. In order to measure thickness of individual layer of elastomer, dimension of laminates and flatness of laminates of a finished bearing, it is essential to cut the bearing, which may be done if agreed upon between the manufacturer and the buyer.

Table 2000-3: Tolerances

	Items	Tolerances
1)	Overall linear plan dimensions	-3 mm, +6 mm
2)	Total mean bearing thickness (The mean thickness is the arithmetic average of the thickness measured at five points on the major surface as indicated for various shaped bearings: Rectangular : corners and centre Circular : corners of inscribed square and centre)	-2.5%, +5%
3)	Parallelism	
a)	Of top surface of bearing with respect to the bottom surface as datum	1 in 200
b)	Of one side surface with respect to the other as datum	1 in 100
4)	Thickness of individual layer of elastomer	
a)	Inner layer of elastomer	±12% (max of 2 mm)
b)	Outer layer of elastomer	+20% (max of 1 mm)
c)	Side cover	-0 mm, +3 mm
5)	Dimension of laminates	
a)	Plan dimensions of laminates	-3 mm, + 0
b)	Thickness of laminate	± 10%
c)	Parallelism of laminate with respect to bearing base as datum (with respect to diameter for plates circular in plan and shorter side for plates rectangular in plan)	1 in 100

	Items	Tolerances
6)	Flatness Flatness shall be assessed by placing a straightedge along the diagonal or diameter. The gap between the straightedge and the surface shall not exceed the tolerances specified below	
a)	Load bearing surface of the bearing	0.3% of diameter or diagonal or 2% of mean bearing thickness which ever is higher
b)	Steel laminate	1% of diameter or diagonal (max of 1.5 mm)

2005.4 Acceptance Specifications

The manufacturer shall have all the test facilities required for the process and acceptance control tests installed at his plant to the complete satisfaction of the Engineer. The test facilities and their operation shall be open to inspection by the Engineer on demand.

All acceptance and process control tests shall be conducted at the manufacturer's plant. Cost of all materials, equipment and labour shall be borne by the manufacturer unless otherwise specified or specially agreed to between the manufacturer and Engineer.

A testing programme shall be submitted by the manufacturer to the Engineer and his approval obtained before commencement of acceptance testing.

Any acceptance testing delayed 180 days beyond the date of production shall require special approval of the Engineer and modified acceptance specification, if deemed necessary by him.

All acceptance testing shall be conducted by the Inspector with the aid of the manufacturer's personnel having adequate expertise and experience in rubber testing, working under the supervision of the Inspector and to his complete satisfaction.

Inspection and acceptance shall be carried out lot by lot.

2005.4.1 Acceptance Lot

A lot under acceptance shall comprise all bearings, including the pair of extra test bearings where applicable, of equal or near equal size produced under identical conditions of manufacture, to be supplied for a particular project.

The size and composition of acceptance lot shall be got approved by the Engineer.

For the purpose of grading levels of acceptance testing, a lot size of 24 or larger number of bearings shall be defined as a 'large lot', while a lot size of less than 24 number of bearings shall be defined as a 'small lot'.

When the number of bearings of equal or near equal size for a single bridge project is large and phased production and acceptance is permitted, the number of bearings supplied in any single phase of supply shall comprise a lot under acceptance. When such phased supply is made, each such lot shall be considered as a large lot for the purpose of acceptance testing.

2005.4.2 Levels of Acceptance Testing

The following two Levels of acceptance testing shall be adopted, depending on lot size :

Acceptance testing Level 1 is a higher level of inspection and testing and shall be applicable to large lots only, unless otherwise specified. This shall involve manufacture of two extra bearings for each lot to be used as test bearings and eventually consumed in destructive testing.

Acceptance testing Level 2 shall be applicable to small lots only, for which one extra bearing shall be manufactured and shall not involve destructive testing of finished bearing. Out of the lot, one bearing shall be selected at random for carrying out material tests. This bearing shall be excluded from the lot accepted.

Acceptance testing Level 1 may be specified for small lots also at the sole discretion of the Engineer taking into account the special importance of a bridge project. The cost of extra bearings, in such cases shall be borne by the user, while the cost of all other materials, equipment and testing shall be borne by manufacturer.

2005.4.3 Testing

Acceptance testing shall comprise general inspection, test on specially moulded test pieces and test on complete bearings or sections for measurement of various quality characteristics detailed below :

2005.4.3.1 Acceptance Testing Level 1

General Inspection

- i) All bearings of the lot shall be visually inspected for absence of any defects in surface finish, shape, hardness or any other discernible superficial defects.
- ii) All bearings of the lot shall be checked for tolerances for overall dimensions, mean bearing thickness, parallelism of bearing surfaces and flatness of load bearing surfaces as specified in Table 2000-3.

- iii) The test shall be carried out on all bearings as part of the standard production process. The temperature of the room in which the bearings are tested shall not vary more than 10 °C. The main objective of this test is to eliminate poorly made bearings by visual inspection in a quick and efficient way. All bearings of the lot shall be subjected to an axial load to correspond to the design load at serviceability limit state while visual examination is made to check for discernible defects like:
- Misalignment of reinforcing plates
 - Poor bond at laminate/steel interface
 - Variation in elastomer layer thickness
 - Any surface defects developed during testing
- iv) During acceptance testing, complete test data shall be furnished by the manufacturer and one bearing per lot shall be selected at random and the same test shall be repeated. The bearings shall then be visually inspected for defects and the stiffness shall also be measured.
- v) During the test, the deflection between 30 percent and 100 percent of the maximum load for the application shall be recorded and used to check the consistency of the stiffness value. Variation in stiffness of any individual bearing from the mean of the measured values for all such bearings of the lot, shall not be larger than 20 percent of the mean value.
- vi) In case of any visual defect or unacceptable stiffness during acceptance testing, all bearings of the lot shall be subjected to the same test again and only the bearing that passes the test in all respects, shall be accepted.

Tests on Specially Moulded Test Pieces

- i) Test pieces shall be moulded by the manufacturer with identical compound and under identical vulcanising conditions as used in the manufacture of the bearings of the acceptance lot. The process shall be open to inspection by the Inspector/Engineer.
- ii) Test pieces offered for inspection shall be identified by suitable markings and duly certified by the manufacturer.
- iii) The quality characteristics to be tested are listed below. The specification reference in parenthesis shall define the corresponding specification for test piece, test method and criterion for acceptance.
- Composition (see Note 1 below)
 - Hardness (Table 2000-1, 1.1)
 - Tensile strength (Table 2000-1, 1.2)
 - Elongation at Break (Table 2000-1, 1.3)

Compression Set (Table 2000-1, 2)
 Accelerated Ageing (Table 2000-1, 3)
 Adhesion Strength (Clause 2005.1.4)
 Ozone Resistance (see Note 2 below)

Note 1 The properties enumerated in **Clause 2005.1** and specific gravity of elastomer of test pieces from test bearing, shall be compared with those for corresponding specially moulded test pieces furnished by the manufacturer. The following variations shall be deemed maximum acceptable:

Specific Gravity + 0.2.
 Ash Content \pm 0.5 per cent (e.g., if the ash content of elastomer from test bearing is 4%, the ash content of the specially moulded test piece shall be within 3.5% to 4.5% or vice versa)

Hardness (Table 2000-1, 1.1)
 Tensile strength (Table 2000-1, 1.2)
 Elongation at Break (Table 2000-1, 1.3)
 Compression Set (Table 2000-1, 2)
 Accelerated Ageing (Table 2000-1, 3)
 Adhesion Strength (Clause 2005.1)

Note 2 Ozone resistance test can be waived by the Engineer for bearings of CR when satisfactory results of ozone resistance tests on similar grade of elastomer may be available from process control records or development test data furnished by the manufacturer.

Where such process control data are not available or the frequency of testing not deemed adequate, ozone resistance test shall be mandatory for acceptance of bearings of CR.

However, such tests may not be insisted upon for bearings not located in adverse conditions of exposure and where the test on accelerated ageing could be considered as adequate.

Process and acceptance control tests for ozone resistance by an independent testing agency shall be acceptable.

Tests on Complete Bearings or Samples

- i) Two bearings shall be selected at random from the lot as test bearings. The tests to be conducted are:
 - a) Test for determination of shear modulus (on a pair of bearings) and
 - b) Test for determination of compression stiffness (on one bearing out of the selected pair).

The test specifications and acceptance criteria shall conform to those given in Appendix-3 of IRC:83 Part II. The tested bearings shall be part of the lot accepted.

- ii) The test for determination of shear bond strength shall be conducted on two identical bearings selected at random from the lot as test bearings or on two identical specially moulded sample bearings of plan dimension 200 mm x 300 mm and overall thickness 41 mm (3 elastomer layers of thickness 8 mm each, 4 reinforcing plates of thickness 3 mm each, face cover 2.5 mm, and side cover 4 mm) as agreed upon between the manufacturer and buyer:

The test specifications and acceptance criteria shall conform to those given in Appendix-3 of IRC:83 Part II. This is a destructive test and the test bearings shall not be used in the structure.

2005.4.3.2 Acceptance Testing Level 2

General Inspection : This shall conform to the provisions in Clause 2005.4.3.1 in all respects.

Test on specially moulded test pieces : This shall conform to the provisions in Clause 2005.4.3.1 in all respects.

Test on complete bearings : Test for determination of shear modulus shall be conducted using two bearings of the lot selected at random and conforming to relevant provisions of Clause 2005.4.3.1. These bearings shall, however, be part of the lot accepted. The remaining tests stipulated in aforesaid clause shall be carried out on two bearings selected at random which shall be excluded from the lot accepted.

2005.4.4 Special Acceptance Inspection

Special acceptance inspection shall comprise the following :

- i) Acceptance testing by a NABL accredited independent external agency with separate or supplemental test facilities provided by it for polymer identification and confirmation about percentage of polymer content and ash content by TGA method.
- ii) Acceptance testing on test pieces prepared from the surface or body of the test bearings instead of specially moulded test pieces.
- iii) Acceptance testing on cut sample from finished bearing in order to measure thickness of individual layer of elastomer, dimension of laminates and flatness of laminates.

- iv) Acceptance test at ULS condition. Bearings tested at ULS condition cannot be used in the structure as its performance at SLS condition cannot be guaranteed after such test.
- v) Acceptance tests not covered by these specifications but according to the specifications laid down by the Engineer.

Special acceptance inspection may be specified under the following conditions :

- a) Special contract agreement between the manufacturer and the buyer. Cost of additional bearings to be consumed for special acceptance inspection, shall be borne by buyer.
- b) Evidence of unsatisfactory process or acceptance control

2005.4.5 Inspection Certificate

A lot under inspection shall be accepted by the Inspector and so certified, when no defect is found with respect to any of the quality characteristics tested on samples drawn from the lot, according to specifications laid down to Clause 2005.4.3 covering general inspection tests on specially moulded test pieces and on complete bearings.

In case any bearing is found defective, the lot shall be rejected by the Inspector and so certified.

In case any bearing is found to be defective with respect to any quality characteristic, discerned by general inspection tests specified in Clauses 2005.4.3.1 and 2005.4.3.2, tests on specially moulded test pieces and complete bearings as applicable according to those Clauses, shall nevertheless be completed. If the said lot, rejected by general inspection, satisfies the acceptance criteria in respect of these other tests, the lot and individual bearings found defective shall be clearly identified in the inspection certificate.

Immediately on completion of inspection by the Inspector authorized by the Engineer, the manufacturer shall obtain an inspection certificate which shall include the details of a lot or lots accepted/rejected by him and records of all test measurements.

2005.4.6 Quality Control Certificate

The manufacturer shall certify for each lot of bearings under acceptance that :

- a) an adequate system of continuous quality control was operated in his plant.
- b) the entire process remained in control during the production of the lot of bearings under acceptance, as verified from the quality control records/charts which shall be open to inspection of Engineer/Inspector on demand.

A certified copy of results of process control testing done on samples of elastomer used in the production of the lot shall be appended and shall include the following information :

Composition of compound – raw elastomer and ash content, the grade of raw elastomer used (including name, source, age on shelf), test results of hardness, tensile strength, elongation at break, compression set, accelerated ageing, etc.

A higher level certification of the process quality control shall be called for at the sole discretion of the Engineer in special cases e.g. where adequate inspection of bearings similar to those comprising the lot under inspection produced in the same plant, is not available with the Engineer or where there is any evidence of process or acceptance control being deemed unsatisfactory. The higher level certification shall comprise submittal of a complete quality control report covering tests as given in Appendix 3 of IRC:83 (Part II), supplementing the quality control certificate.

2005.4.7 Acceptance

The manufacturer shall furnish the following to Engineer for obtaining acceptance:

- 1) Quality control certificate as laid down in Clause 2005.4.6.
- 2) Inspection certificate as laid down in Clause 2005.4.5.

The manufacturer shall furnish any supplementary information on the system of quality control and/or process and acceptance control testing as may be deemed necessary by the Engineer.

In case of any evidence of process or acceptance control testing being deemed unsatisfactory by him, Engineer at his sole discretion may call for a special acceptance testing of the lot according to specifications laid down by him, without any prejudice to his right to reject the lot. The entire cost of such supplementary inspection shall be borne by the manufacturer.

The Engineer shall be the sole authority for acceptance of a lot on scrutiny of the certificates along with any supplementary evidence as mentioned in this Clause, to his complete satisfaction therewith.

In case of rejection of a lot, the Engineer shall reserve the right to call for special acceptance inspection for the succeeding lots offered for inspection, according to the specifications laid down by him. The entire cost of such tightened inspection shall be borne by the manufacturer.

2005.5 Certification and Marking

Bearings shall be transported to bridge site after final acceptance by Engineer and along with an authenticated copy of the certificate to that effect.

Each bearing shall be uniquely and individually numbered on its external faces for identification. The identification number shall be unique and such as to enable other bearings manufactured at the same time, to be traced through the production control records, should the need arise. The manufacturer's name and unique identification number of the bearing should be vulcanized on the top or bottom of the bearing.

An information card giving the following details for the bearings, duly certified by the manufacturer, shall also be appended :

- Name of manufacturer
- Date of manufacture
- Elastomer grade used
- Bearing dimensions
- Production batch no.
- Acceptance lot no.
- Date of testing
- Name and specific location of bridge
- Explanation of markings used on the bearing

All bearings shall have suitable index markings identifying the information. The markings shall be made in indelible ink or flexible paint and if practicable, should be visible after installation. The top of the bearing and direction of installation shall be indicated.

2005.6 Storage and Handling

Each elastomeric bearing shall be clearly labelled or marked. The bearing shall be wrapped in a cover and packed in timber crates with suitable arrangement to prevent movement and to protect corners and edges.

Care shall be taken to avoid mechanical damage, contamination with oil, grease and dirt, undue exposure to sunlight and weather of the bearings during transport and handling prior to and during installation.

2005.7 Installation

- i) Bearings shall be installed in the structure as specified or approved by the Engineer to ensure that right bearing is being installed at the right location.
- ii) Bearings must be placed between true horizontal surfaces (maximum tolerance 0.2 percent perpendicular to the load) and at true plan position of their control lines marked on receiving surfaces (maximum tolerance ± 3 mm).

- iii) Concrete surfaces shall be free from local irregularities (maximum tolerance ± 1 mm in height).
- iv) Departures from common planarity of twin or multiple bearings shall be within such tolerance as may be specified or approved by the engineer.
- v) Design shall be got checked for the actual inclination in seating if larger inaccuracies than those specified are permitted.
- vi) For cast in-situ concrete superstructure, where bearings are installed prior to concreting, the forms around the bearings shall be capable of easy removal. Forms shall also fit the bearings snugly and prevent any leakage of mortar/grout. Any mortar contaminating the bearings during concreting shall be completely removed before setting.
- vii) Fixing of bearing to precast concrete or steel superstructure elements, shall be done by application of epoxy resin adhesive to interface, after specified surface preparation. The specifications for adhesive material, workmanship and control shall be approved by the Engineer. Care shall be taken to guard against faulty application and consequent possibility of behaviour of the adhesive layer as a lubricant. The bonding by the adhesive shall be deemed effective only as a device for installation and shall not be deemed to secure bearings against displacement for the purpose of design.
- ix) Lifting of a cast in-situ post-tensioned bridge deck for relieving time dependent deformation shortly after installation of bearings, should be avoided. In case such lifting is unavoidable, the lifting arrangement, proper seating of the girder on the bearing, etc. shall be rigidly controlled to avoid any risk of misalignment.
- x) Bulging of the rubber layer between the reinforcing steel laminates on free exposed perimeter under load, which is a normal phenomenon, shall be examined carefully for detecting any evidence of crack or bond failure.
- xi) In case seating of bearings on a non-horizontal plane is required, it shall be carried out in accordance with acceptable practice and particular specifications as may be laid out and directed by the Engineer.
- xii) As a measure of ample precaution against accidental displacement, the bearings shall be placed in a recess as shown in Fig. 9 of IRC:83 (Part II).
- xiii) After installation, bearings and their surrounding areas shall be left clean.

2005.8 Maintenance

- i) The maintenance of bearings shall be carried out according to a planned schedule.
- ii) The structure should be designed and detailed in such a way that the bearings are easily accessible after installation for inspection and maintenance. Arrangements for insertion of jacks to lift the bridge deck shall be made in detailing of structure.
- iii) The exposed bearing surface shall be maintained clean and free from contamination with grease, oil or other deleterious matter.
- iv) Annual routine maintenance inspection or special maintenance inspection of all bearings shall be made to check the following aspects and results reported:
 - The top and bottom load bearing surfaces shall be in full contact with the plinth (bottom supporting surface) and the soffit (top supporting surface). If there is imperfect contact between the bearing surfaces and the soffit and plinth, the angle between the soffit and plinth shall be checked against the design specifications.
 - The magnitude of the shear deflection of each bearing shall be checked to ensure that it is within the design specifications.
 - A visual inspection shall be made of all the accessible edges. A note shall be made of the size and position of any cracks, splits or uneven bulges.
 - The plinth and soffit shall be examined for signs of displacement from original position of bearing which may be indicated by black marks left on the plinth and soffit.
 - Where applicable, the sliding surfaces shall be examined for cleanliness and for any movements beyond the design range.
 - Where applicable, protective coating and/or dust protection shall be examined for signs of deterioration.
- v) Damaged bearings shall be replaced immediately. To avoid differences in stiffness, all adjacent bearings on the same line of support shall also be replaced.

2006 POT BEARINGS**2006.1 General**

Pot bearings shall consist of a metal piston supported by a disc of unreinforced elastomer confined within a metal cylinder to take care of rotation. Horizontal movement, if required,

shall be provided by sliding surfaces of PTFE pads sliding against stainless steel mating surfaces, with a system of sealing rings. Pot bearings shall consist of cast steel assemblies or fabricated structural steel assemblies.

2006.2 Materials

2006.2.1 Structural steel, mild steel, high tensile steel and steel for forging shall conform to the requirements of Section 1009 of these Specifications.

2006.2.2 Cast steel shall comply with Grade 280-520W or 340-570W of IS:1030.

2006.2.3 Stainless steel shall conform to AISI 316 L or $O_2Cr_{17}Ni_{12}MO_2$ of IS:6911.

2006.2.4 PTFE

The raw material for PTFE used in bearings shall be pure polytetrafluoroethylene, free sintered without regenerated materials or fillers. The mechanical and physical properties of unfilled PTFE shall comply with Grade A of BS:3784 or equivalent. PTFE shall be either in the form of solid rectangular modules or large sheets with dimples formed by hot pressing or moulding. Sheet with dimples formed by machining or drilling from a solid PTFE sheet, shall not be permitted. The surface of PTFE sheets/modules which are to be in contact with metal backing plates, shall be provided with suitable chemical treatment for proper bonding. Adhesives used for bonding PTFE to backing plates, shall produce a bond with minimum peel strength of 4 N/mm width when tested in accordance with BS:5350 (Part C9).

2006.2.5 Elastomer

The elastomer to be used for the components of bearings shall comply with provisions of Table 2000-1 of this Section.

The confined elastomer inside the pot shall have the properties as given in Table 2000-4:

Table 2000-4 : Properties of Confined Elastomer

S.No.	Property	Unit	Test Method-Specification Reference	Limiting Value
1)	Hardness	IRHD	IS:3400 (Part II)	50 ± 5
2)	Min. tensile strength	MPa	IS:3400 (Part I)	15.5
3)	Min. elongation at break		As per Table 1 of IRC:83 (Part II)	
4)	Max. compression set		-do-	
5)	Accelerated aging		-do-	

2006.2.6 Composite Material

For guide of Pot bearings, composite material may be used for achieving lower coefficient of friction and higher strength. Such composite material shall consist of either (a) a bronze backing strip and a sintered inter-locking porous matrix impregnated and overlaid with a PTFE/lead mixture or (b) a mixture of PTFE, glass fibre and graphite embedded in a bronze mesh which is bonded to a galvanized steel backing strip.

2006.2.7 Seals

- i) Internal seals shall be either of the following:
 - a) Brass sealing ring made of metallic brass conforming to IS:410.
 - b) Poly Oxy Methylene (POM) sealing chain of proven type consisting of individual interlocking elements made of moulded polyoxymethylene having properties as specified in Table 2 of IRC:83 (Part III).
- ii) External seals and wiper seals shall be made of elastomer conforming to provisions of Clause 2006.2.5.

2006.2.8 Fasteners

Bolts, screws, nuts and lock nuts, shall generally conform to IS:1363, IS:1364, IS:1365, IS:2269, IS:3138, IS:6761 and IS:6639 as appropriate with mechanical properties conforming to IS:1367. Threads shall generally conform to IS:4218. Washers shall conform to IS:2016 and IS:6610 as appropriate.

2006.3 Manufacture

- i) The main components of a bearing shall be cast/forged as a single monolithic body. If they are made from mild steel, they shall be machined to the desired shape from a single piece of mild steel free of laminations. No welding is permitted for manufacture of the main components of a bearing.
- ii) The mating surface of the piston and cylinder of Pot bearings and that of the pin and cylinder of Pin bearings, shall be metallurgically hardened. The surface hardness shall not be less than 300 BHN.
- iii) The guides shall always be monolithic with the parent component.
- iv) For cast steel bearings, surfaces which will be in contact with concrete as well as non-working external surfaces of components may be kept in as-cast condition.

- v) For sliding components, stainless steel sheet shall be attached to the backing plate by continuous fillet welding along the edges, in such a fashion as to ensure flatness of the stainless steel sheet throughout its service life and avoid entrapment of air and prevent ingress of moisture at the interfaces. The backing plate shall extend beyond the edges of the stainless steel sheet to accommodate the weld which should not protrude above the top of the stainless steel sheet.
- vi) Suitable glue shall be used while confining the PTFE in the recesses. For large PTFE sheets sub-divided into parts, each individual part shall be confined into separate recess.
- vii) For internal seal, split rings 2 mm thick and 20 mm wide made of metallic brass shall be provided in layers with staggered split positions. For elastomeric pressure pad of up to 480 mm diameter, a minimum of 2 layers of rings shall be provided, while for that above 480 mm diameter, a minimum of 3 layers of rings shall be provided.
- viii) For internal seal of POM, the sealing chain made of individual interlocking elements shall be moulded as an integral part of the elastomeric pressure pad during the vulcanization process.
- ix) Pre-setting of sliding element if required shall be done in the manufacturer's workshop before dispatch.
- x) The bearing assembly shall be provided with temporary clamps to avoid separation of parts during transportation and installation.
- xi) All welding shall be as per IS:816 and IS:9595, with electrodes as per IS:814. Preheating and post-weld stress relieving shall be done if required.
- xii) Movement indicators shall be provided to facilitate routine inspection during service period.
- xiii) All non-working surfaces as well as the surfaces to be in contact with the structure shall be suitably prepared by sand/shot blasting to SA 2½ quality as per IS:9954.
- xiv) All non-working surfaces shall be given suitable protective coating either by painting or by zinc spraying. The total dry film thickness of protective coating shall not be less than 160 µm.
- xv) Painted protective coating shall comprise of two coats of epoxy primer enriched with metallic zinc, one intermediate coat of high build epoxy paint reinforced with MIO (Micaceous Iron Oxide) and one coat of high performance epoxy finish paint as per manufacturer's specification.
- xvi) Bearing components to be embedded in concrete or surfaces of any component to be in contact with concrete structure, shall be given a

coat of epoxy primer or any other suitable coating before dispatch, to prevent corrosion during transportation and storage at site. The protective coating shall be such that it will not affect the bond between the bearing component and the concrete.

- xvii) Silicon grease shall be applied at the PTFE – stainless steel interface of Pot bearings.
- xviii) The confined elastomeric pressure pad shall be lubricated with a suitable lubricant, which will not affect the material of the pad.

2006.3.1 Manufacturing Tolerances

2006.3.1.1 The overall dimensions of any assembled bearing or component thereof shall not exceed the tolerancelimits as given in Table 2000-5:

Table 2000-5 : Manufacturing Tolerances

S.No.	Item	Tolerances
1)	Plan dimension of assembled bearing	-0 mm to +5 mm or 0.5 percent of plan dimension whichever is higher
2)	Overall height of assembled bearing	-0 mm to +3 mm or 1 percent of overall height whichever is higher
3)	Parallelism of top surface of assembled bearing w.r.t. the bottom surface as datum	1 in 200
4)	Height of confined elastomeric pressure pad	-0 per cent to + 0.5 percent
5)	Thickness of any machined steel component	-0 mm to +1 mm
6)	Overall dimensions of any unmachined cast steel component	Class 2 of IS:4897
7)	Stainless steel sliding surface (a) Flatness (b) Surface finish	0.0004L, where L= length in direction of movement Ra≤0.25 μm as per IS:3073

2006.3.1.2 The tolerance on flatness of PTFE shall be 0.2 mm where the diameter or diagonal is less than 800 mm and 0.025 per cent of the diameter or diagonal where this dimension is greater than or equal to 800 mm. On PTFE surfaces made up of more than one piece of PTFE the above conditions shall apply to the diameter or diagonal dimension of the inscribing circle or rectangle around the PTFE. The tolerance of centre-to-centre distance of

dimples, depth of dimples and diameter of dimples for dimpled PTFE sheet shall be ± 0.5 mm, ± 0.5 mm and ± 1.0 mm respectively.

2006.3.1.3 The dimensional tolerances of confined PTFE shall be as given in Table 2000-6. The gap between the edge of the PTFE sheet and the edge of the recess in which it is confined, shall not anywhere exceed 0.5 mm or 0.1 per cent of the corresponding plan dimensions of the PTFE sheet, in the direction measured, whichever is greater, but in no case shall exceed 1 mm, The profile tolerance on the specified projection of PTFE above its confining recess shall be as given in Table 2000-6.

Table 2000-6: Dimensional Tolerance of Confined PTFE and Profile Tolerance of its Projection

Maximum Dimension of PTFE (Diameter or Diagonal) (mm)	Tolerance on Plan Dimension (mm)	Tolerance on Thickness (mm)	Tolerance on Specified Projection above Recess (mm)
<600	± 1.0	-0 to +0.5	-0 to +0.5
>600, ≤ 1200	± 1.5	-0 to +0.6	-0 to +0.6
>1200, ≤ 1500	± 2.0	-0 to +0.7	-0 to +0.8

2006.3.1.4 Tolerance of Fit

Tolerance of fit between different components of bearings shall be as follows:

- i) For Pot bearings the tolerance of fit between the piston and cylinder shall be +0.75 mm to +1.25 mm.
- ii) For Pot bearings the tolerance of fit between the confined elastomeric pressure pad and cylinder shall not exceed 0.5 percent of the diameter of the pad or 1 mm, whichever is higher.
- iii) For Pin bearings the tolerance of fit between the pin and cylinder shall be + 1.5 mm to +2 mm. Manufacturing tolerances of the contact surfaces of pin and cylinder shall be as per h11 and H11 of IS:919 respectively.
- iv) The tolerance of fit between guide(s) and adjacent-component shall be +2 mm to +4 mm.

2006.4 Inspection and Testing

- i) Inspection and testing shall consist of the following actions:
 - a) Inspection and testing of raw materials
 - b) Process inspection
 - c) Inspection and testing of finished bearings

- ii) The manufacturer shall have all test facilities required for process and acceptance control tests, installed at his plant to the complete satisfaction of the Inspector appointed by the Engineer. The test facilities and their operation shall be open for inspection by the Inspector at any time.
- iii) A testing programme shall be drawn up and submitted by the manufacturer to the Inspector and his approval obtained before commencement of testing. All tests on raw materials and finished bearings shall be carried out at the manufacturer's workshop as per procedures laid out in this Section. All the test reports duly certified by the Inspector shall be furnished by the manufacturer at the time of dispatch of the bearing from the workshop.
- iv) Routine test covering all the three items mentioned in i) above shall be carried out by the manufacturer for the bearings of each lot under acceptance. In addition, type test covering items b) and c) of i) above shall be carried out on bearings of each type and load capacity, selected at random by the Inspector, one for each lot. The size of each lot for similar type of bearings shall be 25 nos. or part thereof. Each type of bearing shall be treated as a separate lot. The Inspector may also carry out random tests on raw materials on samples drawn by the manufacturer, in which case the identification and marking of the sample will be done in the presence of the Inspector.
- v) A detailed quality control report of routine tests shall be furnished by the manufacturer to the Inspector, for each lot of bearings offered for inspection.

2006.4.1 Tests on Raw Materials

Tests on raw materials as per relevant material standards, shall be carried out by the manufacturer in accordance with stipulations in Appendix 2 of IRC:83 (Part III).

2006.4.2 Process Inspection/Tests

- i) Test on welding shall consist of DP test and visual inspection as per IS:822.
- ii) The hardness of all major steel components shall be tested to determine the Brinell Hardness Number (BHN), which shall be not less than 120 BHN for mild steel and 150 BHN for cast steel and forged steel.
- iii) All major metallic components shall be ultrasonically tested as per Level 3 of IS:9565.
- iv) The surface hardness of the mating interface shall be checked in accordance with the requirement specified in Clause 2006.3 ii).

- v) Corrosion protection shall be checked in accordance with the requirement specified in Clause 2006.3 xiv).
- vi) In case any of the acceptance control tests are deemed to be unsatisfactory by the Inspector, complete bearing or particular component(s) of the entire lot may be rejected, depending on the cause of rejection i.e. if the test of any material is unsatisfactory, the component involving that material shall be rejected for the entire lot; but if a finished bearing fails in load test, the complete bearing shall be rejected and all the bearings of that type and load capacity, shall be load tested before acceptance. If the result of process inspection is unsatisfactory, proper rectification measures shall have to be adopted by the manufacturer and the acceptance tests shall be repeated.

2006.4.3**Inspection/Test of Finished Bearings**

- i) All bearings of the lot shall be visually inspected for any defects in surface finish, shape or any other discernible superficial defects.
- ii) All bearings shall be checked for overall dimensions as per manufacturing tolerances specified in Clause 2006.3.1.
- iii) At least one or a pair of bearings of each type and different vertical load capacity, selected at random, shall be load tested. For Pot and PTFE bearings, the test load shall be 1.25 times the design vertical load while that for Pin and Metallic Guide Bearings, it shall be 1.25 times the specified design horizontal load. Additionally, for testing of Pot and PTFE bearings under a combination of loads acting in different axes, the test loads shall be 1.1 times the respective design loads. The test load shall be applied in stages and held for 30 minutes. For Pot bearings, the vertical deflection under sustained test load shall not increase by more than 4% of the thickness of the confined elastomeric pressure pad. The load shall then be removed and the bearing dismantled for visual examination.
- iv) Visual examination of the test bearing shall be carried out both during and after the test. Any visual defects, such as physical damage, cold flow of PTFE resulting in reduction of height by more than 0.5 mm, damage of internal seal and/or extrusion of the confined elastomeric pressure pad for Pot bearing, defects/cracks at metal to metal contact surfaces, shall lead to rejection of the bearing.
- v) For bearings with sliding components, friction test shall be performed on properly lubricated PTFE-stainless steel sliding surface at constant vertical load equal to the design vertical load as well as the permanent vertical load. Horizontal load shall be applied till sliding occurs. Coefficient of friction (μ) shall be determined on the basis of applied vertical and

horizontal loads and shall not exceed two-thirds of the value specified in Table 2000-7, depending on the actual average pressure on PTFE due to the applied vertical load.

Table 2000-7 : Coefficient of Friction for Stainless Steel Sliding on Properly Lubricated PTFE

Average Pressure on Confined PTFE (MPa)	Maximum Coefficient of Friction
5	0.08
10	0.06
20	0.04
≥ 30	0.03

- vi) Rotation test shall be performed on Pot bearing with properly lubricated elastomeric pressure pad for design rotation under a constant vertical load equal to the permanent vertical load.

2006.4.4 Certification and Marking

- i) Bearings should be transported to bridge site after final acceptance by the Inspector/inspection agency appointed by the concerned authority, along with an authenticated copy of the certificate of acceptance. An information card listing the required bearing characteristics, duly certified by the manufacturer should also be appended with the certificate.
- ii) All bearings shall have suitable index markings in indelible ink or flexible paint, which if practicable, shall be visible even after installation, giving the following information:
- Name of manufacturer
 - Month and year of manufacture
 - Bearing designation
 - Type of bearing
 - Load and movement capacity
 - Centre line markings to facilitate installation
 - Direction of major and minor movement, if any
 - Preset, if any

2006.5 Installation

2006.5.1 General

- i) Bearings shall be so located as to avoid the accumulation of dirt and debris on or around them. Detailing of the structure shall be such that water is prevented from reaching the bearings.

- ii) In order to avoid contamination of moving surfaces, bearings should not normally be dismantled after leaving the manufacturer's workshop. However, if for any reason, a bearing is required to be dismantled, it shall be done only under expert supervision for which the manufacturer's help may be sought.
- iii) Transfer of load from the superstructure to the bearings should not be allowed until the bedding material has developed sufficient strength. Temporary clamping devices should be removed at the appropriate time before the bearings are required to accommodate movement. The holes exposed on removal of temporary transit clamps should be filled with selected material. Where re-use of these fixing holes may be required, the material used for filling the holes should be capable of being easily removed without damaging the threads.
- iv) Suitable temporary supporting arrangements under bearing base plates should be made to accommodate thermal movement and elastic deformation of the incomplete superstructure. Such temporary supports, if provided, should be removed once the bedding material has reached its required strength. Any voids left as a consequence of their removal should be made good using the same bedding material. Steel folding wedges and rubber pads are suitable for use as temporary supports under bearing plates.

2006.5.2**Bedding**

- i) The bedding material shall be selected keeping in view a number of factors such as the type and size of bearing, construction sequence, load on the bearing, required setting time, friction requirements, access around bearings, design and condition of surface in the bearing area and thickness, strength and shrinkage of bedding material.
- ii) Commonly used bedding materials are cementitious or chemical resin mortar and grout. In some cases, it may be necessary to carry out trials to ascertain the most suitable material.
- iii) The bedding material, whether above or below the bearing, should extend over the whole area of the bearing in order to ensure even loading. After installation, there shall be no voids or hard spots. The top surface of any extension of the bedding beyond the bearing shall have a downward slope away from the bearing.
- iv) The bedding material shall be capable of transmitting the applied load to the structure without being damaged. Surfaces to receive bedding mortar shall be suitably prepared so as to be compatible with the mortar chosen.

2006.5.3 Fixing of Bearings

- i) Bearings should be anchored in order to counter vibration and accidental impact. Anchorage should be accurately set into recesses cast into the structure using templates. The remaining space in the recesses should be filled with material capable of withstanding the loads.
- ii) Bearings that are to be installed on temporary supports should be firmly fixed to the substructure by anchorage or other means to prevent disturbance during subsequent operations. Voids beneath the bearings should be completely filled with bedding material using the appropriate method.
- iii) Bearings may be fixed directly to metal bedding plates that may be cast in or bedded on top of the supporting structure to the correct level and location.
- iv) If the structure is of steel, the bearings may be bolted directly onto it. Care shall be taken to ensure that there is no mismatch between the bolt holes of the structure and those of the bearing.
- v) Threaded fasteners shall be tightened uniformly to avoid overstressing of any part of the bearing.

2006.5.4 Bearings Supporting In-situ Concrete Deck

- i) Where bearings are installed prior to casting of an in-situ concrete deck, formwork around bearings should be properly sealed to prevent grout leakage. It is essential that the bearings and particularly the working surfaces are protected during concreting operations. Sliding plates should be fully supported and care taken to prevent tilting, displacement or distortion of the bearings under the weight of green concrete. Any mortar contaminating the bearings should be completely removed before it sets.
- ii) For bearings supporting precast concrete or steel beams, a thin layer of synthetic resin mortar should be used between bearings and the beams. Bearings shall be bolted to anchor plates or sleeves embedded in precast concrete elements or to machined sole plates on steel elements.

2006.5.5 Installation Tolerances

Bearings shall be located so that their centre lines are within ± 3 mm of their correct position. The level of a bearing or the mean levels of more than 1 bearing at any support, shall be within a tolerance of ± 0.0001 times the sum of the adjacent spans of a continuous girder, but not exceeding ± 5 mm. Bearings shall be placed in a horizontal plane within a tolerance of 1 in 200 in any direction, even under superstructure in gradient.

2006.6 Maintenance

- i) Bearings shall be designed and manufactured to make them maintenance free so as to withstand undesirable effects caused by extreme atmosphere or aggressive environmental conditions/unforeseen events.
- ii) Suitable easy access to the bearings shall be provided for inspection and maintenance. Provision shall also be available for jacking up the superstructure so as to allow repair/replacement of bearings.
- iii) The area surrounding the bearings shall be kept clean and dry to avoid damage to the bearings. The bearings shall also be periodically cleaned to remove deposits of salts, debris, dust or other foreign material.
- iv) Periodic inspection and nominal maintenance of bearings shall be carried out in order to ensure their better performance and longer life. The bearings are required to be inspected at intervals of one year for the first five years after installation and at intervals of two years thereafter.
- v) The bearings shall also be examined carefully after unusual occurrences such as passage of heavy traffic/oversized loads, earthquakes and battering by floating debris in high floods.

2007 INSPECTION AND TESTING

Where any patented items are used, the manufacturer's certificate for the same with test proofs shall be submitted along with the design and got approved by the Engineer before their use in work.

2008 TEST AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2009 MEASUREMENTS FOR PAYMENT

Bearings shall be measured in numbers, according to their capacities and particular specifications given on the drawings.

The quantity of elastomeric bearings shall be measured in cubic centimetres of finished dimensions.

2010 RATE

The contract unit rate of each type of bearing shall include the cost of manufacturing, supplying and fixing the bearings in position complete as specified on the drawings or as directed by the Engineer.

The rate shall also include the cost of samples and their testing as required under the specifications or as directed by the Engineer.

In case of steel bearings the rate shall include the cost of all nuts, bolts and all tests prescribed in the specifications and shown on the drawings.

2100

OPEN FOUNDATIONS

2101 DESCRIPTION

The work shall cover furnishing and providing plain or reinforced concrete foundation placed in open excavation, in accordance with the drawings and these Specifications or as directed by the Engineer.

2102 MATERIALS

Materials shall conform to Section 1000 of these Specifications.

2103 GENERAL

A method statement indicating the following shall be submitted by the Contractor for approval of the Engineer, well in advance of the commencement of construction of open foundation :

- i) Sources of materials
- ii) Design, erection and removal of formwork
- iii) Production, transportation, laying and curing of concrete
- iv) Personnel employed for execution and supervision
- v) Tests and sampling procedures
- vi) Equipment details
- vii) Quality Management System to be adopted including Quality Manual
- viii) Any other relevant information

Details of necessary arrangements for execution under water wherever necessary, shall be included in the method statement.

Dimensions, lines and levels shall be set out and checked with respect to permanent reference lines and permanent bench mark so that the foundations are located correctly and in accordance with the drawings.

Formwork, steel reinforcement and structural concrete for open foundations shall conform to Sections 1500, 1600 and 1700 respectively of these Specifications.

2104 WORKMANSHIP**2104.1 Preparation of Foundations**

Excavation for laying the foundation shall be carried out in accordance with Section 300 of these Specifications. The last 300 mm of excavation shall be done just before laying of lean concrete below foundation. Excavation shall be made only to the exact depth as shown on the drawing. In the event of excavation having been made deeper than that shown on the drawing or as ordered by the Engineer, the extra depth shall be made up with M10 concrete in case of foundation resting on soil and with concrete of the same grade as that of the foundation, in case of foundation resting on rock. This shall be done at the cost of the Contractor and shall be considered as incidental to the work.

Open foundations shall be constructed in dry conditions and the Contractor shall provide for adequate dewatering arrangements, wherever required, to the satisfaction of the Engineer.

Where light blasting is required for excavation in rock or other hard strata, the same shall be carried out in accordance with Clause 302 of these Specifications. Where blasting is likely to endanger adjacent foundations or other structures, controlled blasting with all necessary precautions shall be resorted to.

2104.2 Setting Out

The plan dimensions of the foundation shall be set out at the bottom of foundation trench and checked with respect to original reference line and axis.

2104.3 Construction

- i) Excavation for open foundations shall be carried out in accordance with Section 300 of these Specifications. For guidance regarding safety precautions to be taken, IS:3764 may be referred.
- ii) For foundation resting on soil, a layer of M10 concrete of minimum thickness 100 mm shall be provided above the natural ground to provide an even surface to support the foundation concrete. Before laying of lean concrete layer, the earth surface shall be cleaned of all loose material and wetted. Care shall be taken to avoid muddy surface. If any part of the surface has become muddy due to over-wetting, the same shall be removed. If required, the M10 concrete may be laid to a thickness of more than 100 mm, as per the direction of the Engineer. No construction joint shall be provided in the lean concrete. For foundations resting on rock, the rock surface shall be cleaned of any loose material and then levelled with a layer of concrete of the same grade as that of the foundation, so as to provide an even surface.
- iii) No point of the surface of the lean concrete, in the case of foundation on soil or the surface of hard rock, in the case of foundation on hard rock, shall be higher than the founding level shown on the drawing or as ordered by the Engineer. Levels of the surface shall be taken at intervals of not more than 3 metres centre-to-centre in each direction, subject to a minimum of nine levels on the surface.
- iv) No formwork is necessary for the lean concrete layer. Side formwork shall be used for foundation concrete work. When concrete is laid in slope without top formwork, the slump of the concrete shall be carefully maintained to ensure that compaction is possible without slippage of freshly placed concrete down the slope. In certain cases it may be necessary to build the top formwork progressively as the concreting proceeds up the slope. Reinforcement shall be laid as shown on the drawing.
- v) Before laying foundation concrete, the lean concrete or hard rock surface shall be cleaned of all loose material and lightly moistened. Foundation concrete of required dimensions and shape shall be laid

continuously up to the location of construction joint shown on the drawing or as directed by the Engineer.

- vi) The concrete surface shall be finished smooth with a trowel. The location of construction joint and its treatment shall be done as per requirements of Section 1700 of these Specifications. Formwork shall not be removed earlier than 24 hours after placing of concrete. Where formwork has been provided for top surface, the same shall be removed as soon as concrete has hardened. Curing of concrete shall be carried out by wetting of formwork before removal. After its removal, curing shall be done by laying not less than 100 mm thickness of loose moistened sand free from clods or gravel, over the concrete. The sand shall be kept continuously moist for a period of 7 days. Before backfilling is commenced, the loose sand shall be removed and disposed of as directed by the Engineer.
- vii) Normally, open foundations shall be laid dry. Where dewatering is necessary for laying of concrete, it shall be carried out adopting any one of the following methods or any other method, approved by the Engineer:
 - a) A pit or trench of suitable size, deeper than the founding level as necessary, is dug beyond the foundation excavation so that the water flows into it and the excavated surface at founding level is fully drained.
 - b) Water table is depressed by well point system or other methods.
 - c) Steel/concrete caissons or sheet piling are used for creating an enclosure for the foundations, which can subsequently be dewatered.No pumping of water shall be permitted from the time of placing of concrete up to 24 hours after placement.
- viii) In situations where foundations cannot be laid dry or where percolation is too heavy to keep foundation strata dry, concrete may be laid under water only by tremie. In case of flowing water or artesian spring, the flow shall be stopped or reduced to the feasible extent at the time of placing the concrete.
- ix) Where blasting is required, it shall be carried out in accordance with Section 300 of these Specifications, observing all precautions indicated therein. Where blasting is likely to endanger adjoining foundations or other structures, necessary precautions such as controlled blasting, providing rubber mat cover to prevent flying of debris etc., shall be taken to prevent any damage.
- x) All spaces excavated and not occupied by the foundations or other permanent works shall be refilled with earth up to surface of surrounding ground with sufficient allowance for settlement. All backfill shall be thoroughly compacted and in general, its top surface shall be neatly graded. Backfilling shall be in accordance with Section 300 of these Specifications.

- xi) In case of excavation in rock, the annular space around the footing shall be filled with M15 concrete up to the level of top of rock. Filling with M15 concrete shall also be carried out for excavations having depth up to 1.5 m in ordinary rock or 0.6 m in hard rock. In case, the excavations are even deeper so as to require further filling up to the level of top of rock, the same shall be done by boulders grouted with cement.
- xii) Protective works, where provided shall be completed before the onset of floods so as to avoid the risk of the foundation getting undermined.

2105 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2106 TOLERANCES

- | | |
|---|------------------|
| a) Variation in dimensions | : +50 mm, -10 mm |
| b) Misplacement from specified position in plan | : 15 mm |
| c) Surface unevenness measured with 3 m straight edge | : 5 mm |
| d) Variation of levels at the top | : ± 25 mm |

2107 MEASUREMENT FOR PAYMENT

Excavation in foundation shall be measured in cubic metres in accordance with Section 300 of these Specifications, based on the quantity ordered or as shown on the drawing.

Lean concrete shall be measured in cubic metres in accordance with Section 1700 of these Specifications, based on the quantity ordered or as shown on the drawing.

Concrete in foundation shall be measured in cubic metres in accordance with Section 1700 of these Specifications, based on the quantity ordered or as shown on the drawing.

Reinforcement steel shall be measured in tonnes in accordance with Section 1600 of these Specifications, based on the quantity ordered or as shown on the drawing.

2108 RATE

The contract unit rates for excavation in foundation, lean concrete, including dewatering and blasting where required, concrete in foundation and reinforcement steel shall include all works as given in respective Sections of these Specifications and cover all incidental items for furnishing and providing open foundation as mentioned in this Section and as show on the drawings.

2200

SUBSTRUCTURE

2201 DESCRIPTION

The work shall cover furnishing and providing masonry or reinforced concrete substructure in accordance with the drawings and as per these Specifications or as directed by the Engineer.

2202 MATERIALS

Materials shall conform to **Section 1000** of these Specifications.

2203 GENERAL

2203.1 A method statement for construction indicating the following shall be submitted by the Contractor for approval of the Engineer, well in advance of the commencement of substructure:

- i) Sources of materials,
- ii) Design, erection and removal of formwork,
- iii) Production, transportation, laying and curing of concrete,
- iv) Personnel employed for execution and supervision,
- v) Tests and sampling procedures,
- vi) Equipment details,
- vii) Quality Management System to be adopted including Quality Manual
- viii) Safety measures
- ix) Any other relevant information.

Arrangements for execution under water wherever necessary, shall be included in the method statement.

2203.2 Dimensions, lines and levels shall be set out and checked with respect to permanent reference lines and permanent bench mark so that the substructure is constructed in accordance with the drawings.

2203.3 Brick masonry, stone masonry, formwork, steel reinforcement and concrete for piers, abutments, pier caps, abutment caps, dirt walls, return walls and wing walls shall conform to Sections 1300, 1400, 1500, 1600 and 1700 respectively of these Specifications.

2204 PIERS AND ABUTMENTS

2204.1 For concrete piers, horizontal construction joints shall be avoided as far as possible, by pouring the entire required concrete in one operation. Where construction

joints are unavoidable, they shall be treated in accordance with Section 1700 of these Specifications or in accordance with special provisions as directed by the Engineer. No vertical construction joint shall be permitted.

Construction joints shall not be permitted in splash zones.

The work shall be strictly in accordance with the drawings or as directed by the Engineer.

2204.2 In case of tall piers and abutments, use of slipform shall be preferred. The design, erection and raising of slipform shall be subject to special specifications which will be furnished by the Contractor. The concrete shall also be subjected to additional specifications as necessary. All specifications and arrangements for use of slipform and placing of concrete therein shall be subjected to the approval of the Engineer.

2204.3 The top surface of foundation/well cap/pile cap over which new concrete is to be laid, shall be scraped with wire brush and all loose materials removed. In case reinforcing bars projecting from foundations are coated with cement slurry, the same shall be removed by tapping, hammering or wire brushing. Care shall be taken to remove all loose materials around reinforcements. Just before commencing masonry or concrete work, the surface shall be thoroughly wetted.

2204.4 In case of solid (non-spill through type) abutments and hollow concrete piers, weep holes as shown on the drawings or as directed by the Engineer, shall be provided in conformity with Clause 2706 of these Specifications.

2204.5 The surface finish shall be smooth, except on the earth face of abutments which shall be rough finished.

2204.6 In case of abutments likely to experience considerable movement on account of earth pressure from backfill of approaches and settlement of foundations, the construction of the abutment shall be followed by filling up of embankment in layers to the full height to allow for the anticipated movement during construction. Casting of superstructure resting on the abutment shall be taken up only thereafter.

2205 PIER CAP AND ABUTMENT CAP

2205.1 The locations and levels of pier cap, abutment cap, pedestals and bolts for fixing bearings, shall be checked carefully to ensure alignment in accordance with the drawings.

2205.2 The surface of cap shall be finished smooth and shall have a slope for draining off water as shown on the drawings or as directed by the Engineer. For short span slab bridges with continuous support on pier caps, the surface shall be cast horizontal. The top surface of the pedestal on which bearings are to be placed shall also be cast horizontal.

2205.3 The surface on which elastomeric bearings are to be placed shall be wood float finished to a level plane which shall not vary more than 1.5 mm from straight edge placed in any direction across the area. The surface on which other bearings (steel bearings, pot bearings) are to be placed shall be cast about 25 mm below the bottom level of bearings or as indicated on the drawings.

2206 DIRT WALL, RETURN WALL AND WING WALL

2206.1 In case of cantilever return walls, no construction joint shall be permitted. The dirt wall and cantilever return walls shall be cast in one operation.

2206.2 For gravity type masonry and concrete return and wing wall, the surface of foundation shall be prepared in the same manner as that prescribed for construction of abutment. No horizontal construction joint shall be provided. Vertical construction joint may be provided, if shown on the drawing or as directed by the Engineer.

2206.3 Vertical expansion gap of 20 mm shall be provided in return wall/wing wall at every 10 metre intervals or as directed by the Engineer. The 20 mm gaps shall be filled with suitable type of asphaltic/bituminous board, so as to prevent embankment material from coming out. The cost of such board shall be borne by the Contractor and shall be incidental to the work.

2206.4 For masonry/concrete return walls and wing walls, weep holes shall be provided as prescribed for abutments or as shown on the drawings.

2206.5 The finish of the surface on the earth side shall be rough while that of the front face shall be smooth.

2206.6 Coping for wing wall/return wall in brick masonry/stone masonry shall conform to **Section 1300** of these Specifications.

2207 TESTS AND STANDARDS OF ACCEPTANCE

2207.1 The materials shall be tested in accordance with these Specifications and shall meet the prescribed requirements.

2207.2 The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2208 TOLERANCES IN CONCRETE ELEMENTS

- | | | | |
|----|--|---|---------------|
| a) | Variation in cross-sectional dimensions | : | +10 mm, -5 mm |
| b) | Misplacement from specified position in plan | : | 10 mm |

c)	Variation of levels at the top	:	±10 mm
d)	Variations of reduced levels of bearing areas	:	± 5 mm
e)	Variations from plumb over full height	:	±10 mm
f)	Surface unevenness measured with 3 m straight edge		
	All surfaces except bearing areas	:	5 mm
	Bearing areas	:	3 mm

2209 MEASUREMENTS FOR PAYMENT

2209.1 Masonry in substructure shall be measured in cubic metres in accordance with Section 1300 or Section 1400 of these Specifications, based on the quantities ordered or as shown on the drawings.

2209.2 Concrete in substructure shall be measured in cubic metres in accordance with Section 1700 of these Specifications, based on the quantity ordered or as shown on the drawings. No deduction shall be made for weep holes.

2209.3 Steel in concrete of substructures shall be measured in tonnes, in accordance with Section 1600 of these Specifications, based on the quantity ordered or as shown on the drawings.

2209.4 Weep holes shall be measured as per Section 2700 of these Specifications, based on the numbers provided or as shown on the drawings.

2210 RATE

The contract unit rates for masonry, concrete, reinforcement and weep holes shall include all works as given in respective Sections of these Specifications and cover all incidental items for furnishing and providing substructure as mentioned in these Specifications and shown on the drawings.

2300

**CONCRETE
SUPERSTRUCTURE**

2301 DESCRIPTION

The work shall cover furnishing and providing of concrete superstructure in accordance with the drawings and as per these Specifications or as directed by the Engineer.

2302 MATERIALS

Materials shall conform to Section 1000 of these Specifications.

2303 GENERAL

2303.1 A method statement for construction, indicating the following, shall be submitted by the Contractor for approval of the Engineer, well in advance of the commencement of the construction of superstructure.

- i) Sources of Materials
- ii) Design, erection and removal of formwork
- iii) Production, transportation, laying and curing of concrete
- iv) Prestressing system, if applicable
- v) Personnel employed for execution and supervision
- vi) Tests and sampling procedure
- vii) Equipment details
- viii) Quality Management System to be adopted including Quality Manual
- ix) Safety measures
- x) Any other relevant information

2303.2 Dimensions, lines and levels shall be set out and checked with respect to permanent reference lines and permanent bench mark so that the completed superstructure is in full accordance with the drawings and as approved by the Engineer.

2303.3 The formwork, steel reinforcement, structural concrete and prestressing for concrete superstructure shall conform to Section 1500, Section 1600, Section 1700 and Section 1800 respectively, of these Specifications.

2303.4 Specifications with regard to some of the common types of concrete superstructure construction shall be as given in subsequent Clauses of this Section.

2304 REINFORCED CONCRETE CONSTRUCTION**2304.1 Solid Slabs**

Where adjacent span of slab has already been cast, the expansion joint and filler board shall be placed abutting the already cast span, which shall form the shutter on that side of the new

span to be cast. The reinforcement for the road kerb and railings embedded in the slab shall be tied in position before casting of slab. The entire slab shall be cast in one go. Where the slab is continuous over two spans or more, the entire span of the first slab and the length of the slab in the next adjacent span up to the point of contraflexure, shall be cast in one go, the same sequence of concreting being repeated for additional spans as required. No other construction joint shall be allowed except with the express permission of the Engineer. In very wide slabs, however, longitudinal construction joints may be permitted with the approval of the Engineer. Construction joints, if provided, shall be made in the prescribed manner as per Clause 1710 of these Specifications.

The portions of solid slab near expansion joints shall be cast along with reinforcements and embedments for expansion joints. For this purpose, the portion of solid slab near expansion joints may be cast in a subsequent stage, if permitted by the Engineer.

Where wearing coat is required to be provided after the slab has been cast, the surface of the slab shall be finished rough, but true to lines and levels as shown on the drawings, before the concrete has hardened.

The top of the slab shall be covered with clean moist sand as soon as the surface has hardened. Curing shall be carried out as per Section 1700 of these Specifications.

If bearings are provided for the solid slab, the same shall be placed in position in accordance with the drawings, before casting of slab.

2304.2 RCC T-Beam and Slab

Provision of construction joint shall conform to the drawings or as per directions of the Engineer. No construction joint shall be provided between the bottom bulb and the web. If not indicated on the drawing, construction joint may be provided at the junction of the web and the fillet between the web and the deck slab, with the approval of the Engineer.

The portions of deck slab near expansion joints shall be cast along with reinforcements and embedments for expansion joints. For this purpose, the portion of deck slab near expansion joints may be cast in a subsequent stage, if permitted by the Engineer.

The surface of the deck slab shall be finished rough but true to lines and levels as shown on the drawings before the concrete has hardened. Care shall be taken for setting of bearings as indicated on the drawings.

2305 PRESTRESSED CONCRETE CONSTRUCTION

2305.1 PSC Girder and Composite RCC Slab

PSC girder may be precast or cast in-situ as mentioned on the drawing or as directed by the Engineer. Girders may be post tensioned or pre-tensioned. Where precast construction is

required to be adopted, selection of casting yard and details of methodology and equipment for shifting and launching of girders, shall be included in the method statement.

In case of cast in-situ construction, the sequence of construction including side shifting of girders, if required, and placing on bearings shall be in accordance with the drawings.

The PSC girder constituting the top flange, web and bottom flange shall be concreted in a single operation without any construction joint.

The portions of deck slab near expansion joints shall be cast along with reinforcements and embedments for expansion joints. For this purpose, the portion of deck slab near expansion joints may be cast in a subsequent stage, if permitted by the Engineer.

The surface of the deck slab shall be finished rough but true to lines and levels as shown on the drawings before the concrete has hardened.

Care shall be taken for correct alignment and setting of bearings as indicated on the drawings.

2305.2 Box Girder

Box girders may be simply supported or continuous. Simply supported box girders shall have minimum construction joints as approved by the Engineer. In the case of continuous box girders, the sequence of construction and location of construction joints shall be strictly in accordance with the drawings.

The box section shall be constructed with only one construction joint located in the web below the fillet between the deck slab and the web.

The portions of deck slab near expansion joints shall be cast along with reinforcements and embedments for expansion joints. For this purpose, the portion of deck slab near expansion joints may be cast in a subsequent stage, if permitted by the Engineer.

The surface of the deck slab shall be finished rough but true to lines and levels as shown on the drawings before the concrete has hardened. Care shall be taken for setting of bearings as indicated on the drawings.

2305.3 Segmental Construction

Where segments are cast in-situ using form travellers, continuity of untensioned reinforcement from one segment to the next must be ensured by providing full lap length as necessary.

It shall be ensured that the load of equipment as well as construction live load as taken in the design, are not exceeded during construction.

Pre-cambering of the superstructure during construction shall be done in such a manner that the finally constructed structure under permanent load attains the final profile intended in the drawings.

2305.3.1 Grades of Concrete

Minimum grades of concrete, minimum cement content, maximum water-cement ratio and other durability requirements shall be as indicated in Tables 1700-2 and 1700-3 of these Specifications.

2305.3.2 Precasting

All sides, bottom inside and header forms shall be of steel. Forms shall be of sufficient thickness, with adequate external bracing and shall be stiffened and adequately anchored to withstand the forces due to placement and vibration of concrete. Compaction of concrete may be achieved through needle vibrators or form vibrators along with needle vibrators.

For casting of precast segments, any of the two commonly used techniques of precasting viz. Long Line method or Short Bench method may be used. After the first segment of each unit is cast, succeeding segments shall be match cast against the previous ones and shall be given a unique identification mark so that it is placed at the intended locations in the superstructure. A bond breaking material such as flax, soap, talc, wax or any other approved material shall be used between previously cast segment and newly cast segments, as well as the end headers, where required.

Segments shall not be moved from the casting yard until stipulated strength requirements have been met. They shall be supported in a manner that will minimize warping. Under all circumstances, the concrete shall have attained a minimum compressive strength of 20 MPa at the time of removal of forms. At the time of lifting and assembly of precast segments, the concrete shall have attained sufficient strength to withstand the handling stresses. Curing of segments may be achieved through water curing or steam curing followed by water curing. Approved curing compound may also be used.

In case of spliced girder system, match casting is not necessary because the gap between the girder segments is filled with concrete or epoxy material at the location of splices. The faces which are required to receive the cast-in-situ stitch concrete, shall be adequately roughened and prepared as construction joint before pouring the stitch concrete. In case of epoxy jointed spliced girder system (with no gap between the girder segments), match casting shall be resorted to and all provisions of epoxy jointed segmental structure shall apply.

A full scale mock-up of the lifting and holding equipment (including assembly truss, cantilevering formwork etc.) shall be performed to demonstrate their adequacy and efficacy prior to start of erection/assembly of the segments.

2305.3.3 Tolerances in Precasting

Finished segment tolerances should not exceed the following:

Length of match-cast segment (not cumulative)	:	± 5 mm
Overall span length between bearings	:	± 10 mm
Web thickness, depths of top and bottom flanges, width of top and bottom flanges, overall depth of segment, thickness of diaphragm	:	± 5 mm
Grade of edge and and soffit	:	± 1 mm/m
Tendon hole location	:	± 3 mm
Position of shear keys	:	± 5 mm

2305.3.4 Shear Keys

Shear keys covering as much area of the cross-section as possible, shall be provided at match cast joints of precast segments. Shear keys in the webs shall be smaller in size and more in number than those in top flange and bottom flange, which may have larger sizes and lesser numbers. Shear keys shall be dimensioned in the form of trapezium and shall be located away from tendon holes. In case of spliced girder superstructure, where match casting is not used, large amplitude shear keys may be used.

2305.3.5 Epoxy Jointing of Segments

For epoxy jointed superstructure, mating surfaces of both adjoining segments shall be effectively prepared by wire brushing, water jetting or any other approved means to ensure that bond breaking material is completely removed. Epoxy of about 1 mm thickness shall be applied (usually by hand) on each of the mating surfaces. The epoxy should not have crossed 70 percent of its shelf life at the time of application. The segments shall then be brought in contact and an axial temporary compression of at least 0.3 MPa shall be applied by approved means for a minimum of 24 hours. The erection system shall be so planned by the Contractor that the time elapsed between mixing of components of epoxy and application of temporary axial surface, does not exceed 60 minutes. No epoxy from a batch for which the time since combining the components, has exceeded 20 minutes, shall be used.

2305.3.5.1 Sequence of Operation

The broad sequence of operations shall generally comprise placing of all segments which are to be assembled and prestressed in one stage touching each other and then visually examining the matching of mating surfaces. Subsequently, each segment shall be separated from adjoining segment by a distance just sufficient to enable application of the epoxy. The temporary axial compression shall then be imparted and maintained for a minimum of 24 hours.

Thereafter, intended permanent prestress shall be imparted prior to demobilizing the temporary axial prestress.

2305.3.5.2 Epoxy

Depending on the ambient temperature range, the following types of epoxies may be used:

5° to 20° Celsius	:	Fast reacting
15° to 30° Celsius	:	Medium fast reacting
25° to 40° Celsius	:	Slow reacting

Resin, which is one component of the epoxy, must be stirred by a mixer in its container for about 10 seconds or until homogeneity is achieved. Thereafter, the hardener which is the second component, must be added and mixing continued. For a mix of 5 kg batch, a mixing rotor attached to 350 W, 400 rpm electric hand drilling machine may be used. The speed of revolution should not exceed 400 rpm in order to avoid entrapment of air and excessive frictional heat leading to shorter pot life. The mixing time should not exceed 3 minutes. For fast reacting and medium fast reacting formulations, the temperature should not be allowed to rise above 40°C while for slow reacting formulations, it should not rise above 60°C. The mixing paddles should scrape the bottom and sides of the container so as to ensure complete mixing of the two components. The mixing should be carried out as close as possible to the site where the epoxy is to be used, so as to avoid loss of time and wastage of pot life in transport.

Epoxy shall be tested for its conformance to the FIP-1978 "Proposal for Standard Tests and Verification of Epoxy Bonding Agents for Segmental Construction". Some of the important properties of epoxy (minimum values) are as follows:

Pot life	:	20 minutes at upper temperature limit
Open time	:	60 minutes at upper temperature limit
Compressive strength	:	60 MPa at 24 hrs and 75 MPa at 168 hrs on 50 x 50 x 50 mm cube (at lower temperature limit)

Tensile bonding	:	After 24 hrs at 100% strength, humidity, should have concrete failure, no joint failure with M40 concrete (at lower temperature limit)
Shear strength	:	12 MPa (at lower temperature limit)
Curing rate	:	compressive strength on 50 x 50 x 50 mm cube shall be 20 MPa at 12 hrs, 40 MPa at 24 hrs and 75 MPa at 168 hrs (at lower temperature limit)

2305.3.6 Cast In-Situ Concrete Pour

In every unit of superstructure, consisting of precast segments, there shall be suitable numbers (at least one) cast in-situ concrete pour/stitch so as to ensure longitudinal alignment of the segment.

2305.3.7 Spliced Girder System

Spliced girder system in which smaller segments, usually pre-tensioned at precasting yard, are assembled together using cast in-situ concrete or epoxy and post tensioned, may be used to obtain large girder spans. For this purpose, the girder segments are temporarily supported over centering/steel tower or assembled at ground level and then post tensioned after jointing. In case of superstructures curved in plan, straight girder segments are placed along the chord line of the curvature to obtain the required geometry. In such cases, it is necessary to provide a cast in-situ cross diaphragm at each such kink in plan coinciding with the splice. The splicing can be done either before casting the deck or along with the deck. In the former case, post tensioning is imparted to the girder section alone whereas in the latter case, the post tensioning is imparted to the composite section.

A preferred location of splice will be the points of minimum stress such as one-third span points. At each cast in-situ splice location, adequately designed untensioned reinforcement shall be provided by lapping, welding or use of mechanical couplers subject to the limitation of the relevant codes. However, in case of epoxy jointed splice, such reinforcement is not provided.

2305.3.8 Prestressing Ducts

In the case of dry jointed segments, the prestressing ducts shall necessarily be of HDPE. In the case of epoxy jointed segments, either metallic or HDPE ducts may be used. The ducts shall be corrugated and shall have size and thickness as per the provisions of Clause 1802.2.2 of these Specifications. Adequate precaution shall be taken to ensure that epoxy material does not leak into the joints of the ducts.

2305.3.9 Prestressing Couplers

In case prestressing couplers are used, in general, not more than 50 percent of the prestressing cables passing through a section shall be coupled at that section. Longitudinally the couplers shall be staggered by at least a distance equal to segment length or twice the overall depth of girder, whichever is more. Usual practice is to couple half the cables in one span and the other half in the next span and so on. Two immediately adjacent cables shall not be provided with couplers at one section.

2305.4 Precast Pre-Tensioned Girders

Precast pre-tensioned girders can be used for superstructure of bridges in association with cast in-situ/precast deck slabs and diaphragms. They can also be made continuous either through untensioned reinforcement at the intermediate support or through post tensioning.

All construction requirements of precast pre-tensioned girders shall be in accordance with the provisions of Section 1800 of these Specifications.

2306 CAST IN-PLACE VOIDED SLABS

Voided slabs can be either in reinforced concrete or in prestressed concrete.

Voids can be either circular or rectangular in shape. Void formers may be manufactured from steel sheets, fibre reinforced cement, expanded polystyrene, HDPE, etc. They are generally corrugated to attain sufficient rigidity in order to prevent distortion or collapse during concreting. They should also be leak tight.

Void formers shall be suitably tied down in order to prevent flotation during concreting. Care shall be taken during placement of concrete to ensure that the concrete flows fully into the space beneath the void formers.

2307 TOLERANCES**2307.1 Precast Concrete Superstructure**

- a) Variations in thickness of top and bottom slab for box girders, top and bottom flange for T-girders and slabs : ± 5 mm to
- b) Variations in web thickness : -5 mm to +10 mm
- c) Variations in overall depth or width : ± 5 mm

- d) Variation in length overall and length between bearings : shall not exceed ± 10 mm or ± 0.1 percent of the span length, whichever is less
- e) Permissible surface unevenness in deck slab when measured with a 3 m straight edge or template : 5 mm

2307.2 Cast In-Situ Superstructure

- a) Variations in thickness of top and bottom slab for box girders, top and bottom flange for T-girders and slabs : -5 mm to +10 mm
- b) Variations in web thickness : -5 mm to +10 mm
- c) Variations in overall depth or width : ± 5 mm
- d) Variation in length overall and length between bearings : shall not exceed ± 10 mm or ± 0.1 percent of the span length, whichever is less
- e) Permissible surface unevenness in deck slab when measured with a 3 m straight edge or template : 5 mm

2308 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2309 MEASUREMENT FOR PAYMENT

Concrete in superstructure shall be measured in accordance with Section 1700, based on the quantity ordered or as shown on the drawings.

Steel reinforcement (untensioned) in superstructure shall be measured in accordance with Section 1600, based on the quantity ordered or as shown on the drawings.

High tensile steel (prestressing) in superstructure shall be measured in accordance with Section 1800, based on the quantity ordered or as shown on the drawings.

2310 RATE

The contract unit rates for concrete, steel reinforcement (untensioned) and high tensile steel (prestressing) shall include all works as given in respective Sections of these Specifications and cover all incidental items for furnishing and providing superstructure as mentioned in this Section and as shown on the drawings.

2400

**SURFACE AND
SUBSURFACE
GEOTECHNICAL
INVESTIGATION**

2401 DESCRIPTION

2401.1 The work shall cover investigation to determine the suitability or otherwise of the soil or rock to support the foundations of the bridge or other structure and also to determine soil parameters and rock characteristics required for the design of foundations by in-situ testing or testing of samples/cores taken from bores/drill holes. The subsurface investigation shall be carried out in such a way that the profiles of different types of soil for the entire length of the proposed structure are obtained and recorded. Other information to be obtained are mechanical and physical properties such as grain-size distribution, sensitivity, existence of deleterious material in soil or ground water, porosity of rock, subsidence due to mining, ground water level, artesian condition, likely sinking and driving effort and likely constructional difficulties.

2401.2 The field work shall consist of excavation, drilling of boreholes for the purpose of collection of undisturbed and disturbed samples, standard penetration tests, in-situ vane tests, static and dynamic cone penetration tests, other field tests, as specified by the Engineer and preparation of bore logs. It will also include collection, preservation and testing of disturbed and undisturbed samples from boreholes, borrow pits, etc. as specified by the Engineer. All in-situ tests shall be supplemented by laboratory investigations. Relevant Indian Standards such as IS:1498, IS:1888, IS:1892, IS:2131, IS:2132, IS:2720, IS:4434 and IS:4968 and Annex 2 of IRC:78 shall be followed for guidance.

2401.3 The soundings by dynamic method, where required shall be carried out in bore holes using a standard sampler as specified in IS:2131.

2402 EXTENT AND NUMBER OF BORES

2402.1 Investigations shall cover the entire length of the bridge and also extend on either side for a distance about twice the depth below bed of the last main foundation. Bores shall be taken at the location of each pier and abutment of the bridge. A minimum of two bores shall be taken in the approaches on either side, along the centre line of the alignment, at a distance of 50 m and 120 m behind the abutment positions. In case of viaducts in the approaches on either side of the bridge, bores shall be taken at the location of each foundation of the viaduct spans.

2402.2 Where detailed investigation indicates appreciable variation or where variations in a particular foundation are likely to appreciably affect the construction (specially in case of bridge foundations resting on rock), it will be necessary to take additional bores in the transverse direction also, to establish complete profile of the underlying strata. The number of additional bores shall be decided depending upon the extent of variation in local geology at a particular foundation location and should cover the entire area of that foundation.

2403 DEPTH OF BORES

2403.1 The bores shall be taken below the proposed founding level to a depth of at least $1\frac{1}{2}$ times the width of foundation. In case the soil at that level is found to be unsuitable or of doubtful bearing capacity, the depth of investigation below the proposed founding level, shall be extended to 4 times the width of foundation or till firm and stable soil or rock is met with. If rock is met with, the depth of drilling into rock having RQD more than 75, may be limited to 3 metres.

2403.2 For embankments and guide bunds, the depth of bore should cover all strata likely to cause undesirable settlement affecting their stability. The depth of bore holes below the ground level may ordinarily be 2.5 times the maximum height of the embankment/guide bund, subject to a minimum of 20 m. However, borings can be terminated at shallower depths when firm strata or bed rock is encountered. Where highly compressible strata are encountered, the boring may have to be taken deeper. In order to ensure that firm strata is sufficiently thick, the boring should extend 3 metres into the firm strata.

2404 DETAILED INVESTIGATION

2404.1 The subsurface investigation for bridges shall be carried out in the following three zones:

- i) between bed level and up to anticipated maximum scour depth (below H.F.L.)
- ii) from the maximum scour depth to the founding level
- iii) from founding level to a depth of about $1\frac{1}{2}$ times the width of the foundation

The data required to be obtained from each zone will cover soil classification, particle size distribution, shearing strength characteristics, compressibility and permeability as detailed in Table 1 of Annex 2 of IRC:78. In all cases, samples of soils shall be collected at every 1 m to 1.5 m depth or at change of strata.

2404.2 For high embankments, the average shear stress of each strata below ground level and compressibility of clayey strata, if present, shall be ascertained. The location and depth of bore for undisturbed sampling, shall be such as to give information regarding boundaries of the various strata. At least one representative undisturbed sample should be collected from each strata. When the homogeneous strata is very thick, one representative sample shall be collected for each 3 m thickness of the strata.

2404.3 Whenever a change in the subsoil strata/rock profile is encountered during construction, further investigations shall be carried out to establish the correct data required for revised design of foundations, if necessary.

2404.4 Logging of bore holes by radioactive methods for detailed investigations, if required, shall be done as specified in the contract or in special provisions.

2404.5 For bridge works, the investigations shall be comprehensive enough to give the following information to the designer:

- i) the engineering properties of the soil/rock,
- ii) the location and extent of soft layers, cavities and gas pockets, if any, under the hard founding strata,
- iii) the geological condition like type of rock, faults, fissures or subsidence due to mining, cavities, hollows, porosity etc.,
- iv) ground water level,
- v) artesian conditions, if any,
- vi) quality of water in contact with the foundation,
- vii) the depth and extent of scour,
- viii) suitable depth of foundation,
- ix) bearing capacity of the stratum
- x) probable settlement and differential settlement of the foundations,
- xi) likely sinking or driving effort, and
- xii) likely construction difficulties.

2405 DETAILED INVESTIGATION FOR BRIDGE FOUNDATIONS RESTING ON ROCK

2405.1 Investigation and interpretation of data of rock strata, is a specialised work for which the services of an engineering geologist shall be availed of. To arrive at the characteristic strength of rock mass, reliance shall be placed more on in-situ tests than on laboratory tests.

2405.2 Identification and classification of rock types for engineering purposes may in general be limited to broad, basic geological classes in accordance with accepted practice. Strength of parent rock alone is of limited value because overall characteristics depend to a large extent on character, spacing and distribution of discontinuities such as joints, bedding planes, faults and weathered seams in the rock mass. An important factor affecting the behaviour of the rock is the weathered zone at top.

2405.3 Basic Information Required from Investigations

- i) Geological system
- ii) Depth of rock strata and its variation over the length of the bridge

- iii) Whether bed consists of isolated boulders or continuous rock formation
- iv) Extent and character of weathered zone
- v) Structure of rock – including bedding planes, faults, fissures, solution cavities etc.
- vi) Properties of rock material – strength, geological formation, etc.
- vii) Colour, quality and quantity of water coming out of drill holes
- viii) Erodability of rock to the extent possible, where relevant

2405.4 Extent of Investigation

2405.4.1 The extent of investigation shall be adequate enough to cover the whole area of the bridge site for general characteristics and in particular, the foundation locations, to obtain definite information regarding depth of rock and its variation over the foundation area. A complete picture of the rock profile both in depth and across the channel width is necessary to assess the constructional difficulties in reaching the founding levels.

2405.4.2 The depth of boring in rock depends primarily on local geology, erodibility of the rock and extent of structural loads coming on the foundations. Normally, the bore shall pass through the upper weathered or otherwise weak zone and to sufficient depth to distinguish an isolated boulder from a continuous rock formation.

2405.5 Drilling through rock is a very specialised work requiring careful noting and recording of every change that occurs during drilling. The time required to drill through a certain depth, amount of core recovery, physical condition, length of pieces of core, joints, colour of water residue, weathering and evidence of disturbance and other effects shall be carefully noted and entered in the drilling log. For guidance, IS:5313 may be referred. The data shall be recorded in accordance with IS:4464. The cores shall be stored properly in accordance with IS:4078.

2405.6 Core Recovery and Rock Quality Designation

The quality of rock cores shall be classified according to Rock Quality Designation as given in Table 2400-1.

Table 2400-1 : Classification According To RQD

RQD Percent	Core Quality
90 – 100	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
25	Very Poor

2405.7 The rock cores obtained shall be subjected to the following tests:

- i) Visual identification for texture, structure, composition, colour and grain size.
- ii) Laboratory tests for specific gravity, porosity and moisture content.

2405.8 In-situ tests shall be carried out for measuring strength and deformation characteristics. The in-situ tests shall be in accordance with IS:7292; IS:7317; and IS:7746. Bore hole photography will also be desirable to evaluate the presence of faults, fissures or cavities, etc. In addition, laboratory tests can also be made on samples.

2405.9 Special Cases

2405.9.1 Investigation for Conglomerate

A drill hole shall be made same as for rock. The samples collected shall be subjected to suitable tests depending on the material. Care shall be taken to ascertain erodibility of the matrix. Where possible, especially for shallow foundation, Plate Load Test shall be conducted.

2405.9.2 Investigation for Laterites

The investigation shall be generally similar to that required for cohesive soils. Use of penetration tests shall be preferred, if suitable correlation charts are available. These may be static or dynamic penetration tests or vane shear tests. In the case of hard laterite, core drilling as for soft rocks may have to be resorted to. For laterites at shallow depths, use of Plate Load Test may be advantageous.

2405.10 Caution

2405.10.1 The interpretation of laboratory results on rock samples depends upon the relationship of the specimens tested to the overall rock characteristics, enumerated in Annex 2 of IRC:78. For this purpose, care shall be exercised in the choice of specimen size and its orientation in relation to the joint pattern.

2405.10.2 In some cases, the foundation behaviour will be dominated by a possible mode of failure involving movement along some joint planes, fissures or weak layer within a generally strong rock system and also by possible weathering. In-situ shear tests may be conducted wherever feasible, as such tests are likely to give more representative data than the shear tests conducted on core samples.

2405.11 Presentation of Data

The data shall be given in diagrammatic form in 3 sheets giving the following details:

Sheet 1 : Plan showing the position of bore-holes clearly marked so as to fix the locations which can be easily identified at a future date.

Sheet 2 : Bore log chart and test results of the samples separately for each bore hole/ drill hole/pit.

Sheet 3 : Pictorial representation of the bore log data to get an overall idea of the soil profile at the cross section of the river along the length of the bridge.

Note: For guidance refer to IRC:78

2406 BORING

Boring shall be done by any of the following methods depending on the soil type and types of samples required for the investigation.

- i) Auger Boring
- ii) Shell and Auger Boring
- iii) Percussion Boring
- iv) Wash Boring
- v) Rotary Boring

For detailed subsurface investigation, only rotary drills shall be used. Casing shall also be invariably provided with diameters not less than 150 mm up to the level of rock, if any. Use of percussion or wash boring equipment shall be permitted only to penetrate through bouldery or gravelly strata for progressing the boring but not for the collection of samples. While conducting detailed borings, the resistance to the speed of drilling i.e. rate of penetration, core loss, etc., as specified in Annex-2 of IRC:78 shall be carefully recorded to evaluate the different types of strata and specially to distinguish sand from sandstone, clay from shale, etc.

2407 RECORDS OF BORINGS AND TRIAL PITS

2407.1 The field records for the preliminary and detailed investigation shall contain the date when the boring was made, the location of the boring with reference to a permanent system of co-ordinates and the elevation of the ground surface with respect to a permanent

bench mark. They shall include elevation at which the water table and the upper boundary of each of the successive soil strata were encountered, the investigator's classification of the layer on the basis of general information obtained from field examination (refer to Appendix 2.1 of IRC:75) and the value of the resistance obtained by means of Standard Penetration Test. The type of tools used for borings shall be recorded. If the tools were changed at any stage, the depth at which the change was made and the reason therefore shall also be noted. Incomplete and abandoned borings shall be described with no less care than successfully completed ones. The notes shall contain everything of significance observed on the job such as the elevation at which wash water was lost from the hole.

2407.2 For borings and trial pits, necessary information shall be given covering the following. A site plan showing the disposition of the bore holes shall also be attached:

- a) Agency
- b) Location with reference map
- c) Pit/Bore-hole number
- d) Reduced level (R.L.) of ground surface or other reference point
- e) Dates of starting and completion
- f) Name of supervisor
- g) Scales of plans and sections
- h) Description of methods such as hand tools, blasting, boring, etc. used for proceeding with investigation
- i) General description of strata met with the RLs at which they are met
- j) Position and altitude of contacts, faults, strong joint, slicken sides, etc.
- k) Inflow of water, methods of controlling the water, required capacity of pumps for dewatering
- l) The level at which subsoil water is met
- m) Dip and strike of bedding and of cleavage
- n) Visual description of strata
- o) Results of field tests e.g. SPT, in-situ vane shear test etc.
- p) Any other information and remarks.
- q) The length of the sample in the tube and the length between the top of the tube and the top of the sample in the tube upon removal of sampling tube.

2408 METHODS OF SAMPLING

There are two types of samples viz. (a) Disturbed sample (b) Undisturbed sample. The usual methods for sampling conforming to IS:1892 and IS:2132 are given below :

Nature of Ground	Type of Sample	Method of Sampling
Soil	Disturbed	Hand Samples Auger Samples Shell Samples
	Undisturbed	Hand Samples Tube Samples
Rock	Disturbed	Wash samples from Percussion or rotary drilling
	Undisturbed	Cores

2409 PROCEDURE FOR TAKING SAMPLES

2409.1 For proper identification of subsurface material, sample should be recovered containing all the constituents of the materials in their proper proportion. In clayey deposits, such samples could be collected by split spoon samplers. In sandy deposits, sampling spoons shall be fitted with suitable devices for retaining samples. All data required for soil identification (Appendix-2.1 of IRC:75) should be collected from the samples so extracted when undisturbed samples, are not available. Penetration test should be carried out with the standard splitspoon sampler or penetrometers if the soil is coarse grained. If the soil profile is known to be fairly regular, preliminary and detailed investigation may be combined. Tube samplers can be used in place of split spoon samplers for collecting samples in clayey strata.

2409.2 Disturbed Soil Samples

2409.2.1 Disturbed samples of soil shall be obtained in the course of excavation and boring. For procuring samples from below the ground water level, where possible, special type of sampler shall be used. Where Standard Penetration Test is conducted, representative samples shall be obtained from the split spoon. While collecting disturbed samples from borrow areas it shall be ensured that the samples collected represent all types of borrow materials to be used in the construction of embankment and subgrade.

2409.2.2 The size of sample generally required shall be as given in Table 2400-2.

Table 2400-2 : Size of Soil Sample Required

S.No.	Purpose of Sample	Soil Type	Weight of Sample Required Kg
1)	Soil identification, natural moisture content tests, mechanical analysis and index properties, chemical tests	cohesive soils	1
		sands & gravels	3
2)	Compression tests	cohesive soils and sand	12.5
3)	Comprehensive examination of construction material and borrow area soil including soil stabilization	cohesive soils	25-50
		sands gravelly soil	50-100

2409.2.3 While taking out disturbed soil samples, Standard Penetration Test may also be conducted to find out the bearing capacity of the subsoils at specified levels.

2409.3 Undisturbed Soil Samples

2409.3.1 The location of the bore-hole shall be as indicated on the drawing or given by the Engineer. The depth of the bore-hole shall be as indicated on the drawing or shall be governed by the criteria given therein or as directed by the Engineer.

2409.3.2 Samples shall be obtained in such a manner that their moisture content and structure do not get altered. This may be ensured by use of correctly designed sampler and by careful preservation and packing.

2409.3.3 Standard Penetration Test may have to be conducted in each case to obtain additional data as directed by the Engineer. In soft clay, in-situ vane shear test as per IS:4434 may have to be conducted. Where all the three operations have to be carried out in one layer, the sequence shall be as follows: undisturbed soil sampling, in-situ vane shear test, Standard Penetration Test.

2409.3.4 For compression test samples, a core of 40 mm diameter and about 150 to 200 mm length may be sufficient, but for other laboratory tests, a core of 100 mm diameter and 300 mm length shall be taken unless otherwise specified by the Engineer.

2409.3.5 The upper few millimeters of both types of sample shall be removed as the soil at the bottom of the bore hole usually gets disturbed by the boring tools.

2409.4 Rock Samples

2409.4.1 Disturbed Samples

The sludge from percussion borings or from rotary borings which have failed to yield a core,

shall be collected to serve as a disturbed sample. It may be recovered by settlement of circulating water in a trough.

2409.4.2 Undisturbed Samples

Block samples taken from the rock formation shall be dressed to a size of about 90 mm x 75 mm x 50 mm.

Cores of rock shall be taken by means of rotary drills fitted with a coring bit with core retainer, if warranted.

2409.4.3 In case rock is met with at shallow depths, test pits or trenches may be dug. These are most dependable since they permit a direct examination of the surface, the weathered zone and discontinuities, if any. It is also possible to take representative samples for tests. For guidance, IS:4453 may be referred.

2410 PRESERVATION, HANDLING AND LABELLING OF SAMPLES

2410.1 The samples shall be labelled and handled carefully so that they are received in the laboratory in a fit state for examination and testing and can be correctly identified as coming from a specified trial pit or bore.

2410.2 The disturbed material in the upper end of the tube shall be completely removed before applying wax for sealing. The length and type of material so removed should be recorded.

2410.3 The soil at the lower end of the tube shall be reamed for a length of about 20 mm. After cleaning, both ends shall be sealed with wax applied in such a way that it does not enter the sample. Wax used for sealing should not be heated to more than a few degrees above its melting temperature. The empty space in the samplers, if any, should be filled with moist soil or saw dust and the ends covered with tight fitting caps.

2410.4 Labels Giving the Following Information Should be Affixed to the Tubes:

- a) Job designation
- b) Sample location
- c) Boring number
- d) Tube number
- e) Sample number
- f) Depth

- g) Penetration
- h) Gross recovery ratio

The tube and boring numbers should be marked in duplicate.

The boring number and sample number should also be marked on a sheet of material which will not be affected by moisture and enclosed in the tube.

2411 TESTS FOR INVESTIGATION OF SHALLOW FOUNDATIONS OF BRIDGES

2411.1 Digging of test pits or trenches is the most dependable method of investigation, since it permits direct and reliable visual examination of the type of soil and its stratification. In-situ tests like plate bearing tests, shear tests and uni-axial jacking tests can also be conveniently carried out in the test pits.

2411.2 Tests shall be conducted on undisturbed samples, which may be obtained from open pits. The use of Plate Load Test (as per IS:1888) is considered desirable to ascertain the safe bearing capacity and settlement characteristics. A few exploratory bore holes or soundings extending to a depth of about 1½ times the proposed width of foundation shall also be made to ascertain whether there is any weak strata underlying the foundation.

The results of laboratory tests shall be correlated with those of in-situ tests like Plate Load Tests and Penetration Test.

2412 TESTS FOR INVESTIGATION FOR DEEP FOUNDATIONS OF BRIDGES

2412.1 The tests to be conducted for obtaining the properties of soil are different for cohesive soils and for cohesionless soils. These are enumerated below and shall be carried out, wherever practicable, according to soil type. While selecting the tests and interpreting the results, limitation of applicability of particular tests shall be taken into account. A most suitable and appropriate combination of tests shall be chosen, depending on the properties needed for design and constructional aspects.

2412.1.1 Cohesionless Soil

- a) Laboratory Tests
 - i) Classification tests, index tests, density determination, etc.
 - ii) Shear strengths by triaxial/direct shear, etc.

- b) Field Tests
 - i) Plate Load Test (as per IS:1888)
 - ii) Standard Penetration Tests (as per IS:2131)
 - iii) Dynamic Cone Penetration Test (as per IS:4968 Part I or Part II)
 - iv) Static Cone Penetration Test (as per IS:4968 Part III)

2412.1.2 Cohesive Soil

- a) Laboratory Tests
 - i) Classification tests, index tests, density determination, etc.
 - ii) Shear strengths by triaxial/direct shear, etc.
 - iii) Unconfined Compression Test (as per IS:2720 Part X)
 - iv) Consolidation Test (as per IS:2720 Part V)
- b) Field Tests
 - i) Plate Load test (as per IS:1888)
 - ii) Vane Shear Test (as per IS:4434).
 - iii) Static Cone Penetration Test (as per IS:4968 Part III)
 - iv) Standard Penetration Tests (as per IS:2131),
 - v) Dynamic Cone Penetration Test (as per IS:4968 (Part I or Part II)

2412.1.3 For both cohesionless and cohesive soils where dewatering is expected, permeability tests may be conducted as per IS:2720 Part XVII.

2412.2 The subsoil water shall be tested for chemical properties to ascertain whether there is any hazard which may cause deterioration of concrete in foundations. Where dewatering is expected to be required, permeability characteristics shall also be determined.

2413 TESTING OF MATERIAL FOR FOUNDATIONS OF GUIDE BUNDS AND HIGH EMBANKMENTS

2413.1 The soil properties of the embankment foundation shall be got verified prior to start of construction in order to ascertain whether they conform to the requirements as specified in particular specifications. In case they do not, then the embankment design will have to be got revised.

2413.2 In addition to the relevant identification tests, mentioned in IRC:75, it shall be necessary to conduct some of the following tests on the undisturbed samples collected from

the sub-strata. The choice of test is primarily determined by the type of soil, type of stability analysis (vide Table 2400-3), availability of apparatus and cost of investigation.

Table 2400-3 : Shear Strength Tests for Stability Analysis

S. No.	Stage in Life of Embankment	Strength Parameters	Shear Test	Type of Analysis
1)	(a) During construction or immediate post-construction	c_{uu}, Φ_{uu}	Unconsolidated undrained triaxial shear test on undisturbed samples and on compacted embankment material	Total stress analysis
	(b) — do —	S_u	Unconfined compression test in laboratory or vane shear test	— do —
	(c) — do —	$C\Phi$	Consolidated undrained test with pore-pressure measurement on compacted soil samples embankment materials and on undisturbed samples	Effective stress analysis
2)	Long term stability	$C\Phi$	— do —	— do —

2413.3 The results of reconnaissance, field and laboratory investigations for embankments shall be compiled into a well-knit report. The record of findings and recommendations, if any, may be presented in the form of, graphs, figures and tables, as appropriate for different types of data and findings.

Information and data to be contained in the report should include general location map, pertinent geological information on reconnaissance observations, subsoil profile (Fig. 2.1 of IRC:75), boring logs and summary of subsoil properties (Fig. 2.2 of IRC:75), graphs and tables related to laboratory investigations, results of borrow area investigations (Fig. 2.3 of IRC:75) and recommendations, if any.

Undisturbed samples shall be collected from each layer of subsoil. In case, the stratum is such that undisturbed samples cannot be collected using ordinary sampler, they shall be collected using piston sampler or core-cutter or such special devices as directed by the Engineer. In thick layers undisturbed samples shall be collected at 3 m intervals.

2414 MEASUREMENT FOR PAYMENT

For bridge and road structures, the work of boring and trial pits shall be considered as incidental to the foundation works and nothing extra shall be paid unless otherwise specified

in the contract. In cases, where contract for soil investigation is given separately, the work shall be measured in running metres for borings, in cubic metres for trial pits, in number of samples for collection of disturbed and undisturbed samples and in number of tests for each type of test.

2415 RATE

The contract unit rate shall include the cost of all labour, materials, tools and plant and equipment including mobilization / demobilization of rigs of specified type, required for doing the boring or making pits as per these Specifications, taking out and packing the samples, sending and getting them tested in approved laboratories and making available the test report as specified or directed by the Engineer, inclusive of all incidental costs to complete the work as per specifications.

2500

**RIVER TRAINING AND
PROTECTION WORK**

2501 DESCRIPTION

River training and protection work shall include construction of guide bunds, guide walls, spurs, groynes, bank protection, flooring, cut-off walls, apron and approach embankment protection, as required for ensuring safety of the bridge structure and its approaches against damage due to flood/flowing water. Construction of various components shall conform to IRC: 89 and these Specifications or as directed by the Engineer.

2502 GUIDE BUND

2502.1 This work shall consist of construction of embankment of guide bund and provision of pitching/rivetment on slopes, apron and toe protection, etc., as indicated on the drawing, in accordance with these Specifications or as approved by the Engineer.

The provisions given hereunder are applicable only to guide bunds for bridges across alluvial rivers. Guide bunds for bridges across submontane rivers will require supplemental specifications.

2502.2 The alignment and layout of guide bund shall be as indicated on the drawing or as approved by the Engineer. The construction of embankment for guide bund shall conform to provisions of Section 300 of these Specifications. Pitching, filter underneath pitching and turfing, apron, toe protection, curtain walls, etc., shall be as per these Specifications.

2502.3 Guide bunds shall be made of locally available materials. Trial pits shall be taken in borrow areas to examine suitability of soil for construction and also to decide the types of earth moving machinery to be used. No borrow pits should be dug on the river side of the guide bunds.

Construction of guide bund shall be taken in hand along with the construction of the bridge. Every effort shall be made to complete the work of the guide bund in one working season. Where this is not possible, suitable measures shall be planned and executed for protection of completed work. In such cases, the construction of guide bund shall be started from abutment towards upstream.

2502.4 Construction of apron and pitching of the guide bunds shall conform to Clauses 2503 and 2504 of these Specifications. Sufficient area along the side of the guide bund shall be ready within one to two months of commencement of work, so that the placing of stones in the apron and in the slope pitching can be commenced. As a guideline, earth work should be completed within 80 percent of the working season. Also, about 70 percent of the working season shall be available for laying apron and pitching. No portion of the guide bund should be left incomplete below high flood level before the onset of the monsoon. Bottom of apron pit shall be as low as permitted by subsoil water/lowest water level. Sufficient labour and appropriate earth moving machinery and trained staff shall be deployed in construction so as to complete the work in the required time.

2502.5 The Contractor shall furnish for approval of the Engineer, his methodology for transport of stones from the quarries to the site of work taking into account the quantities of stone required to be transported every day, type of transport to be used (train, truck, ferry,

boats) and labour for loading, unloading and laying within the time frame for construction of guide bund. Adequate reserve of stones should be maintained for major works as decided by the Engineer. Reserve stones shall be stacked away from the main channel of the river.

2502.6 Where the alignment of guide bund or the approach embankment crosses branch channel of the river, the branch channel shall be either diverted to the main channel of the river with the help of spurs, etc. or closed by a properly designed closing dyke or closure bund, before taking up construction of guide bund.

2503 APRON

2503.1 General

This work shall consist of laying boulders directly or in wire crates on the bed of rivers for protection against scour.

The stones used in apron shall be sound, hard, durable and fairly regular in shape. Stones subject to marked deterioration by water or weather shall not be used.

Quarry stones having angular shapes shall be preferred to round boulders.

Where the stones of required size are not economically available, cement concrete blocks in minimum M15 grade conforming to Section 1700 of these Specifications or stones in wire crates shall be used.

2503.2 Boulder Apron

The size of stone shall conform to Clause 5.3.7.2 of IRC: 89.

The size of stone shall be as large as possible and no stone shall weigh less than 40 kg. The specific gravity of stones shall be as high as possible and not less than 2.4.

To ensure regular and orderly disposition of the full intended quantity of stone in the apron, template cross walls in dry masonry shall be built about a metre thick and to the full height of the specified thickness of the apron, at intervals of 30 metres all along the length and width of the apron. Within these walls, the stone shall be hand packed.

The surface on which the apron is to be laid shall be levelled and prepared for the length and width, as shown on the drawings. In case the surface is below the low water level, the ground level may be raised upto low water level by dumping earth and the apron laid thereon. In such cases, the quantity of stone required in apron shall be re-worked by taking the toe of pitching at higher level.

2503.3 Wire Crates and Mattresses for Apron

Wire Crates and Mattresses shall be any of two types mechanically woven and hand woven.

2503.3.1 Mechanically Woven Crates (Gabions and Mattresses)**2503.3.1.1 Description**

Mechanically woven wire crates shall be made of hot dipped galvanized mild steel wire of diameter not less than 2.2 mm having minimum tensile strength 350 MPa conforming to IS:280. The galvanisation shall be heavy coating for soft condition conforming to IS:4826. For corrosive environment, an additional PVC coating of 0.5 mm thickness shall be provided over the galvanisation, or zinc alloy coating as per EN 10244-2 shall be provided in place of galvanisation. The mesh of the crate shall be of type 10 x 12, 8 x 10, and 6 x 8 as per EN 10223. Mesh shall be given double twist at each intersection and shall be mechanically selvaged all along the edges of the boxes. Wire crates standard sizes shall be as per ASTM A975. The wire crates shall be divided into compartments by diaphragms placed at 1 m centre to centre.

2503.3.1.2 Mesh and Box Characteristics

Mesh types and shapes shall be as given in Table 2500-1. The mesh and box characteristics of gabions and mattresses shall be as per Tables 2500-2 and 2500- 3 respectively.

Table 2500-1 : Mesh Types and Sizes

Mesh Type	'D' Nominal Size, mm	Tolerances
10 x 12	100	+ 16% to – 4%
8 x 10	80	
6 x 8	60	

Table 2500-2 : Mesh & Box Characteristics for Gabions

Mesh Type	10 x 12			8 x 10		
	'D', mm	100			80	
Wire Type	Only Zinc Coated		Zinc + PVC Coated	Only Zinc Coated		Zinc + PVC Coated
Mesh Wire Dia, mm	2.70	3.00	2.70/3.70*	2.70	3.00	2.70/3.70*
Edge/Selvage wire Dia, mm	3.40	3.90	3.40/4.40*	3.40	3.90	3.40/4.40*
Lacing wire dia, mm	2.20	2.20	2.20/3.20*	2.20	2.20	2.20/3.20*
PVC coating thickness, mm	N. A		Nominal – 0.50 Minimum – 0.38	N. A		Nominal – 0.50 Minimum – 0.38
Typical Sizes Length x Width x Height (m)/ Number of diaphragms	4 x 1 x 1 / 3 Nos, 3 x 1 x 1 / 2 Nos, 2 x 1 x 1 / 1 No, 1.5 x 1 x 1 / 0 No, 2 x 1 x 0.5 / 1 No, 3 x 1 x 0.5 / 2 Nos, 4 x 1 x 0.5 / 3 Nos, 2 x 1 x 0.3 / 1 No, 3 x 1 x 0.3 / 2 Nos, 4 x 1 x 0.3 / 3 Nos					
Tolerances in Size of Gabion Boxes	Length & Width... +/- 5%; Height > 0.3m... +/- 5% and Height <= 0.3m... +/- 10%					

* Internal Diameter/External diameter of PVC Coated Wire

Only standard sizes of Gabion boxes are indicated in the table above. Special sizes can also be ordered as agreed between the purchaser and manufacturer.

Table 2500-3 : Mesh & Box Characteristics for Revet Mattresses

Mesh Type	6 x 8	
'D', mm	60	
Wire Type	Only Zinc Coated	Zinc + PVC Coated
Mesh Wire Dia, mm	2.20	2.20/3.20*
Edge/Selvedge wire Dia, mm	2.70	2.70/3.70*
Lacing wire dia, mm	2.20	2.20/3.20*
PVC coating thickness, mm	N. A	Nominal – 0.50 Minimum – 0.38
Typical Sizes Length x Width x Height (m)/Number of diaphragms	4 x 2 x 0.17 / 3 Nos, 3 x 2 x 0.17 / 2 Nos, 2 x 2 x 0.17 / 1 No 4 x 2 x 0.23 / 3 Nos, 3 x 2 x 0.23 / 2 Nos, 2 x 2 x 0.23 / 1 No 4 x 2 x 0.30 / 3 Nos, 3 x 2 x 0.30 / 2 Nos, 2 x 2 x 0.30 / 1 No	
Tolerances in Size of Revet Mattresses	Length & Width ... +/- 5%: Height <= 0.3m ... +/- 10%	

* Internal Diameter/External diameter of PVC coated wire

2503.3.1.3 Dimensions and Tolerances

The diameter of galvanized steel wire shall conform to the values as per Table 2500-2 for Gabions and Table 2500-3 for Revet mattresses. The diameter of the wires shall also conform to the tolerance limits plus and minus the values as shown in Table 2500-4.

Table 2500-4 : Permitted Tolerances on Galvanized Steel Wire Diameters

Nominal Diameter of Galvanized Wire, mm	Permitted Tolerances (+/-) on Wire Diameters, mm
2.00	0.05
2.20	0.06
2.40	0.06
2.70	0.07
3.00	0.08
3.40	0.09
3.90	0.10

Note :

- 1) The minimum and nominal thickness of PVC coating uniformly applied in a quality workmanlike manner shall be as shown in Tables 2500-2 and 2500-3.

- 2) Gabions shall be manufactured with a 10 x 12 or 8 x 10 mesh type (Fig. 2500-1) having a nominal mesh opening size as per Table 2500-2. Dimensions are measured at right angles to the center axis of the opening and parallel to the twist along the same axis.
- 3) Revet mattresses shall be manufactured with a 6 x 8 mesh type (Fig. 2500-1) having a nominal mesh opening size as per Table 2500-2. Dimensions are measured at right angles to the center axis of the opening and parallel to the twist along the same axis.
- 4) The width and length of the gabions and revet mattresses as manufactured shall not differ more than +/- 5% from the ordered size prior to filling. Typical gabion and revet mattress sizes are shown in Tables 2500-2 and 2500-3 respectively.
- 5) The height of the gabions and revet mattresses as manufactured shall not differ more than +/- 10% if the height is less than or equal to 0.3 m and shall not differ more than +/- 5% if the height is more than 0.3 m from the ordered size prior to filling.
- 6) Mesh Opening Tolerances – Tolerances on the hexagonal, double-twisted wire mesh opening shall not exceed +16% to -4% on the nominal dimension D values mentioned in Table 2500-1.

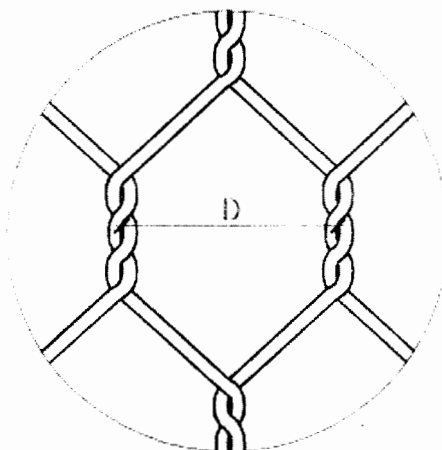


Fig. 2500-1 : Mesh Type & Nominal Size 'D'

2503.3.1.4 Terminology, mechanical properties, physical properties, number of tests and test methods related to mechanically woven wire crates shall be as per Appendix-2500/I.

2503.3.2 Hand Woven Wire Crates

Wire crates shall be made from hot dipped galvanized mild steel wire of diameter not less than 4 mm in annealed condition having tensile strength of 300 MPa-450 MPa conforming to IS:280. The galvanizing shall be heavy coating for soft condition conforming to IS:4826.

The mesh size of the crate shall not be more than 150 mm.

Wire crates for shallow or accessible situations shall be 3 m x 1.5 m x 1.25 m in size. Where these have to be deposited and there is a possibility of overturning, the crate shall be divided into 1.5 m compartments by cross netting.

For deep or inaccessible situations, wire crates can be made smaller subject to the approval of the Engineer.

Wire crates built in-situ, shall not be larger than 7.5 m x 3 m x 0.6 m, nor smaller than 2 m x 1 m x 0.3 m. Sides of large crates shall be securely stayed at intervals of not more than 1.50 m to prevent bulging.

The netting shall be made by fixing a row of spikes on a beam at a spacing equal to the mesh. The beam must be a little longer than the width of netting required. The wire is to be cut to lengths about three times the length of the net required. Each piece shall be bent at the middle around one of the spikes and the weaving commenced from the corner.

A double twist shall be given at each intersection. The twisting shall be carefully done by means of a strong iron bar, five and half turns being given to the bar at each splice.

The bottom and two ends of the crate or mattress shall be made at one time. The other two sides shall be made separately and shall be secured to the bottom and the ends by twisting adjacent wires together. The top shall be made separately and shall be fixed in the same manner as the sides after the crates or mattress have been filled.

2503.3.3 Laying of Wire Crates

Wherever possible, crates shall be placed in position before filling with boulders. Undulations in the bed shall be levelled prior to placement of wire crate units. The crates shall be filled by carefully hand-packing the boulders as tightly as possible and not by merely throwing in the stones or boulders.

Where the crates are to be laid on the sides and bed of the stream in underwater conditions, they shall be prefilled on dry area, lifted by cranes using suitable size frames with lifting slings at every 0.5 m to 1 m maximum spacing and placed at designated locations. Sacrificial steel rods of diameter 20 mm to 25 mm may also be used, in place of frame, by tying them to the edges and lifting directly with closely spaced slings. Once placed, divers shall lace the crates together at all contact surfaces. For sides of the banks a tilting platform, pantoon or barge can be used where mattresses are filled with stones on the level platform, resting at one end on the bank and has the other edge hinged to the pantoon/barge. One end of the filled wire crate is anchored to the dry edge of the slope and then the pantoon/barge is moved away

from the bank, thus lowering and sliding out the tilted platform under the crate, gradually placing the crate on the slopes while the tilted platform rotates around its hinges.

2504 PITCHING/REVETMENT ON SLOPES

2504.1 Description

The work shall consist of covering the river side slopes of guide bunds, training works and road embankments with stone, boulders, cement concrete blocks or stones in wire crates over a layer of granular material which will act as a filter. The rear slopes, not subjected to direct attack of the river, may be protected by 300 mm - 600 mm thick cover of clayey or silty earth and turfing.

2504.2 Pitching and Filter Medium

2504.2.1 Pitching

The pitching shall be provided with stones of thickness and shape as indicated on the drawings.

The stones shall be obtained from quarries and shall be sound, hard, durable and fairly regular in shape. Round boulders shall not be allowed. Stones showing marked deterioration by water or weather shall not be accepted.

The size and weight of stone shall conform to Clause 5.3.5.1 of IRC: 89. No stone, shall weigh less than 40 kg. The size of spalls shall be a minimum of 25 mm and shall be suitable to fill the voids in the pitching.

Where the stones of required size are not economically available, cement concrete blocks in minimum M15 grade concrete conforming to Section 1700 of these Specifications or stones in wire crates, shall be used.

Geosynthetics, if used in pitching, shall conform to Section 700 of these Specifications.

2504.2.2 Filter Medium

The material for the filter shall consist of coarse sand, gravel or stone. One or more layers of graded materials, to act as a filter medium, shall be provided underneath the pitching, to prevent loss of the embankment material and build up of uplift head on the pitching.

The gradation of the filter material shall satisfy the following requirements:

$$\frac{D 15 (\text{Filter})}{D 85 (\text{Base})} < 5$$

$$4 < \frac{D 15 (\text{Filter})}{D 15 (\text{Base})} < 20$$

$$\frac{D 50 (\text{Filter})}{D 50 (\text{Base})} < 25$$

Notes :

- 1) Filter design may not be required if embankment consists of CH or CL soils with liquid limit greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching
- 2) In the foregoing, D 15 means the size of that sieve which allows 15 percent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85 (15 being replaced with 50 and 85 respectively).
- 3) If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as base material for selection of coarser filter.
- 4) The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 150 mm.

2504.3 Construction Operations

Before laying the pitching, the side of banks shall be trimmed to the required slope and profiles by means of lines and pegs at intervals of 3 m. Depressions shall be filled and thoroughly compacted.

The filter granular material shall be laid over the prepared base and compacted to the thickness specified on the drawings by means of suitable equipment.

The lowest course of pitching shall be started from the toe wall and built up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3, of these Specifications in case of dry rubble pitching. It shall be in nominal mix cement concrete (M 15) conforming to Clause 1704.3, of these Specifications in case of cement concrete block pitching.

The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.

The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.

In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible.

When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size wedged in with hammers to ensure tight packing.

When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

2504.4 Toe Protection

A toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to prevent the slope pitching from sliding down. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Section 1400 of these Specifications or in cement concrete of M15 grade. The pitching/revetment shall be of stones in wire crates or cement concrete blocks in M15 grade. For protection of ties of bank slopes terminating either in short aprons at bed levels or anchored in flooring/rocky bed, the provision of Clause 8.2.2 of IRC:89 may be complied with.

2505 RUBBLE STONE/CEMENT CONCRETE BLOCK FLOORING OVER CEMENT CONCRETE BEDDING

2505.1 The work shall consist of constructing rubble stone/cement concrete block flooring laid over a bedding of cement concrete (M15).

2505.2 Construction Operations

Excavations for laying the bedding and floor protection works shall be carried out as per specifications under proper supervision. Before laying the foundation and protection walls, the excavated trenches shall be inspected by the Engineer to ensure that:

- a) There are no loose pockets and unfilled depressions left in the trench.
- b) The soil at the founding level is properly compacted to true lines and level so as to have an even bedding.
- c) All concrete and other elements are laid in dry bed.

Bedding of cement concrete nominal mix (grade M15) of 300 mm thickness shall then be laid in accordance with Section 1700 of these Specifications except that the surface of the concrete shall not be given a smooth finish.

Flooring shall consist of 150 mm thick flat stone/cement concrete block M15 grade conforming to Section 1700 of these Specifications. It shall be bedded on a layer of cement mortar (1:3) prepared to Section 1300 of these Specifications. Spalls shall be used to fill in the voids. The joints shall be filled with cement mortar and finished neat. The stone shall break joints and the thickness of joints shall not exceed 20 mm. The top of flooring shall be kept 300 mm below the lowest bed level.

2506 DRY RUBBLE FLOORING

Dry rubble flooring shall be provided for relatively less important works such as cross drainage structures.

The base for the flooring shall be prepared to the specified levels and slopes and compacted suitably with hand rammers or other means to have even bedding.

The stones shall be laid closely on the prepared base in one or more layers with appropriate bond as specified by the Engineer.

2507 CURTAIN WALL AND FLEXIBLE APRON**2507.1 Curtain Wall**

The rigid flooring shall be enclosed by curtain walls (tied to the wing walls) with minimum depth below floor level of 2 m on upstream side and 2.5 m on downstream side. The curtain wall shall be in cement concrete M15 grade or stone masonry in cement mortar 1:3.

2507.2 Flexible Apron

Flexible apron 1 m thick comprising loose stone boulders (weighing not less than 40 kg) shall be provided beyond curtain walls for a minimum distance of 3 m on upstream side and 6 m

on downstream side. The work of floor protection shall be simultaneously completed along with the work on bridge foundations.

2508 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2509 MEASUREMENTS FOR PAYMENT

The earth work in construction of embankment for guide bund shall be measured in cubic metres unless otherwise specified.

The boulders/cement concrete block and boulder/block filled wire crates in apron shall be measured in cubic metres.

The filter and stone pitching shall be measured separately in cubic metres unless otherwise specified.

Rubble stone/cement concrete block flooring and cement concrete bedding shall be measured in cubic metres for each class of material.

Preparation of base for laying the flooring shall be deemed incidental to the work.

For laying apron, excavation upto an average depth of 150 mm shall be deemed to be included in the main item and shall not be measured separately unless otherwise specified. Excavation more than 150 mm shall be measured in cubic metres as per Section 300 of these Specifications.

If directed by the Engineer, the materials shall have to be stacked at site before laying and such stacking shall be considered incidental to the work.

2510 RATE

The contract unit rate for the construction of embankment for guide bund shall cover the cost of all materials including transportation, laying, compacting, all labour, tools, equipment, sampling and testing, supervision and all incidentals necessary for completing the work according to these Specifications.

The contract unit rate for apron shall include the cost of all material, labour, tools and plant for completing the work according to these Specifications. Excavation up to an average depth of 150 mm shall also be deemed to be included in the rate as dressing of the bed. Excavation beyond the depth of 150 mm shall be paid for separately unless otherwise specified

The contract unit rate for stone/cement concrete block pitching on slopes shall include the cost of preparing the bases, laying and compacting the filter and placing of stone pitching of dry rubble/cement concrete block revetment for embankment slopes to the specified thickness, lines, curves, slopes and levels and all labour and materials as well as tools and plant required for the work.

The contract unit rate for rubble stone/cement concrete block flooring shall include the cost of all material, labour and tools and plant for completing the work as per specifications for the relevant item.

Appendix 2500/I
(Refer Clause 2503.3.1.4)

Mechanically Woven Wire Crates for Gabions and Mattresses

1. Terminology

Double twisted wire mesh: a non-ravelling mesh made by twisting continuous pairs of wires through three one-half turns (commonly called double-twisted) to form hexagonal shaped openings which are then interconnected to adjacent wires to form hexagonal openings.

Gabion: a double-twisted wire mesh container of variable sizes, uniformly partitioned into internal cells, inter-connected with other similar units, and filled with stone at the project site to form flexible, permeable monolithic structures for earth retaining and erosion control projects (Fig. 1).

Revet Mattress: a double-twisted wire mesh container uniformly partitioned into internal cells with relatively smaller height in relation to other dimensions, having smaller mesh openings than the mesh used for gabions; revet mattresses are generally used for riverbank protection and channel linings (Fig. 2).

Selvage Wire: a terminal wire used to edge the wire mesh perpendicular to the double twist by mechanically wrapping the mesh wires around it at least 2.5 times (Fig. 3).

Edge Wire: a terminal wire of the same diameter as the selvage wire used to edge the wire mesh parallel to the double twist by continuously weaving it mechanically into the wire mesh (Fig. 3).

Lacing Wire: a galvanized wire or galvanized wire with PVC coating used to assemble and interconnect empty units, to close and secure stone-filled units, and for internal stiffeners (Fig. 4).

Diaphragm: an internal partition made of same double twisted wire mesh panel in a gabion/revet mattress that is attached to the bottom, the sides, and, after the gabion cage is packed with stones, to the lid of the cage (Fig. 1).

Bracing Wire: a length of galvanized wire or galvanized wire with PVC coating used for support of facing by connecting the front panel to the back panel of a gabion and having the same diameter as the lacing wire (Fig. 5).

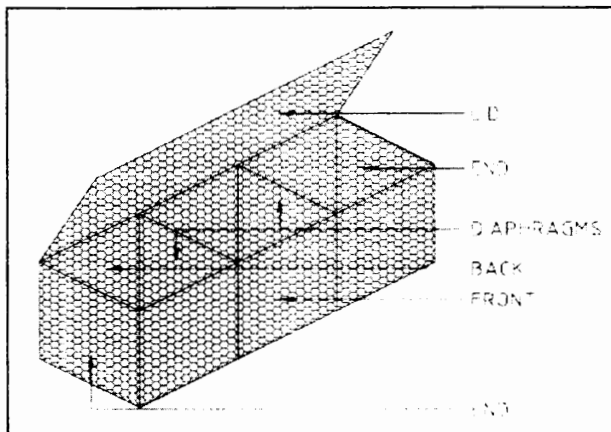


Fig. 1 Gabion Box

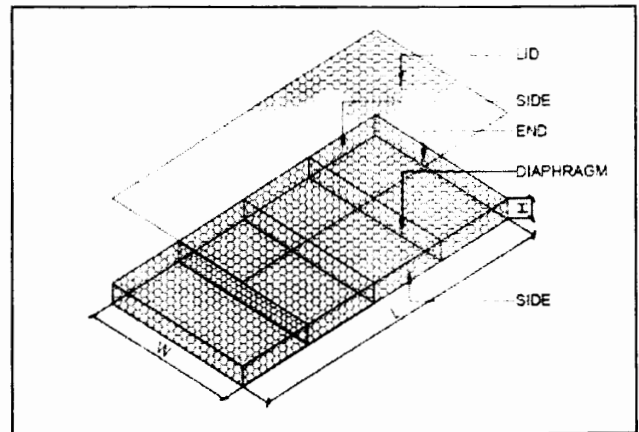


Fig. 2 Revet Mattress

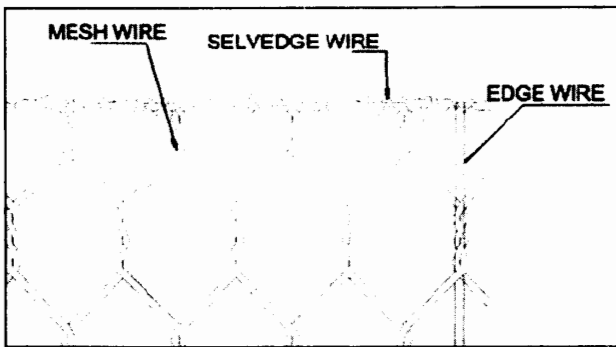


Fig. 3 Mesh Wire, Selvedge & Edge Wire

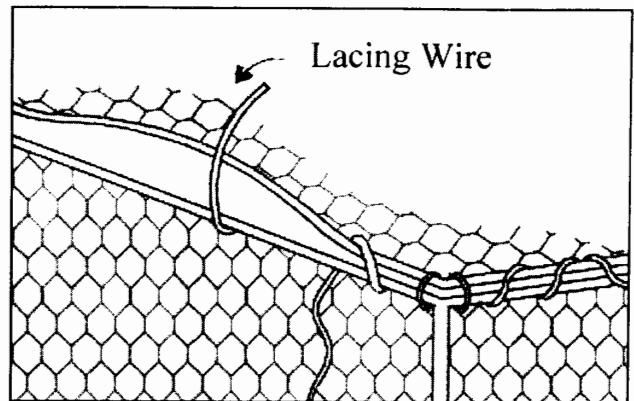


Fig. 4 Lacing Wire for Typing

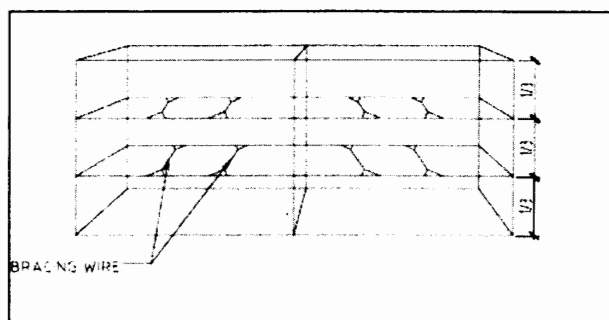


Fig. 5 Bracing Wire

2 Mechanical Properties

Minimum strength requirements of the mesh when tested in accordance with Para 5, shall be as shown in Table-2500/1.

Table-2500/1 : Minimum Strength Requirements of Mesh and Connections

Mesh Type	10 x 12			8 x 10		6 x 8	
	Zn	Zn	Zn+PVC	Zn	Zn+PVC	Zn	Zn+PVC
Mesh Wire Dia. (mm)	2.7	3.0	2.7	3.0	2.7	2.2	2.2
Parallel to twist (kN/m)	32.0	40.0	32.0	51.1	42.3	33.6	33.6
Perpendicular to twist (kN/m)	15.4	20.5	15.4	26.3	20.4	13.1	13.1
Connection to Selvedges	10.2	11.22	10.2	20.4	16.32	10.2	10.2
Panel to Panel Connection using lacing wire or fasteners	10.2	11.22	10.2	20.4	16.32	10.2	10.2
Punch Test	17.8	19.58	17.8	26.7	21.36	17.8	17.8

3 Physical Properties

3.1 Mass of Zinc Coating

The coating weights shall conform to the requirements of IS:4826 Heavily Coated and soft type. Refer Table-2500/2 for the minimum mass of zinc coating for different wire sizes.

Table-2500/2 : Minimum Mass of Zinc Coating

Nominal Diameter of Galvanized wire, mm	Mass of Zinc Coating, gms/m ²
2.00	240
2.20	240
2.40	260
2.70	260
3.00	270
3.40	270
3.90	280

3.2 Adhesion of Zinc Coating

The zinc coating shall remain adherent to the steel wire and conform to IS:4826 such that zinc coating does not flake off, nor crack to such an extent that there is possibility of removing any zinc by rubbing with bare fingers, the use of finger nails being not allowed.

3.3 PVC for Coating

The initial properties of PVC coating material shall have a demonstrated ability to conform to the following requirements

- i) Specific Gravity: In the range from 1.30 to 1.35 when tested in accordance with Test Method IS:13360:Part 3:Sec 1:1995/ISO 1183:1987.
- ii) Tensile Strength: Not less than 20.6 MPa when tested in accordance with Test Method IS:13360:Part 5:Sec 1:1996/ISO 527 1:1993.
- iii) Hardness : Shore "D" between 50 and 60, when tested in accordance with Test Method IS:13360:Part 5:Sec 11:1992/ISO 868.
- iv) Resistance of PVC coating to Sodium Chloride Solution: When PVC coated wire is tested in accordance with Para 5.4 , there shall be no loss of mass.

4. Number of Tests

- i) The tensile strength, galvanizing weight, and PVC coating thickness of the coated steel wire used in the fabrication of mesh, lacing wire and

stiffeners shall be certified by the steel wire/ PVC Coated steel wire producers for conformance to the requirements of Para 3 above.

- ii) A minimum of three tests each for conformance to strength of galvanized steel wire mesh parallel to twist and perpendicular to twist shall be performed. A retest for conformance with the aforementioned strength tests shall be required when changes of the physical characteristics of the mesh products occur. For galvanized steel wire with PVC coating, the same requirements as for the galvanized steel wire mesh shall be followed. The results of all three tests must meet the requirements of Table-2500/1.

5 Test Methods

5.1 Tensile Strength of Wire Mesh Panel

The wire mesh specimens shall be representative of proper field construction as to materials, mesh geometry, and workmanship, and shall be as large as practical to minimize the effect of variations. The tests shall be run with the load applied parallel to the axis of the twist and repeated on a separate test specimen with the load applied perpendicular to the axis of the twist.

Place the mesh into the machine grips such that the gripped mesh will be maintained in the mesh geometry characteristic of field use. The specimen of approximately 0.8 m width and 0.5 m height shall be tested. The effective width to be considered for test specimen shall be the distance between two extreme gripping points. The specimen should extend by at least one mesh repetition beyond the extreme gripping points on either side. However, specimen should not extend more than two mesh repetitions beyond extreme gripping points. The mesh shall be pre-loaded to 10 percent of the specified minimum strength and machine head travel stopped. The mesh gauge dimensions shall be recorded at this time and taken as the initial dimensions of the specimen where such dimensions are required. If the sample slips at any of the gripping point during the test, such a test shall be discarded and a new sample shall be taken. The loading shall then continue uniformly maintaining the displacement rate of 75 to 100 mm per minute, until first fracture or unwrapping of an individual wire in the system occurs. The distortion of the mesh or changes in gauge length shall be measured to accuracy consistent with reporting the percent elongation to the nearest 0.5 percent.

5.2 Punch Test

The punch test could be done using two different apparatus.

- i) **Pre-Tensioned Punch Test**

An uncut section of 1.82 m in length (unselvaged) and not less than 0.91 m in width shall have the ends securely clamped for 0.91 m along

the width of the sample. When the width of the section under test exceeds 0.91 m, the clamps shall be centered along the width and the excess width will be allowed to fall free on each side of the clamped section. The sample shall then be subjected to tension sufficient to cause 10 % elongation of the sample section between the clamps. After elongation and while clamped as described above (and otherwise unsupported), the section shall be subjected to a load over 960 cm² of area applied to the approximate center of the sample section between the clamps and in a direction perpendicular to the direction of the tension force.

ii) **Secured Punch Test**

An uncut section of 1.24 m in length and not less than 0.9 m in width (selvedged), including all selvedge bindings, shall have the sides and the ends securely clamped at every mesh opening to a rigid frame. After being secured as described above, the section shall be subjected to a load over 960 cm² applied to the approximate center of the sample section between the clamps and in a direction perpendicular to the direction of the tension force.

The sample shall withstand, without rupture of any strand or opening of any mesh fastening, an actual load applied by means of a circular ram at a uniform rate not to exceed 220 N/s equalling or exceeding the values shown in Table-2500/1. The ram head used in the test shall be circular with a 350 mm diameter and have its edges bevelled or rounded to prevent cutting of the wire strands.

iii) **Pull-Apart Resistance Test**

A set of two identical rectangular gabion panels, each with a width about $10\frac{1}{2}$ mesh openings along a selvedge wire, shall be joined by properly installed wire fasteners along the two selvedge wires so that each fastener confines two selvedge and two mesh wires. If the fasteners are also to be used to join two individual empty gabion baskets, two additional selvedge wires that are each mechanically wrapped with mesh wires shall be included so that each fastener confines four selvedge and four mesh wires. The set of the jointed panels shall be subject to pull-apart resistance test.

The specimen shall be mounted on a loading machine with grips or clamps such that the panels are uniformly secured along the full width. The grips or clamps shall be designed to only transmit tension forces. The load will then be applied at a uniform rate not to exceed 220 N/s until failure occurs. The failure is defined as when the maximum load is reached and a drop of strength is observed with subsequent loading or alternately the opening between any two closest selvedge wires, applicable to a fastener confining either two or four selvedge wires, becomes greater than 50 mm at any place along the panel width. The strength requirements of the jointed panels at failure shall be as shown in Table-2500/4.

5.2 Metallic Coating Weight

Coating weight tests and adhesion tests shall be performed as per IS:4826.

5.3 PVC Coating Thickness

- i) The thickness of the PVC coating shall be determined on a randomly chosen individual piece of wire removed from the mesh.
 - ii) Measure with a micrometer the diameter of the metallic coated steel wire with PVC coating. Determine the thickness of the PVC coating by stripping the PVC coating from the wire and measure the reduced diameter with a micrometer. The thickness of the coating is the difference between the diameter of the metallic coated steel wire with PVC coating and the measured diameter of the metallic coated steel wire divided by two. The average value should be in accordance with Tables 2500/2, and 2500/3 of Specifications for gabions andrevet mattresses respectively. When removing the PVC coating by stripping, care shall be taken not to remove any of the metallic surface.
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2600

EXPANSION JOINTS

2601 DESCRIPTION

The work shall consist of fabrication and installation of expansion joints. The filler joint, asphaltic plug joint, compression seal joint and reinforced elastomeric joint of slab seal, strip seal and box seal type shall conform to these Specifications.

2602 GENERAL

2602.1 The type of expansion joint proposed to be used shall conform to the design and got approved by the Engineer.

2602.2 Expansion joints shall be robust, durable, water-tight and easy for inspection, maintenance and replacement. Site fabricated expansion joints shall be prohibited. Expansion joints shall be procured from approved manufacturers and shall be of proven type.

2602.3 Alternative proprietary type deck joints proposed by the Contractor in lieu of the type specified shall comply in all respects with the manufacturer's specifications and meet the required range of movements and rotations and be fit for the purpose of ensuring satisfactory long term performance. For such proprietary type deck joints the following information shall be provided.

- i) Name and location of the proposed manufacturer.
- ii) Dimensions and general details of the joint including material specifications, holding down bolt or anchorage details and installation procedures.
- iii) Evidence of satisfactory performance under similar environmental conditions of similar joints being produced by the manufacturer.

Acceptance of any alternative type of expansion joint shall be at the sole discretion of the Engineer. Such deck joints shall be installed in accordance with the manufacturer's recommendations and to the requirements of these Specifications.

Vehicular traffic shall not be allowed over expansion joints after their installation for such period as may be determined by the Engineer.

2602.4 The expansion joint shall be provided to cover the entire carriageway, kerb and footpath, wherever provided. It shall follow the profile of the deck including the kerb, footway and fascia. The expansion joint for kerb, footway and fascia may be of different type and specification from that used for the carriageway and it shall cater to all movements and rotations for which the carriageway expansion joint is designed and shall be water tight.

2603 PERFORMANCE REQUIREMENTS

2603.1 The expansion joint proper and the transition zone (the zone of connection of joint assembly and the adjoining deck) shall satisfy the performance requirements specified herein. The expansion joint proper shall satisfy the performance requirements of both the bridge structure and the road users.

2603.2 Performance Requirements with Respect to Bridge Structure

The expansion joint shall:

- i) withstand the imposed loads including the impact load from live load and other sources,
- ii) allow expansion and contraction movement due to temperature, creep, shrinkage, pre-stressing and structural deformations,
- iii) permit relative rotation in elevation and plan due to the causes mentioned above,
- iv) be waterproof,
- v) be properly sealed,
- vi) ensure long life by being resistant to corrosion,
- vii) be easy to install,
- viii) be easy to maintain.
- ix) be easy to replace. and
- x) be resistant to the materials likely to collect/spill over the deck in its normal service.

2603.3 Performance Requirements with Respect to User

The expansion joint shall:

- i) provide smooth continuity at the top of the deck for riding comfort,
- ii) be skid resistant,
- iii) be non-damaging to rubber tyres,
- iv) make little or no noise during passage of vehicles,
- v) ensure that animal paws and hooves do not get entangled when used by animal drawn traffic,
- vi) permit passage of steel tyre of bullock carts without being damaged, and
- vii) look good aesthetically.

2603.4 Performance Requirements for Transition Zone

The expansion joint shall:

- i) permit transfer of generated forces to the deck without distress, i.e., without getting uprooted, and
- ii) ensure that surface in the transition zone stays undisturbed during long term service.

2604 FILLER JOINTS**2604.1 Components**

The components of this type of joint shall be corrugated copper plate at least 2 mm thick placed slightly below the wearing coat, 20 mm thick compressible fiber board to protect the edges, 20 mm thick pre-moulded joint filler filling the gap up to the top level of the wearing coat and sealant of suitable joint sealing compound.

2604.2 Material

- i) The material used for filling expansion joint shall be bitumen impregnated felt, elastomer or any other suitable material, as specified on the drawings. Impregnated felt shall conform to the requirements of IS:1838, and shall be got approved from the Engineer. The joint filler shall consist of large pieces. Assembly of small pieces to make up the required size shall be avoided.
- ii) Expansion joint materials shall be handled with care and stored under cover by the Contractor to prevent damage.
- iii) Any damage occurring after delivery shall be made good to the satisfaction of the Engineer and at the expense of the Contractor.

2604.3 Fabrication and Installation

- i) Joint gaps shall be constructed as shown on the drawings. Surfaces of joint grooves shall be thoroughly cleaned with a wire brush to remove all loose materials, dirt and debris, then washed or jetted out.
- ii) Pre-moulded expansion joint filler shall not be placed in position until immediately prior to the placing of the abutting material. If the two adjacent faces of the joint are to be installed at different times, the joint filler shall be placed only when the second face is ready to be kept in position
- iii) Sealants shall be installed in accordance with the manufacturer's recommendations.

- iv) Sealants shall be finished approximately 3 mm below the upper surfaces of the joint.
- v) Joint materials spilt or splashed onto finished surfaces of the bridge during joint filling operations shall be removed and the surfaces made good to the Engineer's approval.
- vi) No joint shall be sealed until inspected by the Engineer and approval is given to proceed with the work.

2605 REINFORCED ELASTOMERIC JOINT

2605.1 Components

Reinforced elastomeric expansion joint shall comprise of following components:

- i) **Steel Inserts** : The elastomeric slab units shall be fixed to the steel inserts properly anchored in the deck concrete. Fixing of elastomeric slab units with anchoring bolts directly embedded in deck concrete shall not be permitted. Steel inserts along with anchorage shall be fabricated at manufacturer's workshop and not at site.
- ii) **Anchorage** : The anchorage shall either be loop anchors connected to the inserts by anchor plate or sinusoidal anchor bars welded with the horizontal leg of the steel inserts. For loop anchors with anchor plate, the thickness of the anchor plate shall not be less than 12 mm. Diameter of anchor loops shall not be less than 16 mm and the spacing of anchors shall not be more than 250 mm. For sinusoidal anchors, diameter of bar shall not be less than 12 mm.
- iii) **Fixing Bolts** : Fixing bolts and nuts shall be made of stainless steel. Tightened nuts shall be locked by using lock washers.
- iv) **Elastomeric Plugs** : The plug holes provided in elastomeric slab units to house fixing bolts shall be plugged with elastomeric plugs pressed in position after applying adhesive on the surfaces.
- v) **Adhesives and Sealants** : Special sealant to be poured into the plug holes before plugging and special adhesive to be used for installation, shall be as per the recommendation of manufacturer.
- vi) Necessary spacer bars to ensure proper positioning of bolts and leveling and aligning steel inserts during fixing with deck as well as special jigs to be used to preset the elastomeric slab units, shall be provided by the manufacturer.

2605.2 Material

- i) Mild steel to be used for manufacture of steel reinforcing plates, inserts and anchorage shall comply with Grade B of IS:2062.
- ii) Cast steel to be used for manufacture of steel reinforcing plates shall comply with IS:1030.
- iii) The elastomer to be used for manufacture of elastomeric slab units shall comply with Clause 915.1 of IRC:83 (Part II), compounded to give hardness IRHD 60 ± 5 .

2605.3 Fabrication

- i) All surfaces of the steel inserts and anchorage including the surfaces to be in contact with or embedded in concrete shall be sand/shot blasted to SA 2½ and provided with a coat of epoxy primer enriched with metallic zinc. Surfaces not to be in contact with or embedded in concrete shall be provided with an additional coat of epoxy primer enriched with metallic zinc, one intermediate coat of high build epoxy paint reinforced with MIO (Micaceous Iron Oxide) and one coat of high performance epoxy finish paint as per manufacturer's specification with minimum total dry film thickness of 150 micron.
- ii) Elastomeric slab units shall be fully moulded to the required size in one single vulcanizing operation including the reinforcing plates and encasing layers as one integral and homogeneous unit. Edges of reinforcing steel sections shall be rounded. The elastomeric slab units shall be manufactured generally as per the stipulations laid down in Clause 917 of IRC: 83 (Part II). Adjoining portions of elastomeric slab units shall be provided with suitable male-female groove to ensure water tightness.
- iii) Permissible tolerances of fabrication shall be as follows:

Plan dimension	:	± 5 mm
Total height	:	± 3 mm

2605.4 Supply and Handling

- i) The Contractor shall supply all steel-reinforced elastomeric expansion joints including bolts, nuts, sealant, plugs and all other accessories for the effective installation of the joints including angled jointing sections for kerbs.
- ii) Expansion joint material shall be handled with care and stored under cover by the Contractor to prevent damage. Any damage occurring after delivery shall be made good at the expense of the Contractor to the satisfaction of the Engineer.

2606 SINGLE STRIP/BOX SEAL JOINT**2606.1 Components**

Strip seal expansion joint shall comprise the following:

- i) **Edge Beam** : This shall be either extruded or hot rolled steel section including continuously shop welded section with suitable profile to mechanically lock the sealing element in place throughout the normal movement cycle. Further, the configuration shall be such that the section has a minimum thickness of 10 mm all along its cross section (flange and web). Thickness of lips holding the seal shall not be less than 6 mm. The minimum height of the edge beam section shall be 80 mm. The minimum cross sectional area of the edge beam shall be 1500 mm².
- ii) **Anchorage** : The edge beams of single strip/box seal joints shall be anchored in the concrete with rigid loop anchorage. The anchor loops shall be connected to the edge beam by means of anchor plate welded to the edge beam. Total cross sectional area of anchor loop on each side of the joint shall not be less than 1600 mm² per metre length of the joint and the centre to centre spacing shall not exceed 250 mm. The thickness of anchor plate shall not be less than 0.7 times the diameter of anchor loop or 12 mm whichever is higher. The anchor loop at the edge profiles should be at right angles to the joint. Planned deviations of this direction are allowable only for the range of $90^\circ \pm 20^\circ$. The anchoring reinforcement of the construction must lie parallel to the anchor loops.
- iii) **Sealing Element** : This shall be a preformed/extruded single strip of such a shape as to promote self-removal of foreign material during normal joint operation. The seal shall possess high tear strength and be insensitive to oil, gasoline and ozone. It shall have high resistance to ageing. The specially designed proprietary type of locking system of seal in the housing of edge beam shall be such as to ensure 100% water tightness as well as ease of installation and replacement. Mechanical fastening of sealing element with edge beam shall not be permitted. Sealing element shall be continuous over the entire joint.

The working movement range of the sealing element shall be at least 80 mm with a maximum of 100 mm at right angles to the joint and ± 40 mm parallel to the joint.

Minimum gap for inserting the Chloroprene seals in the expansion joint shall be 25 mm.

2606.2 Material

- i) The steel for edge beams shall conform to any of the steel grade equivalent to RST 37-2 or 37-3 (DIN), S235JRG2 or S355K2G3 of EN10025 (DIN 17100), ASTM A 36 or A 588, CAN/CSA Standard G40.21 Grade 300 W and Grade B of IS:2062. For subzero condition, material for steel shall conform to IS:2062 Grade C.
- ii) The sealing element shall be made of Chloroprene Rubber (CR). The properties of CR shall be as specified in Table 2600-1.
- iii) Anchorage steel shall conform to Grade B of IS:2062 or equivalent standard.

Table 2600-1 : Properties of Chloroprene Seal

Property	Standard	Specific Value
Hardness	DIN 53505 ASTM D 2240 *	63 + 5 Shore A 55 + 5 Shore A
Tensile Strength	DIN 53504 ASTM D 412*	Min 11 MPa Min 13.8 MPa
Elongation at fracture	DIN 53504 ASTM D 412*	Min 350% Min 250%
Tear propagation strength longitudinal transverse	DIN 53507 ASTM D 624* (Dia C)	Min 10N/mm Min 10N/mm
Shock elasticity	DIN 53512	Min 25%
Abrasion	DIN 53516	Max 220 mm ³
Residual compression strain (22h/70°C/30% strain)	DIN 53517 ASTM D 395* (Method B)	Max 28%
Ageing in hot air (14 days/70°C) Change in hardness Change in tensile strength change in elongation at fracture	DIN 53508	Max + 7 Shore A Max - 20% Max - 20%
Ageing in ozone (24h/50pphm/25°C/20% strain)	DIN 53509	No cracks
Swelling behavior in oil (168h/25°C) ASTM oil No. 1 Volume Change Change in hardness ASTM oil No. 3 Volume Change Change in hardness	DIN 53521	Max + 5% Max - 10 Shore A Max + 25% Max - 20 Shore A
Cold hardening point	ASTM D 1043	Min -35°C

Note : * Only one specification viz., ASTM or DIN shall be followed depending on the source of supply.

2606.3 Fabrication (Pre-installation)

- i) Rolled steel profiles for edge beams shall be long enough to cater for the full carriageway width. These shall be cut to size as per actual requirements. Alignment of the steel profiles shall then be made on work tables in accordance with the actual bridge cross-section. For this purpose, the contour of bridge cross-section shall be sketched on the tables. After the steel profiles are aligned, these will be fixed to the tables by means of screw clamps and tacked by arc welding.
- ii) Anchor plates shall be cut to the required size by gas cutting. These shall be welded to the edge beams.
- iii) Anchor loops shall be bent to the required shape and welded to anchor plates.
- iv) All steel sections shall be protected against corrosion by either hot dip galvanizing with a minimum thickness of 150 micron or by epoxy coating.
- v) All surfaces of the steel inserts and anchorage including the surfaces to be in contact with or embedded in concrete shall be given treatment as mentioned in Clause 2605.3 (i).
- vi) The finally assembled joints shall then be clamped and transported to the work site.

2606.4 Handling and Storage

- i) For transportation and storage, auxiliary brackets shall be provided to hold the joint assembly together.
- ii) The manufacturer shall supply either directly to the Engineer or to the Contractor all the materials of strip seal joints including sealants and all other accessories for the effective installation of the joint.
- iii) Expansion joint material shall be handled with care. It shall be stored under cover on suitable wooden padding to prevent damage. Any damage occurring after delivery shall be made good at the cost of Contractor to the satisfaction of the Engineer

2607 MODULAR STRIP/BOX SEAL EXPANSION JOINTS**2607.1 Components**

A modular expansion joint shall consist of two or more modules/cells of individual capacity 80 mm to cater to a horizontal movement in excess of 80 mm. It shall allow movements in all three directions and rotation about all three axes as per the design requirements. The structural system shall consist of two edge beams, one or more central/separation beams or

lamellas and cross support bars supporting individuals or multiple central beams to transfer the loads to the bridge deck through the anchorage system.

- i) **Edge Beams and Central Beams/Lamella** : These shall be as per Clause 2606.1(i).
- ii) **Anchorage** : Anchorage of edge beam shall be as per Clause 2606.1 (ii). Studs and/or loop anchors with anchor plate may be used as anchorage of other components like joist box and covers of controlling system.
- iii) **Sealing Element** : This shall be as per Clause 2606.1 (iii). Minimum gap for inserting the neoprene seals in the expansion joint shall be 25 mm.
- iv) **Support and Control System** : The control system should allow closing and opening of the joint and also ensure that all modules open and close equally during all movement cycles of the joint. The overall support and control system shall be either single/multiple support bar control system or swivel joint system comprising of resilient/shock absorption components and elastic/sliding control system conforming to the specifications recommended by the manufacturer. The gap between the consecutive centre beams at the joint surface shall be limited to 80 mm when the joint opens fully due to maximum contraction of deck.

2607.2

Material

- i) The steel for edge beams, centre beam/lamella, transverse support bar and other steel components shall conform to any of the steel grade corresponding to RST 37-2 or 37-3 or 52-3 (DIN), S235JRG2 or S355K2G3 of EN10025 (DIN 17100), ASTM A36 or A588, CAN/CSA standard G40.21 Grade 300 W.
- ii) The sealing element shall be of Chloroprene Rubber (CR). The properties of CR shall be as specified in Table 2600-1.
- iii) The specification for all other materials shall be as per manufacturer's recommendation.

2607.3

Fabrication (Pre-installation)

- i) Profile of edge beam, centre beam/lamella shall be long enough to cater for full carriageway width.
- ii) The fabrication of all components of the joints including anchorage system and transportation of assembled joints shall be as per manufacturer's specification.

- iii) All steel sections shall be suitably protected against corrosion as stated in Clause 2606.3 (iv).
- iv) All surfaces of the steel inserts and anchorage including the surfaces to be in contact with or embedded in concrete shall be given treatment as mentioned in Clause 2605.3 (i).

2607.4 Handling and Storage

- i) Arrangement for transportation and storage shall be as per manufacturer's specification.
- ii) The manufacturer shall supply either directly to the Engineer or to the Contractor all the materials of strip seal joints including all sealants and other accessories for the effective installation of the joint.

2608 ASPHALTIC PLUG JOINT

2608.1 General

- i) This joint shall consist of a polymer modified bitumen binder, carefully selected single size aggregate, closure/bridging metallic plate and heat resistant foam caulking/backer rod
- ii) The joint shall be capable of performing satisfactorily, within the temperature (ambient) range of -5°C to +50°C.

2608.2 Material

- i) **Binder:** The polymer modified bitumen binder shall have the capacity to fill the gaps and voids between single size aggregates and to impart flexibility to accommodate various design movements. It shall be a patented blend of bitumen, synthetic polymer, filler and surface active agent and shall be so formulated as to combine necessary fluidity for the installation process, low temperature flexibility and flow resistance at high ambient temperature. The binder shall satisfy following requirement:

- Softening point : 100°C minimum
- Cone penetration at 25°C, 0.1 mm (BS:2499) : 100 mm max
- Flow resistance at 70°C, 5 hours (BS:2499) : 3 mm max
- Extension Test
5 cycle of extension to 50% (blocks prepared to ASTM D1190 at a rate of 3.2 mm/hour at and tested to limits BS:2499) : 25°C
- Safe heating temperature. : 210°C

- ii) **Aggregates** : The aggregate shall be of single size chosen from basalt granite, grit stone or gabro group. The nominal size of aggregate shall be 12.5 mm for joints up to 75 mm depth and 20 mm for joints of larger depth. The flakiness index shall not be more than 25 percent. The aggregate shall satisfy grading requirements stipulated in Table 2600-2.

Table 2600-2 : Grading Requirements of Aggregate

IS Sieve Designation	Nominal Size of Aggregate	
	20 mm	25 mm
	Percentage by Weight Passing the Sieve	
26.5 mm	100	-
19.9 mm	85 - 100	100
13.0 mm	0 - 35	85 - 100
9.5 mm	0 - 7	0 - 35
6.3 mm	-	0 - 7
2.3 mm	0 - 2	0 - 2
75 micron	0 - 1	0 - 1

The Polished Stone Value (PSV), Aggregate Abrasion Value (AAV), Aggregate Impact Value (AIV) and Aggregate Crush Value (ACV) shall be as below:

$$\text{PSV} > 60$$

$$\text{AAV} > 05$$

$$\text{AIV} < 18$$

$$\text{ACV} = 10-25$$

The surface characteristics should promote proper adhesion.

- iii) **Closure Plate** : The closure plate shall be weld able structural steel conforming to IS:2062. The minimum thickness of steel plate shall be 6 mm and the width shall not be less than 200 mm. Closure plate shall preferably be of single length but it shall not have more than 2 pieces per traffic lane width which shall be welded together to form the required length. It shall be provided with equidistant holes at a maximum spacing of 300 mm centers for anchorage to the caulking/backer rod along the longitudinal centre line of the plate. The plate shall be protected against corrosion by galvanizing or by any other approved anti-corrosive coating paint with a minimum thickness of 100 micron.

- iv) **Foam Caulking/Backer Rod:** The foam caulking shall be closed cell polyolefin or open cell polyurethane foam cylindrical type. The backer rod shall be of diameter equal to 150 percent of the joint opening. It shall be heat resistant and possess good flexibility and recovery characteristics with density of 25 kg/m³ to 30 kg/m³.

2609**COMPRESSION SEAL JOINT****2609.1****Components**

- i) Compression seal joint shall consist of steel armoured nosing at two edges of the joint gap suitably anchored to the deck concrete and a preformed chloroprene elastomer or closed cell foam joint sealer compressed and fixed into the joint gap with special adhesive binder.
- ii) **Steel Nosing :** The steel nosing shall be of angle section ISA 100 x 100. The thickness of legs shall not be less than 12 mm. The top face of the angle shall be provided with bleeder holes of 12 mm diameter spaced at maximum 100 mm centres so as to ensure that there are no voids in the concrete beneath the angle.
- iii) **Anchorage :** The steel nosing shall be anchored to the deck by headed shear studs or anchor plates cast in concrete or a combination of anchor loops. Anchor bars shall engage the main structural reinforcement of the deck and in case of anchor plates and anchor loops, transverse bars shall be passed through them. The minimum thickness of anchor plates shall be 12 mm. Total cross sectional area of bars on each side of the joint shall not be less than 1600 sq. mm per metre length of the joint and the centre to centre spacing shall not exceed 250 mm for loop anchors and 150 mm for headed shear studs. The ultimate resistance of each anchorage shall not be less than 600 in kN/m any direction. Steel shall conform to Grade B of IS:2062. For sub zero condition material for steel shall conform to IS:2062, Grade C.
- iv) **Joint Seal :** The sealing element shall be a preformed continuous chloroprene/closed cell foam seal with high tear strength, insensitive to oil, gasoline and ozone. It shall have high resistance to ageing and ensure water tightness. The seal should be continuous for the full length of the joint required for carriageway, kerbs and footpaths, if any. The seal shall cater for a horizontal movement upto 40 mm and vertical movement of 3 mm.

2609.2**Material**

- i) The steel for nosing and anchorage shall conform to weldable structural steel as per IS:2062 Grade B.
- ii) The physical properties of chloroprene/closed cell foam sealing element shall conform to the following:
 - a) **Chloroprene Seal** : Shall be preformed extruded multi-web cellular section of chloroprene of such a shape as to promote self removal of foreign material during normal service operations. Chloroprene of joint seal shall satisfy the properties stipulated in Table 2600-1.
 - b) **Closed Cell Foam Seal** : This shall be of preformed non-extruded non-cellular section made from low density closed cell, cross linked ethylene vinyl acetate, polyethylene copolymer that is physically blown using nitrogen. The material shall have properties as indicated in the Table 2600-3.

Table 2600-3 : Properties of Closed Cell Foam Seal

Property	Value
Density	41.7 - 51.3 kg/cum
Compression set on 25 mm (ASTM D 3575)	50 percent compression samples for 22 hours at 23°C, 2 hour recovery; 13 percent set.
Working temperature	-70°C to +70°C
Water absorption (total immersion for 3 months) (ASTM 3575)	0.09766 kg/sq.m
Tensile Strength	0.8 MPa
Elongation at break (ASTM D 3575)	195 ± 20 percent

- c) **Chemical Tests** : Chemical tests shall be performed on specimens of elastomer and the properties of elastomer shall conform to the values/standards indicated in Table 2600-4.

Table 2600-4 : Properties of Elastomer

Adhesion Strength	IS:3400 Part XIV	7kN/m
Low temperature stiffness	ASTM D 797	Young's modulus 70 N/mm ² (max)
Ash Content	IS:3400 Part XXII	5%
Polymer identification test (infrared spectro photometry)	ASTM D 3677	Comparison of spectra with reference to sample of polychloroprene

- iii) **Lubricant cum Adhesive** : The type and application of material used in bonding the preformed joint seal to the steel nosing and concrete shall be as recommended by the manufacturer/supplier of the seal system.
- iv) **Corrosion Protection** : All steel sections shall be suitably protected against corrosion as stated in Clause 2606.3 (iv).

2610**INSTALLATION OF EXPANSION JOINTS****2610.1****General Procedure**

- i) Expansion Joints shall be installed under close supervision of the manufacturer's/supplier's engineer in order to ensure the quality of installation and its function as intended during the entire life span. Detailed Installation Manual shall be supplied by the manufacturer/supplier.
- ii) The dimensions of the recess in the deck shall be established in accordance with the drawings or design data of the manufacturer, taking into account the width of gap for movement of the joint.
- iii) The pre-setting of expansion joint shall be done by means of an auxiliary construction.
- iv) The road surfacing/wearing coat shall be laid before commencing installation of joint. Before laying wearing coat, the recess portion shall be filled with sand and wearing coat shall be laid in a continuous manner over the deck slabs and recess portion. Prior to installation of the joints, portion of wearing coat over the recess shall be removed by a suitable method e.g. saw cutting and the infill sand shall also be removed.
- v) **Preparation of the Recess** : The size and form of recess shall suit the geometry of the expansion joint. However, the width shall not be less than the specified value for a particular type of joint. In order to avoid difficulties during installation, the following points must be checked and considered:
 - a) Dimension of recess
 - b) Levels
 - c) Skew and slope
 - d) Designed gap between bridge deck and abutment and/or between adjoining decks
 - e) Existing structural reinforcement according to the drawings

Reinforcing bars that would obstruct the installation of expansion joint shall be bent to accommodate the expansion joint anchorages. Cutting off or removal of interfering reinforcing bars shall only be done after consultation with the Engineer.

The recess shall be cleaned thoroughly. If necessary, the surface should be roughened. All loose dirt and debris shall be removed by wire brushing, air blowing and dried with hot compressed air.

- vi) **Shuttering** : Shuttering must be used to seal the space between the underside of the joint and the vertical face of the recess. The shuttering must be fitted in such a way that it forms an appropriate seal against the edge of the recess. The recess shall be shuttered in such a way that dimensions shown on the drawing are maintained. The formwork shall be rigid and firm.
- vii) **Placing in the Recess** : Level marks shall be set next to the recess. This enables a controlled leveling of the expansion joint. Lowering the expansion joint/joint construction/insert into the recess shall be done in such a way that the entire length of the joint is evenly lowered into the recess. Thereafter, the joint/joint construction/insert is precisely leveled and adjusted in the longitudinal, transverse and vertical planes. If required, the joint must also be adjusted to the gradient of the final surface level.
- viii) **Connection**
 - a) The expansion joint/joint construction/insert shall be installed preferably in the early morning when the temperature is distributed almost uniformly over the whole bridge. Immediately before the installation, the actual temperature of the bridge shall be measured. If it is not within the considered tolerance, the preset adjustment shall be corrected. The joint/joint construction/insert shall be lowered in a predetermined position. Following placement of the joint/joint construction/insert in the prepared recess, the joint/joint construction/insert shall be leveled and finally aligned and the anchorage steel on one side of the joint welded to the exposed reinforcement bars of the structure. Upon completion, the same procedure shall be followed for the other side. With the expansion joint/joint construction/ insert finally held at both sides, the auxiliary brackets shall be released, allowing it to take up the movement of the structure. After carrying out the final fixing, the protection against corrosion shall be completed.
 - b) For fully assembled joints with one end fixed and other end movable e.g. modular strip/box seal joint, connection shall be as detailed below:

The 1st side : The fixed side of the assembled joint (either the abutment or the bridge deck side) is designated the 1st side for connecting the joint. The preliminary fixing is made by evenly placing and welding of reinforcing bars over the entire length between the anchor loops and the

deck reinforcement. To facilitate concreting, the gap between recess and shuttering is sealed by a grout seam. The seam must be left to dry prior to final concreting. After this, additional reinforcing bars are welded until all anchor loops are firmly connected to the deck reinforcement. The expansion joint shall be considered sufficiently fixed when no vibration is noted when it is lightly tapped. The expansion joint shall not be subjected to any loads that could in any way displace the precise location of this fixing.

The 2nd side : Depending on the size of the expansion joint and the expected movement during installation, the most suitable time must be determined for fixing of the 2nd (moveable) side. Usually this is the early morning hours with the smallest temperature deviations. The procedure is identical to that for the 1st side. The joint shall be provisionally fixed to the reinforcement as fast as possible.

Immediately afterwards, the fixation brackets shall be removed. Thereafter, the gap between recess and shuttering shall be sealed with grout seam and the remaining reinforcing bars welded as described previously.

ix) **Concreting**

- a) Prior to final concreting, the position of the joint/joint construction/insert must be recorded. The Engineer must give written confirmation of the correct position of the joint and recess concreting. The recess shall be thoroughly watered. Before pouring the concrete the joint construction should be protected by a cover. Controlled concrete having strength not less than that in superstructure subject to a minimum of M35, shall be filled into the recess. The water cement ratio shall not be more than 0.4. If necessary, admixtures may be used to improve workability. The concrete must exhibit low shrinkage. The freshly placed concrete shall be properly vibrated. Damage to the shuttering shall be avoided during vibration. The concrete shall be finished flush with the carriageway surfacing. The concrete shall be kept damp until it has cured in order to avoid fissures caused by drying too fast. After the concrete has cured, the movable installation brackets and shuttering still in place shall be removed.
 - b) For modular strip seal joint the space beneath the joint boxes shall be completely filled with concrete. So that traffic loads are safely transmitted into the structure.
- x) As soon as the concrete in the recess has become initially set, a sturdy ramp shall be placed over the joint to protect it from traffic at site.

Expansion joint shall not be exposed to traffic loading before completion of carriageway surfacing.

- xi) The elastomeric sealing element may be field installed. For strip seal and modular strip seal joints the sealing element shall be in continuous lengths spanning the full carriageway width. Proper fit of the seal of the sealing element must be ensured. The seal shall be installed by suitable methods in such a way that it is not damaged.

2610.2**Specific Procedure for Asphaltic Plug Joint**

- i) The recess in the deck slab, if required, shall be repaired with epoxy mortar and cleaned and dried again.
- ii) The foam caulking/backing rod shall be placed about 25 mm down into the joint opening.
- iii) The aggregate shall be washed, cleaned and heated to a temperature between 120°C and 180°C prior to placement.
- iv) The binder shall be preheated to temperature of 170°C to 190°C before application.
- v) While sealing the joint opening with preheated binder, care shall be taken that the binder does not spill on to the surface of the deck.
- vi) The joint shall not be installed when the ambient temperature goes below 5°C or above 35°C or while it is raining/ snowing. Planning for installation shall take into account the weather condition.
- vii) When work is resumed after stoppage due to weather condition, the joint installation shall be continued after the upper layer and/or exposed surface of the partially completed joint has been prepared by heating and/or coating with binder as necessary.
- viii) The joint shall be provided over the entire width of the structure including kerb and/or footpath. A recess in the kerb and/or footpath shall be made to allow the joint to pass beneath them. The expansion gap in the adjoining kerbs and/or footpaths shall be sealed with a suitable sealant such as polysulphide sealant.
- ix) The joint shall extend to the full depth of the wearing course down to structural concrete. Where needed, a recess may be cut into the deck slab concrete to accommodate the minimum required depth (75 mm) of the joints.
- x) The minimum width (in traffic direction) of the joint shall be 500 mm and maximum width shall be 750 mm.
- xi) Minimum depth of joint shall be 75 mm and maximum depth shall not exceed 100 mm.

2610.3 Specific Procedure for Compression Seal Joint

- i) The dimension of the joint recess and the width of the gap shall conform to the approved drawing.
- ii) Anchoring steel shall be welded to the main reinforcement in the deck maintaining the level and alignment of the joint.
- iii) The width of the recess shall not be less than 300 mm on either side of the joint. Care shall also be taken to ensure efficient bonding between already cast/existing deck concrete and the concrete in the joint recess.
- iv) At the time of installation, joint shall be clean and dry and free from spalls and irregularities, which might impair a proper joint seal.
- v) The lubricant cum adhesive shall be applied to both faces of the joint and joint seal prior to installation in accordance with the manufacturer's instructions.
- vi) The joint seal shall be compressed to the specified thickness for the rated joint opening and ambient temperature at the time of installation which shall be between 5°C and 35°C.
- vii) The joint seal shall be installed without damage to the seal. Loose fitting or open joints shall not be permitted.

2610.4 Specific Procedure for Single Strip/Box Seal Joint

- i) The width of the gap to cater for movement due to thermal effect, pre-stress, shrinkage and creep, superstructure deformations (if any) and substructure deformations (if any) shall be determined and intimated to the manufacturer. Depending upon the temperature at which the joint is likely to be installed, the gap dimension shall be preset.
- ii) Immediately prior to placing the joint, the pre-setting shall be inspected. In case the actual temperature of the structure is different from that taken for pre-setting, suitable correction shall be done. After adjustment, the brackets shall be tightened again.
- iii) Rolled up neoprene strip seal shall be cut to the required length and inserted between the edge beams by using a crow bar pushing the bulb of the seal into the steel grooves of the edge beams.
- iv) The carriageway surfacing shall be finished flush with the top of the steel sections. The actual junction of the surfacing/wearing coat with the steel edge section shall be formed by a wedge shaped joint with a sealing compound. The horizontal leg of the edge beam shall be cleaned beforehand. It is particularly important to ensure thorough and

careful compaction of the surfacing in order to prevent any premature depression forming in it.

2610.5 Specific procedure for Modular Strip/Box Seal Joint

- i) The procedure given Clause 2610.4 (i) and (ii) applies to modular strip/box seal joint also.
- ii) To ensure proper fit of the seal, dirt, spatter or standing water shall be removed from the steel cavity using a brush, scraper or compressed air.
- iii) The actual junction of the surfacing/wearing coat with the block out concrete/steel edge section shall be cleaned beforehand. It is particularly important to ensure thorough and careful compaction of the surfacing in order to prevent any premature depression forming in it.

2610.6 Specific Procedure for Reinforced Elastomeric Joint

Expansion joints shall be installed as per approved drawing. The procedure for installation of various components shall be as follows:

- i) **Steel Inserts**
 - a) Deck casting shall be done leaving pockets or recesses for steel inserts and anchors of the expansion joint as per drawing.
 - b) Steel inserts shall be lowered at the appropriate location inside the pocket.
 - c) The top of the insert shall be flush with the finished level of wearing course maintaining the camber.
 - d) Spacer bars, duly set appropriately to the month of installation, shall be fitted under proper supervision.
 - e) Anchor rods shall be tied/welded with the existing deck main reinforcement, maintaining level and alignment.
 - f) Welding between anchor rods and deck reinforcement is preferable. If welding is not possible, strong steel tie wires shall be used for fastening under proper supervision.
- ii) **Spacer Bar**
 - a) Spacer bars shall be used to ensure proper positioning of bolts and also leveling of the steel inserts during fixing of the same with the deck reinforcement and casting second stage concreting in the pocket thereafter.
 - b) The 2nd stage concreting operation shall preferably be started within 24 hours of fixing the steel inserts. In such cases, spacer

bars should be removed just after concreting is finished. If there is a substantial time lag between fixing of inserts and concreting, then any one of the following methods shall be adopted, depending on the support condition:

For simply supported bridge resting on simple elastomeric bearings, (with no dowel pins), insert shall be placed in position with spacer bars at every alternate joints. Such joints shall be called restrained joints hereafter. In other words, inserts shall not be fixed simultaneously at two ends of one span. If the above condition is satisfied, inserts with spacer bars shall be kept in position for a substantially longer period at such restrained joints. Spacer bars shall be removed after concreting of such restrained joints and inserts placed in position with spacer bars at the other unrestrained joints thereafter.

For bridges resting on other than elastomeric bearings (including bearings with dowel pins at one end), after placing and aligning the inserts and securing the same, the spacer bars shall be removed. Concreting shall be done with great care so that inserts are not dislocated or distorted.

- c) While removing the spacer bar after concreting, one must take care to see that the concrete is not damaged during withdrawal of spacer bar. If the spacer bar happens to be snugly fitted, it shall not be pulled by any means; it shall be gas cut in two pieces and then removed.

iii) **Concreting of Pocket**

- a) Concreting of pocket shall be done with great care using proper mix conforming to grade similar to that of the deck casting besides ensuring efficient bonding between deck and steel insert. Also proper care shall be given for ensuring efficient bonding with the already cast concrete. Requirement of concrete as per Clause 2610.9.1 shall be followed.
- b) Needle vibrators shall be used. Care shall be taken so that the position of steel insert is not disturbed during vibration.
- c) Spacer bar shall be removed within an appropriate time before the joint is required to permit movement.

iv) **Fixing of Elastomeric Slab Unit (ESU)**

- a) Special jig shall be used to preset the ESU during installation
- b) ESU (mounted on the jig, if preset) shall be lowered to position.

- c) The line and level on the ESU should be adjusted.
 - d) ESU shall be removed and coated with special adhesive
 - e) ESU shall be placed in position again, ensuring waterproof joining at required faces.
 - f) ESU shall be tightened with stainless steel nuts and lock washers in position. Tightened nuts shall be locked with lock washers.
 - g) Special sealant shall be poured inside the plug holes.
 - h) The elastomeric plugs shall be pressed in position after applying adhesive on the appropriate surface.
 - i) ESU shall be fitted in position after completion of wearing course. While completing this part of the wearing course, adequate care shall be taken to ensure a waterproof joining with the already existing wearing course.
- v) **Pre-setting**
- a) The main purpose of pre-setting of the steel inserts at the time of its installation is to ensure as closely as possible the condition that in the long run at the mean average annual temperature, the ESU remains at its nominal state.
- The steel insert unit of expansion joint can be fixed in any month of the year. The expansion gap between bridge super structures may vary from time to time; hence the initial fixing distance between fixing points will obviously depend on the month of installation of steel insert. The c/c distance between stainless steel fixing of bolts as indicated in the drawing can be taken as only nominal. The same shall be modified by pre-setting depending on:
- The difference between the mean temperature of the month of fixing of steel insert and the annual average temperature, and
 - The elapsed period between the casting and/or pre-stressing and fixing of steel insert for calculating the remnant creep and shrinkage.
- vi) **Special Requirements for Installation**
- a) The supplier shall provide detailed working drawings showing the location of all bolts, recesses and holes necessary for the installation of the joint shall be obtained from the supplier before construction of bridge deck area adjacent to the joint. If required detailing of reinforcing bars in superstructure shall be modified to ensure that there will be no interference in the installation of the joint.

- b) All bearing surfaces and recesses which are in contact with the joint assembly shall be checked with a straight edge to ensure flatness of profile.
- c) No holes shall be drilled for fixing bolts within 7 days of concreting. Holes for the bolts shall be drilled to the size and depth shown on the drawings.
- d) Sections of the jointing making the completed joint shall follow a straight line.
- e) The fixing bolts shall not be placed in a position until at least 4 weeks after stressing is completed in post-tensioned box or beam and slab structures. Prior to placing sections of jointing, contact surfaces shall be cleaned to remove all grease, tar, paint, oil, mud or any other foreign material that may affect adhesion of the sealant.
- f) Sealant shall only be applied to dry contact surfaces. Sufficient quantity shall be applied to the contact surfaces so that sealant is extruded when the jointing is fixed in position.
- g) Final sealing of the finished expansion joint shall be completed immediately after installation. All exposed ends, joints between units, other areas of possible leakage, voids between the sides of the jointing and concrete or plates, shall be filled with sealant.
- h) Bolt cavities shall be cleaned and plugged with neoprene cavity plugs. Prior to placing the plugs sufficient sealant shall be placed in the cavities to cause extrusion of the sealant by the plugs.
- i) All excess sealant shall be removed from the jointing and adjacent areas.

2611 Procedure for installation of various joints, shall also take into account suppliers own specific procedures for installation of each type of joint as the suppliers shall be responsible for performance of the joints for the period of guarantee.

2612 TESTING AND ACCEPTANCE STANDARDS

2612.1 Before installing joints in a bridge, sufficient evidence of the reliability of the proprietary products shall be furnished. A copy of the fatigue and wear test reports, as applicable depending upon the type of joint, carried out by a recognized laboratory/university/institute on the joint components as a part of product development test, shall be furnished once for the entire lot of supply. The tests covered in Clauses 2612.1. (i) to 2612.1. (vi) need not be carried out on the materials of the joints of supply lot but shall be carried out from time to time by the original manufacturer as per their product development and quality plan for the

same type of joints to ensure the performance requirement of the particular joint component against fatigue and/or wear.

- i) For single strip seal and modular strip seal joints, the manufacturer shall produce complete report of the test of anchorage system from a recognized laboratory to determine optimum configuration of anchorage assembly under dynamic loading in support of the efficacy of the anchorage system adopted for the entire lot of joints.
- ii) For modular strip seal joints the manufacturer shall produce a test report from a recognized laboratory that the sliding bearings (suspension system) have been fatigue tested for six million load cycles with a frequency of 5 Hz and the loads of 80 kN, 120 kN and 160 kN.
- iii) For modular strip seal joints the manufacturer shall produce a test report from a recognized laboratory that the wearing of sliding interface of bearings of modular joints has been tested for a total sliding distance of 5000 m at a load of 48 kN.
- iv) For modular strip seal joints the manufacturer shall also produce a test report from a recognized laboratory that the sliding material of sliding springs of expansion joints has been tested for a total sliding distance of 20,000 m with a load equivalent to a stress of 30 MPa.
- v) For modular strip seal joints the manufacturer shall also produce a test report from a recognised laboratory that the butt-welded splicing of centre beams has been tested with two million load cycles with a load equivalent to a stress of 165 MPa.
- vi) In case of reinforced elastomeric joints abrasion resistance test shall be carried out in accordance with IS:3400 (Part 3) or DIN 53516.

2612.2 Pre-installation Criteria

The pre-installation criteria shall include the routine tests and acceptance tests as described below:

2612.2.1 Routine Tests

Routine tests including tests for materials conforming to specifications shall be carried out by the original manufacturer i.e., in case of imported joints, by the foreign manufacturer as part of their quality control procedure for all joints to be supplied by them. Detailed documentation of all the tests and inspection data as per complete quality control procedure shall be supplied by the original manufacturer in the form of Quality Control Report. Routine tests shall include:

Raw materials inspection,

Process inspection, and

Complete dimensional check as per approved drawings.

- i) **Raw Material Inspection** : Test on all raw materials used for the manufacturing of joints as per relevant material standard based on these Specifications shall be carried out by the manufacturer.
 - a) **Confirmation of the Grade of Steel** : Grade of the steel for the edge beam shall be confirmed by conducting tests for yield stress, tensile strength and elongation. Corresponding to RS7 37-2 or 37-3 or 52-3 (DIN), S235 JRG2 or S355K2G3 of EN10025 (DIN 17100), ASTM A36 or A 588, CAN/CSA standard G 40.21 grade 300 W or equivalent to Grade B of IS: 2062. The manufacturers/suppliers shall have in-house testing facilities for conducting these tests.
 - b) Tests for steel for the anchorage shall conform to IS:2062.
 - c) The tests as indicated in Table 2600-1 shall be made for checking the following properties of the chloroprene seal: (a) hardness, (b) tensile strength, (c) elongation at fracture, (d) tear propagation strength, (e) residual compressive strain, (f) change in hardness, (g) change in tensile strength, (h) change in elongation at fracture, (i) ageing in ozone, and (j) swelling behaviour in oil. The manufacturers/suppliers shall have in-house testing facilities for conducting these tests.
- ii) **Process Inspection** : Process inspection including inspection of all manufacturing processes adopted to manufacture the joints e.g., welding, corrosion protection, clamping, pre-setting, greasing, bonding by adhesives and riveting, as appropriate, shall be carried out by the manufacturer.
- iii) **Complete Dimensional Check** : Complete dimensional check of all components of joint as well as the assembled joint with respect to the approved drawings and tolerances as per these Specifications, shall be carried out by the manufacturer.

2612.3 Acceptance Tests

2612.3.1 In addition to the tests specified under Clause 2612.1, the manufacturer as well as the local supplier in case of imported joints shall have complete in-house testing facilities for the following tests. The Engineer shall insist upon these tests before acceptance of the joint.

- i) **Cyclic Motion** : Cyclic motion test may be carried out once on one complete joint assembly or one meter sample piece selected at

random from the entire lot of supply for each type of joint irrespective of movement capacity. The test sample shall be subjected to 5000 expansion and contraction cycles at minimum 30 cycles per hour. The test movement shall be 10 percent more than the design expansion/contraction movement. Any sign of distress or permanent set of any component or the assembly due to fatigue, will lead to rejection of entire lot of supply.

- ii) **Ponding** : Prior to acceptance, 25 percent of the completed and installed joints, subject to a minimum of one joint, shall be subjected to water tightness test. Water shall be continuously ponded along the entire length for a minimum period of 4 hours for a depth of 25 mm above the highest point of deck. The width of ponding shall be at least 50 mm beyond the anchorage block of the joint on either side. The depth of water shall not fall below 25 mm anytime during the test. A close inspection of the underside of the joint shall not reveal any leakage.
- iii) **Debris Expelling Test** : Debris expelling test shall be carried out on one metre sample piece selected at random from the entire lot of supply. The fully open gap shall be filled flush with granular debris and cycled 25 times for full opening and closing. The mass of debris repelled after 25 cycles shall be expressed as the percentage of initial mass. The percentage expelled shall not be less than 75.
- iv) **Pull-out Test** : Pull-out test shall be carried out on one meter sample piece selected at random from the entire lot of supply. The joint shall then be stretched until the sealing element slips off from its housing. The minimum stretching of the joint before slip-off shall be least 150 percent of the rated movement capacity of the seal.
- v) **Vehicular Braking/Traction Test** : This is the only initial acceptance (in-house) test. This test may be carried out once on one complete joint assembly or one metre sample piece selected at random from the entire lot of supply for each type of Joint irrespective of movement capacity. The test sample shall be installed between two blocks of concrete in its mean position. A truck wheel load of 40 kN shall be drawn across the specimen with an engaged ratchet with wheel locked to stimulate locked brakes and then rolled back. The cycle shall be repeated for 50,000 times with a period of 2 seconds. Continuous water cooling will be necessary to control excessive heat generated during the test.
- vi) **Erosion Protection Test** : Adequacy of the treatment for protection of steel sections against corrosion should be checked.

2612.3.2 Applicability of Acceptance Tests on Different Types of Joints

The acceptance tests described in Clause 2612.2.1 shall be applicable as per Table 2600-5 for different types of joints.

Table 2600-5 : Applicability of Acceptance Tests on Different Types of Joints

Performance Evaluation Tests	Asphaltic Plug Joint	Compression Seal Joint	Reinforced Elastomeric Joint	Single Gap Strip/Box Seal Joint	Modular Strip/Box Seal Joint
Cyclic motion	Not Applicable	Applicable	Applicable	Applicable	Applicable
Ponding	Not Applicable	Applicable	Applicable	Applicable	Applicable*
Debris expelling test	Not Applicable	Applicable	Applicable	Applicable	Applicable*
Pull-out test	Not Applicable	Not Applicable	Not Applicable	Applicable	Applicable*
Vehicular braking/traction test	Not Applicable	Not Applicable	Applicable	Applicable	Applicable*

* For modular strip seal expansion joint ponding test, debris expelling test, pull-out test and vehicular braking/traction test shall be carried out on one metre edge beam samples only, complete with sealing element and anchorage, to be supplied by manufacturer.

Note: For all expansion joints which are proprietary a minimum guarantee of 10 years for their satisfactory performance shall be given by the contractor.

2613 TESTS AND STANDARDS OF ACCEPTANCE

The materials shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2614 MEASUREMENTS FOR PAYMENT

The expansion joint shall be measured in running metres.

2615 RATE

In the case of supply and installation contract, the contract unit rate shall include the cost of all material, labour, equipment and other incidental charges for procuring and fixing the joints complete in all respects as per these Specifications. For filler joints, the rate per running metre shall include the cost of sealant for the depth provided in the drawing.

In the case of supply contract, the contract unit rate shall include cost of all components of expansion joint including anchorage system, pre-installation fabrication, transportation of assembled joints, handling and other incidental charges.

In the case of installation only contract, the contract unit rate shall include the cost of all material, labour, equipment and other incidental charges for installation of the joints complete in all respects as per these Specifications.

2700

**WEARING COAT AND
APPURTENANCES**

2701 DESCRIPTION

The work shall include wearing coat and bridge appurtenances such as railing, crash barrier, approach slab, drainage spout and weep holes. The work shall be executed in conformity with details shown on the drawings and these specifications or as approved by the Engineer.

2702 WEARING COAT**2702.1 Bituminous Wearing Coat**

Bituminous wearing coat shall comprise of following types:

- Type 1: Bituminous Concrete 50 mm thick laid in single layer
- Type 2: Bituminous Concrete 40 mm thick overlaid with 25 mm thick mastic asphalt
- Type 3: Stone Matrix Asphalt 50 mm thick laid in single layer
- Type 4: Mastic Asphalt 50 mm thick laid in single layer

Before laying wearing coat the deck surface shall be thoroughly cleaned and tack coat shall be applied. The construction operations and bituminous mixes and tack coat shall conform to Section 500 of these Specifications.

2702.2 Cement Concrete Wearing Coat

Cement concrete wearing coat shall be laid separately over the bridge deck. The thickness of wearing coat shall be 75 mm. The concrete shall be of minimum M30 grade. Steel reinforcement of 8 mm diameter at 150 mm spacing in both directions shall be provided at the mid depth of the wearing coat. In a length of 1 m near the expansion joint additional reinforcement of 8 mm diameter bars shall be provided in both directions to make the spacing as 75 mm.

Cement concrete and steel reinforcement shall conform to Section 1700 and Section 1600 respectively of these Specifications.

Curing of wearing coat shall start as early as possible.

All carriageway and footpath surfaces shall have non-skid characteristics.

2702.3 The cross slope in the deck shall be kept as 2.5 percent.

2702.4 For the structures with flat deck surface, camber/super elevation in the wearing coat shall be achieved as below:

- i) In bituminous wearing coat provide profile making course before laying wearing coat. The profile making course shall be of the same material as of wearing coat. The thickness of wearing coat at any point shall not be less than that given in Clause 2702.1 of these Specifications.

- ii) In case of cement concrete wearing coat provide profile corrective course along with wearing coat in single layer.

2702.5 Overlay on the existing wearing coat on bridge decks shall not be permitted. In case the wearing coat is damaged, it shall be repaired or replaced. The dismantling of wearing coat shall be as per Section 2800 of these Specifications.

2703 RAILING AND CRASH BARRIER

2703.1 General

- a) Bridge railing/crash barrier includes the portion of the structure erected on and above the kerb.
- b) Railing/crash barrier shall not be constructed until the centering false work for the span has been released and the span is self-supporting.
- c) For concrete with steel reinforcement, specifications for the items of controlled concrete and reinforcement mentioned under relevant Sections of these Specifications shall be applicable.
- d) The railing/crash barrier shall be carefully erected true to line and grade. Posts shall be vertical with a tolerance not exceeding 6 mm in 3 m. The pockets left for posts shall be filled with non-shrink mortar.
- e) The type of railing/crash barrier to be constructed shall be as shown on the drawings and shall conform to IRC:5 and IRC:6.
- f) Care shall be exercised in assembling expansion joints in the railing/crash barrier to ensure that they function properly.
- g) The railing/crash barrier shall be of such design as to be amenable to quick repairs.
- h) The material of metal railing/crash barrier shall be handled and stored with care, so that it remains clean and free from damage. Railing/crash barrier materials shall be stored above the ground on platforms, skids, or other supports and kept free from grease, dirt and other contaminants.

Any material which is lost, stolen or damaged after delivery shall be replaced or repaired by the Contractor. Methods of repairs shall be such that they do not damage the material or protective coating.

2703.2 Metal Railing/Crash Barrier

Materials, fabrication, transportation, erection and painting for bridge railing/crash barrier shall conform to the requirements of Section 1900 of these Specifications.

All steel railing elements, pipe terminal Sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanised or painted with an approved paint.

If galvanised, all elements of the railing/crash barrier shall be free from abrasions, rough or sharp edges, and shall not be kinked, twisted or bent. If straightening is necessary, it shall be done as per method approved by the Engineer.

Damaged galvanised surfaces, edges of holes and ends of steel railing/crash barrier cut after galvanising shall be cleaned and re-galvanised.

The railing/crash barrier shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout its length. Holes for field connections shall be drilled with the railing/crash barrier in place in the structure at proper grade and alignment.

Unless otherwise specified on the drawings, metal railing/crash barrier shall be given one shop coat of paint and three coats of paint after erection, if sections are not galvanised.

Railing/crash barrier shall follow the alignment of the deck. Where required as per the drawings, the rail elements shall be before erection.

2703.3 Cast In-Situ Concrete Railing/Crash Barrier

The portion of the railing/crash barrier or parapet which is to be cast in-situ shall be constructed in accordance with the requirements for Structural Concrete Section and reinforcement conforming to Sections 1600 and 1700 of these Specifications.

Forms shall be fabricated conforming to the shape of railing/crash barrier shown on the drawings. It shall be ensured that no form joint appears on plane surfaces. For bridges/viaducts of length more than 500 m horizontal slip forms shall be used for casting of crash barriers.

All mouldings, panel work and bevel strips shall be constructed according to the details shown on the drawings. All corners in the finished work shall be true, sharp and clean-cut and shall be free from cracks, spalls or other defects. Castings of posts shall be done in single pour.

2703.4 Precast Concrete Railing/Crash Barrier

Precast members for railing/crash barrier shall be of reinforced cement concrete and shall conform to Sections 1600 and 1700 of these Specifications. The maximum size of the aggregate shall be limited to 12 mm and minimum concrete grade shall be M30 for railings and M40 for crash barriers. The precast members shall be removed from the moulds as soon as practicable and shall be kept damp for a period of at least 10 days, during which they shall be protected from sun and wind. Any precast member that becomes chipped, marred or cracked before or during the process of placing shall be rejected.

2704 APPROACH SLAB

Reinforced concrete approach slab with 12 mm dia bars at 150 mm c/c in each direction both at top and bottom in M30 grade of concrete covering the entire width of the roadway, shall be provided as per details given on the drawings or as approved by the Engineer. Minimum length of approach slab shall be 3.5 m and minimum thickness 300 mm.

The cement concrete and reinforcement shall conform to Sections 1700 and 1600 respectively of these Specifications.

The approach slab shall rest on a base of 150 mm thick M15 grade concrete or as shown on the drawings or as directed by the Engineer.

2705 DRAINAGE SPOUTS

Drainage along longitudinal direction shall be ensured by sufficient number of drainage fixtures embedded in the deck slab. The spouts shall be of not less than 100 mm in diameter and shall be of corrosive resistant material such as galvanised steel with suitable cleanout fixtures. The spacing of drainage spouts shall not exceed 10 m. The discharge from drainage spout shall be kept away from the deck structure by means of suitable down pipes upto 500 mm above High Flood Level. In case of viaducts in urban areas, the drainage spouts should be connected with suitably located runners and down pipes to discharge the surface run-off into drains provided at ground level.

2705.1 Fabrication

The drainage assembly shall be fabricated to the dimensions shown on the drawings. All materials shall be corrosion resistant;. Steel components shall be of mild steel conforming to IS:226. The drainage assembly shall be seam welded for water tightness and then hot-dip galvanised.

2705.2 Placement

The galvanised assembly shall be given two coats of bituminous paint before placement. The whole assembly shall be placed in true position, lines and levels as shown on the drawings with necessary cutouts in the shuttering for deck slab and held in place firmly. Where the reinforcements of the deck are required to be cut, equivalent reinforcements shall be placed at the corners of the cut out.

2705.3 Finishing

After setting of the deck slab concrete, the shrinkage cracks around the assembly shall be sealed with polysulphide sealant or bituminous sealant as per IS:1834 and the excess

sealant trimmed to receive the wearing coat. After the wearing coat is completed, similar sealant shall be provided to cover at least 50 mm on the wearing coat surface all round the drainage assembly.

2706 WEEP HOLES

Weep holes shall be provided on all plain concrete, reinforced concrete, brick masonry and stone masonry structures such as, abutment, wing wall and return walls as shown on the drawings or as directed by the Engineer to permit water to flow out without building up pressure in the back fill. Weep holes shall be provided with 100 mm diameter AC/PVC/HDPE pipe for structures in plain/reinforced concrete or brick masonry. In case of stone masonry, weep holes shall be of rectangular shape 80 mm wide, 150 mm high or circular with 150 mm diameter. Weep holes shall extend through the full width of concrete/masonry with slope of about 1 vertical: 20 horizontal towards the draining face. The spacing of weep holes shall be 1 m in either direction or as shown in the drawings with the lowest at 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer.

2707 TESTS AND STANDARDS OF ACCEPTANCE

The material shall be tested in accordance with these Specifications and shall meet the prescribed criteria and requirements.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2708 MEASUREMENTS FOR PAYMENT

The measurement for payment for wearing coat, railing/crash barrier, approach slab, drainage spout and weep holes shall be made as under:

- i) Bituminous and cement concrete wearing coat shall be measured in cubic metres. Steel reinforcement in wearing coat shall be measured in tonnes.
- ii) Railing and metal beam crash barriers shall be measured in running metres.
- iii) For concrete crash barriers concrete shall be measured in cubic metres and steel shall be measured in tonnes.
- iv) Approach slab and its base shall be measured separately in cubic metres.
- v) Drainage spouts shall be measured in numbers.

- vi) Weep holes in concrete/brick masonry structure shall be measured in numbers. For structures in stone masonry, weep holes shall be deemed to be included in the item of stone masonry work and shall not be measured separately.

2709 RATE

The contract unit rate for wearing coat shall include the cost of all labour, material, tools and plant and other costs necessary for completion of the work as per these specifications.

The contract unit rate of railing and crash barrier shall include the cost of all labour, material, formwork, tools and plant required for completing the work as per these Specifications.

The contract unit rate for approach slab shall include the cost of all labour, material, tools and plant required for completing the work as per these Specifications. The rate for base shall include cost of all labour, material, tools and plant required, including preparation of surface and consolidation complete in all respects.

The contract unit rate for drainage spout shall include the cost of all labour, material, tools and plant required for completing the work as per these Specifications. It shall also include the cost of providing runners and down pipes with all fixtures upto 500 mm above high flood level or up to the drains at ground, as applicable or as shown on the drawings.

The contract unit rate for weep holes shall include the cost of all labour, material, tools and plant required for completing the work as per these Specifications.

2800

**REPAIR OF
STRUCTURES**

2801 DESCRIPTION

Repair of structures shall be carried out in accordance with the repair plans and these Specifications or as directed by the Engineer. Where repair work is not covered by these Specifications, special specification may be framed.

Implementation of repair schemes shall also conform to provisions of IRC:SP:40, IRC:SP:74 and IRC:SP:80.

2802 GENERAL**2802.1 Environmental Aspect**

Care shall be taken to ensure suitable mitigation measures against noise and dust, pollution and damages to the environs whether temporary or permanent.

2802.2 Phasing

The sequence of work shall be in accordance with the drawings or as directed by the Engineer.

2802.3 Traffic Management

Traffic management, signage, signaling, barricading, and lighting arrangement shall be in accordance with Section 100 of these Specifications.

2802.4 Safety Precautions

Adequate precautions shall be taken for safety of personnel, road users and existing services.

2802.5 Dismantling and Removal of Material

Dismantling of any bridge component and removal of materials shall conform to Section 200 of these Specifications and as shown on the drawings or as directed by the Engineer.

2803 SEALING OF CRACKS BY INJECTION OF EPOXY RESIN**2803.1 General**

The work of structural bonding of concrete using epoxy adhesive shall conform to these Specifications.

2803.2 The Contractor shall furnish a method statement giving details of methodology of construction, sources of supply of materials, tools, equipment, and appliances to be used on work, personnel and supervision.

2803.3 Personnel

The Contractor’s personnel shall be qualified and experienced in epoxy injection process.

2803.4 Material

The material for injection shall be suitable two-component low viscosity epoxy resin, having the required characteristics of bonding with concrete and resistance to moisture penetration. Epoxy mortar or polysulphide resin may be used for sealing the surface.

The material for epoxy injection shall conform to the following:

- i) The resin and hardener shall be mixed by weight and the mixing ratio shall generally be between 1 pbw (parts by weight) to 50 pbw subject to manufacturer’s recommendation.
- ii) Neither the mixed epoxy adhesives nor their individual component shall contain solvents and thickeners.
- iii) The components shall be free of lumps or foreign material. The viscosity of the individual components shall not change more than ±15 percent kept in closed containers at 25°C after two weeks.
- iv) Consistency of mixed adhesive shall satisfy the requirements given in Table 2800 -1.

Table 2800-1: Consistency of Adhesive

		Standard Version (cps)	Low Viscosity Version (cps)
i)	Viscosity of Mixed Adhesive at 25°C	(200-300)	(100-190)
ii)	Pot Life of mixed adhesive at 25°C	1 hour ± 15 minutes *	
iii)	Set time of mixed adhesive at 25°C	3 - 6 hours	

* In the case of two component injection system where resin and hardener get mixed at point of injection pot life at 25°C shall be not greater than 15 minutes ± 10 minutes.

2803.5 Equipment for Injection

The equipment shall be portable positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at nozzle. The pumps shall be generally electrically powered and shall provide in-time metering and mixing. The tolerance

on mix ratio shall be 5 percent by volume. The injection equipment shall have automatic pressure control capable of discharging mixed adhesive at any pre-set pressure within the prescribed limits and shall be additionally equipped with a manual pressure control.

The injection equipment shall be equipped with sensors on both the components A and B reservoirs that will automatically stop the machine when only one component is being pumped to the mixing head.

If considered appropriate, suitable compressed air operated epoxy injection gun can be used with prior approval of the Engineer for manual injection of mix when resin and hardener had been mixed in a separate unit.

2803 6 Preparation

Surfaces adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil efflorescence or other foreign matter by brushing/water jetting/sand blasting. Acids and corrosives shall not be permitted for cleaning.

Entry ports shall be provided along the crack at intervals of not more than the thickness of concrete at the location.

Surface seal shall be applied to the face of the crack between the entry ports. For through cracks, surface seal shall be applied to both faces.

Before proceeding with the injection, it shall be ensured that the surface seal has gained adequate strength corresponding to concrete strength of the member and to withstand the injection pressure.

2803.7 Epoxy Injection

Injection of epoxy adhesive shall begin at the lowest entry port and continue until the epoxy adhesive appears at the next adjacent entry port. The injection shall then be discontinued at the first entry port which shall be sealed. Thereafter, epoxy injection shall be carried out from the next adjacent port and continued successively from each port until the crack is completely filled.

If travel of epoxy adhesive from one port to the next does not occur, the work shall be stopped immediately. In case the volume of the injected material exceeds 2 litres for a particular entry port, the work shall be stopped and the specifications may be reviewed.

2803.8 Precautions for Application

- a) Temperature of components A and B, i.e., resin and hardener shall be between 10°C and 35°C at the time of mixing unless otherwise specified.
- b) Temperature of structural member during epoxy injection shall be between 10°C and 35°C unless otherwise specified.
- c) Immediately prior to use, each component shall be thoroughly mixed with a clean paddle. The paddle shall be of a type that does not propel air into the material. Separate clean paddle must be used for each component.
- d) Any heating of the adhesive components shall be done by application of indirect heat, in case the work is to be done in cold climate.
- e) Just before use, the two components shall be thoroughly mixed in the ratios specified by the manufacturer. The mixing time shall be strictly in accordance with manufacturer's recommendations. When adhesives with different coloured components are mixed, the mixture shall have a uniform colour without streaks.
- f) The use of solvents and thinners shall not be permitted except for cleaning of equipment.

2803.9 Testing**2803.9.1 Material Testing**

Prior to approval of material, the following tests shall be carried out by the Contractor at site or in an authorised laboratory for each batch of resin and hardener and each combination.

- i) Viscosity test for resin and hardener and the mix: three specimens each.
- ii) Pot life test: three specimens each.
- iii) Bond test: three specimens each.
- iv) Shear test: six specimens each, 3 after 24 hours and the other three after 72 hours of curing.

Subsequent tests shall be carried out as directed by the Engineer. Procedure for tests shall be as below:

i) Pot Life Test

- a) 500 gm of resin formulation shall be prepared by thoroughly mixing the resin and hardener / accelerator / catalyst component in proposed proportion in a 1 kg capacity hemispheric

porcelain bowl by means of a spatula or any other agitating device and time and the ambient temperature noted.

- b) The resin formulation shall be applied with a clean dry 25 mm size painter's brush, on a clean dry surface such as cement concrete over 150 mm - 200 mm length, starting immediately after mixing the formulation and repeating the operation every five minutes. When it becomes just difficult to spread the resin properly with the brush, the time is noted. The time elapsed since completion of mixing of resin formulation, is taken as its pot life.
- c) One pot life test shall be performed on commencement of work and the same shall be repeated every four hours.
- d) In case the material fails to satisfy the pot life test, it shall not be used for injection.

Where the resin and hardener get mixed at point of injection, the pot life is not important and no tests may be required.

ii) **Bond Test**

A standard 150 mm diameter and 300 mm long concrete cylinder shall be cast in 2 pieces by providing a separating medium at an axis of 45 degrees to the longer axis of the cylinder as shown in Fig. 1 of Appendix 2800/1.

Three such split cylinders shall be prepared. Two pieces of each cylinder shall be joined with epoxy mortar at four points to give a clear gap of about 0.2 mm, which will be injected with epoxy resin at site. After epoxy has been cured, load test shall be carried out on the cylinder. The failure shall not take place at the joint injected with epoxy resin. Also the strength of cylinder at failure shall not be less than 80 percent of the 28 days cube strength of the concrete mix.

iii) **Shear Tests**

Two steel plates, minimum 3 mm thick, shall be bonded with epoxy at site using the same resin mix as used/proposed to be used for injection. The assembly shall be kept in mechanical clamp till epoxy is cured. A total of six specimens shall be prepared for each batch of materials. Three test specimens shall then be subjected to a shear force along the axis after 24 hours and the minimum shear strength before failure shall not be less than 1 MPa (Refer Fig. 2 of Appendix 2800/1).

The remaining test specimens shall be similarly tested after 72 hours of curing. The shear strength before failure shall not be less than 2.5 MPa.

2803.9.2 Core Test

If directed by the Engineer, cores shall be tested for the acceptance of the work. The selection of the location of cores shall be as directed by the Engineer in such a way that damage in critical/stressed areas of the structure is avoided.

The Contractor shall obtain 50 mm diameter initial core samples in the first 50 linear metres. Thereafter, frequency of core sampling shall be as specified or as agreed by the Engineer. The depth of the core shall normally be less than 200 mm.

Tests and Acceptance Criteria shall be as follows:

- a) Penetration- Visual examination of the core should show epoxy adhesive filling a minimum of 90 percent of the crack.
- b) Bond Strength- When tested for bond, concrete failure should occur before adhesive failure. Also, minimum bond strength of 40 MPa should be developed with no failure of either concrete or adhesive.

If the cores taken in first 50 m length pass tests as specified above, epoxy adhesive injection work at area represented by cores will be accepted.

If cores fail either by lack of penetration or bond strength, work shall not proceed further until the areas represented by the cores are re-injected and re-tested for acceptance.

Filling of Core Holes

Two-component bonding agent shall be applied to surfaces of cored holes followed by filling of non-shrink cement grout mix placed by hand trowel, thoroughly rodded and tamped in place. The surface shall be finished to match the finish and texture of existing concrete to the satisfaction of the Engineer. Materials to be used and procedures for filling core holes shall be got approved by the Engineer before proceeding with work.

2803.9.3 Test for Injection Equipment

At all times during the course of the work, the Contractor shall keep complete and accurate records and make available to the Engineer, the results of the pressure and ratio tests specified below so that the efficacy and accuracy of the injection equipment is verified.

The Engineer at any time may direct the Contractor to conduct additional tests in his presence.

a) Pressure Test

The mixing head of the injection equipment shall be disconnected and the two adhesive component delivery lines shall be attached to

the pressure check device, which shall consist of two independent valved nozzles capable of sensing the pressure. The check device shall be closed and equipment operated until the gauge pressure in each line reads 5 MPa. The pumps shall be stopped and the gauge pressure shall not drop below 4 MPa within 2 minutes.

The pressure test shall be run for each injection unit at the beginning and after break of every shift.

b) **Ratio Test**

The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through the ratio check device, which shall consist of two independent valved nozzles. There shall be a pressure gauge capable of controlling back pressure by opening or closing valved nozzles capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to read 5 bar for both adhesive components, which shall be simultaneously discharged into separate calibrated containers during the same time period. The amounts thus discharged shall be compared to determine whether the volume/discharge conforms to the manufacturer's recommended ratio for applicable material.

**2804 REPLACEMENT OF SPALLED CONCRETE BY EPOXY MORTAR/
POLYMER MORTAR**

2804.1 Epoxy Mortar

2804.1.1 Material

The epoxy resins for use in the mortar shall be obtained from a reputed manufacturer and shall conform to the following:

Pot Life	60 minutes at 30°C
Bond Strength	12 MPa
Tensile Strength	16 MPa

The Contractor/user shall carry out tests on the samples to demonstrate that the above requirements are met.

The sand to be used in the mortar shall be graded quartz sand.

2804.1.2 Proportioning and Mixing

The resin and hardener shall be first mixed. Thereafter, dry filler shall be added and again mixed thoroughly. The resultant mix shall be free of lumps of dry filler and shall be of uniform

colour. For a total weight of 1kg or less, the components shall be mixed for 3 minutes in a slow speed (400-600 rpm) mixer. The stirrer shall be moved up and down and along the sides until uniform colour without streaks, is obtained. While stirring, it shall be ensured that excessive amount of air is not entrapped. If no power is available, a flat putty knife may be used to reach into the corners of the can and hand mixing done for at least 5 minutes.

2804.1.3 Surface Preparation

Two general methods of surface preparation shall be followed:

- a) Mechanical that includes grinding, grit blasting, water blasting and scarification.
- b) Chemical that includes acid etching with 15 percent by weight of hydrochloric solution, followed by repeated flushing with high pressure stream of water

Contaminants, such as oil, grease, tar, asphalt, paint, wax, curing compounds, surface; impregnants like linseed oil or silicons and laitance, loose material and unsound concrete, shall be removed from the surface on which epoxy mortar is to be placed.

2804.1.4 Application

The epoxy primer coat which acts as a bonding agent, shall consist of resin and hardener mixed in the proportions as given by the manufacturer. Epoxy bonding agent shall be applied only on a dry surface and shall not be applied when it rains or in standing water. The overlay, whether epoxy or cement based, shall be done within the pot life of the epoxy primer coat. Epoxy primer coat shall be applied with the help of stiff nylon bristle brushes or hard rubber rollers or spray gun, depending upon the nature of surface and extent of work area. As far as possible, the coating shall be uniformly thick.

Before the primer coat is fully cured, epoxy mortar shall be applied by means of trowels and floats. The interval between the application of primer coat and epoxy mortar shall be approximately 15/30 minutes depending upon the ambient temperature.

Seal coat shall be applied 24 hours after curing and mild roughening of the surface of the mortar.

2804.1.5 Coverage

The coverage of resin mix would depend on the system of resin used. However, as a general guideline the coverage area shall be as under:

- a) Primer Coat. An area of 3-6 square metres will be covered by 1 kg of resin hardener mix, depending on the finish of the concrete.

- b) Epoxy Mortar. One square metre of surface requires approximately 20-24 kg of epoxy mortar, when laid to a thickness of 10 mm.
- c) Seal Coat. An area of 4 to 6 square metres will be covered by 1 kg depending on the temperature of application.

2804.1.6 Cleaning and Maintenance of Equipment

Tools and equipment are best cleaned immediately after use since the removal of cured resin is difficult and time consuming. The bulk of resin shall be removed using a scraper and remainder washed away completely using solvents such as toluene, xylene or acetone. Equipment shall always be cleaned before the epoxy hardens. Solvents used for this purpose may be Acetone (flammable), Methyl Ethyl Kethone (flammable), Methyl Chloride (non-flammable). Cured epoxies may be removed using Methylene Chloride

2804.1.7 Testing

Epoxy used for making mortar shall conform to all requirements and testing procedures as laid down in Clause 2803.9.

2804.1.8 Personnel and Environment Safety

Any skin contact with epoxy materials, solvents and epoxy strippers should be avoided. Epoxy resins and particularly epoxy hardeners (B component) may cause a rash on the skin. The official toxicity classification on the container labels may be looked at before starting work.

Rubber gloves, with a cloth liner, and protective clothing shall be worn. Barrier creams are recommended but are not substitutes for protective clothing. Eyes shall be protected where splashing could occur while spraying or mixing. Good ventilation shall be ensured and inhalation of vapours avoided. If materials are sprayed, a respirator shall be used.

If contact occurs with the skin, it shall be immediately washed with a cleaner, followed by soap and water. Should eye contact occur, it shall be flushed immediately with plenty of water for 15 minutes and a doctor called for.

If contact occurs with the clothing, it shall be immediately changed to prevent further skin contact, and if the contact occurs with components A or B, the clothing shall be thrown away. Hardened epoxy is not harmful but will break the clothing.

All emptied, used buckets, rags and containers shall be removed from site. These shall be stored in waste disposal bags and suitably disposed of.

2804.2 Polymer Mortar**2804.2.1 Material**

The latex acrylic polymer for use in the polymer modified cementitious mortar (PMC) shall be obtained from a reputed manufacturer and shall conform to the following:

Pot Life	60 minutes at 30°C
Compressive strength at 28 days	18.20 N/mm ²
Flexural strength at 28 days	3.0 N/mm ² to 5.0 N/mm ²
Addition to concrete (slant shear)	3.0 N/mm ² to 5.0 N/mm ²

The sand to be used in the mortar shall be graded quartz sand and the sand content shall be in accordance with the desired consistency.

2804.2.2 Proportioning and Mixing

A dry mortar of quartz sand and cement (OPC) shall be prepared as per the proportions recommended by the manufacturer. The quantity of polymer shall be measured by measuring jars and shall be added to dry mortar. It shall be mixed with trowel or by hand so that no lumps remain in the mixed mortar.

2804.2.3 Surface Preparation

Same as in Clause 2804.1.3.

2804.2.4 Application

The polymer bond coat shall consist of a mix of polymer and cement as per recommendations of manufacturer and shall be applied in the same manner as indicated in Clause 2804.1.4 for epoxy primer coat.

The cement and sand shall be dry mixed and then mixed with liquid polymer, adding the required amount of water in prescribed proportions as per manufacturer's recommendation. The mortar shall be mixed till it attains a smooth consistency. The mix shall be applied over the polymer bond coat by hand and finished by trowel.

2804.2.5 Coverage

- a) An area of 3 to 4 square metres will be covered by 1 litre of polymer bond coat, depending on substrata conditions.
- b) An area of 1 square metre of surface will be covered by approximately 21-22 kg of polymer mortar when laid to a thickness of 10 mm.

2804.2.6 Testing

The polymer used in making polymer mortar, shall be tested for all requirements as indicated by the manufacturer and to satisfy requirements given in Clause 2804.2.1.

2805 EPOXY BONDING OF NEW CONCRETE TO OLD CONCRETE

2805.1 Epoxy resin used for bonding shall be obtained from a reputed manufacturer. The pot life of such bonding epoxy shall not be less than 60 minutes at normal temperature.

2805.2 The entire surface of the existing concrete member should be thoroughly cleaned by wire brush and then with compressed air to remove dust and loose particles from the surface. Any crack or spalling of concrete shall be sealed by epoxy injection/epoxy mortar/grouting as decided by the Engineer. A coating of suitable epoxy resin at the rate of 0.8 kg/sq.m (minimum) should then be applied on the surface of the existing concrete members. Fresh concrete shall then be placed within the pot life of the resin system.

2805.3 Testing

2805.3.1 Epoxy used for bonding work shall satisfy the criteria mentioned in **Clause 2803.9**.

2805.3.2 Two concrete cubes of 150 mm size cast as per approved design mix shall be placed at a distance of 150 mm from each other, as shown in Fig. 3 of Appendix-2800/1. Epoxy resin system suggested for bonding new to old concrete shall be applied on the opposite faces of the cubes.

Fresh cement concrete cube of grade as per approved design mix shall be cast with water cement ratio of 0.4 or less in the manner shown in Fig. 3 of Appendix 2800/1. The assembly shall be cured in water for 28 days and steel spacer removed thereafter.

The cube assembly shall be subjected to compression load after 28 days of curing, thereby subjecting the bond to shearing load. Failure must not occur at this joint.

2806 CEMENT GROUTING**2806.1 Material**

Grouting shall normally be performed with a mixture of neat Portland cement and water. Other additives and admixtures may be added to improve the impermeability and strength, with the approval of the Engineer. The size of the particles and the consistency of the grout must be suited to the passageways it must follow. Neat grout will not flow freely into holes smaller

than about three times the largest cement particle. Except in large cavities where thick mortar can be placed, the sand should all pass the 28-mesh sieve and have a large portion passing the 50-mesh and 100-mesh sieves. The proportions of Ordinary Portland cement to sand will depend upon the size of the spaces to be filled and will vary from a neat grout to about 1:1 mix. The amount of water to be added depends upon the consistency required. Grouts with as little as 16 litres of water per bag of cement could be used and it should seldom be necessary to use more than 35 to 40 litres of water per bag of cement.

Where necessary and approved by the Engineer, additives and admixtures may be added to Portland cement grout mixtures for improving impermeability and strength, delaying the setting time, increasing flowability and minimizing segregation and shrinkage.

2806.2 Preparation

The surface shall be cleaned with wire brush and compressed air. Thereafter holes of 15 mm dia and 150 mm to 200 mm deep may be drilled along the length of the cracks at a spacing of 500 mm by wet drilling using rotary percussion drills and nipples shall be inserted in these holes.

2806.3 Proportioning, Mixing and Equipment for Grouting

The cement grout shall be mechanically mixed using a system of power-driven paddles of high speed centrifugal pump. The grout pump to be used shall permit close control of pressures to allow a flexible rate of injection with minimum clogging of valves and ports. The most satisfactory equipment for injecting grout is a pump of the double-acting flexible reciprocating type giving a steady flow. The grout pump shall be so placed as to reduce the waste in cleaning lines. It is preferable to put 50 percent or more of the mixing water into the mixer before adding the dry ingredients and then the remaining water. A continuous supply of grout is preferable to an intermittent one. Consistency of the grout may be determined by trials starting with thin grout i.e. about 40 litres of water per bag of cement and progressively decreasing the water content to about 15 litres per bag of cement.

Where the mixer and pump are combined in one unit, the dry material shall be screened before mixing. If the mixer and pump are in separate units, the grout shall pass through a screen before it enters the pump.

2806.4 Application

Highest practical pressure within the limits of 100 kPa - 400 kPa should be used in order to force the surplus water from the grout. As the pressure may be distributed hydraulically over considerable areas, vigilance must be exercised to prevent damage or needless waste of grout. Adequate precaution shall be taken to ensure that leakage of grout does not occur.

Pressure shall be steady to ensure a continuous flow of grout. Grouting shall not be continued till the hole consumes mix at the rate of not less than 30 litres in 20 minutes or until refusal at the grouting pressure of 400 kPa at any hole. Should the grout escape from an adjacent nipple, it should be plugged or capped. Any seam, crack or joint through which grout escapes shall be caulked with epoxy mortar as soon as thick grout appears.

2806.5 Cleaning of Equipment

After completion of each grouting operation or temporary shutdown, it is advisable to force clear water through the pump until the discharge line shows no colour, after which the pump covers shall be removed and the valve chambers thoroughly cleaned.

2806.6 Testing

Percolation test done at the end of grouting operation shall give a value of less than 2 lugions. For specialised treatment like polymer modified cementitious grout injection, manufacturer's literature and specification shall be followed.

2807 GUNITING/SHOTCRETING

2807.1 The gunite shall comprise 100 parts by weight of cement, 300 parts by weight quartz sand, 35-50 parts by weight water and 2 parts by weight approved quick setting compound. In general, dry mix shotcrete shall be used.

2807.2 Ordinary Portland cement conforming to IS:269 shall be used in guniting.

2807.3 Sand for guniting shall comply with the requirements stipulated in IS: 383. In general, sand should neither be too coarse to increase the rebound nor too fine to increase the slump. Sand should preferably have moisture content between 3 to 6 percent.

The grading of sand shall lie within the limits given below:

IS Sieve Designation	Percent Passing the Sieve
4.75 mm	95-100
2.36 mm	65-90
1.18 mm	45-75
600 micron	30-50
300 micron	10-22
150 micron	2-8

2807.4 For thick sections it may be advantageous to incorporate coarse aggregate in the mix provided adequate guniting equipment is available. Coarse aggregate, when used,

shall conform to grading given in Table-1 of IS:9012. The percentage of coarse aggregate may normally be kept as 20 to 40 percent of the total aggregate and the mix shall be suitably designed.

2807.5 Water/cement ratio for guniting shall fall within the range of 0.35 to 0.50 by mass; wet enough to reduce the rebound. Drying shrinkage may be between 0.06 percent and 0.10 percent. The quick setting compound shall be added at the nozzle with water just before guniting.

2807.6 Workmanship

The cement and sand shall be batched and mixed and conveyed through a hose pipe with the help of compressed air. A separate line shall bring the water under pressure. The cement, sand and water mix shall be passed through and intimately mixed in a special manifold and then projected at high velocity to the surface being repaired. The density of gunite shall not be less than 2000 kg/cu.m. The strength of gunite shall not be less than 25 MPa. For effective guniting, the nozzle shall be kept 600 mm to 1500 mm away from the surface, preferably normal to that surface. While enclosing reinforcement bars during repairs the nozzle shall be held closer at a slight angle and the mix shall be wetter than the normal.

2807.7 Test panels simulating actual field conditions shall be fabricated for conducting preconstruction testing. The procedure for testing the cubes or cylinders taken from the panels stipulated in Clause 6 of IS:9012 shall be followed.

2807.8 It should be ensured from tests that strength of about 25 MPa at 28 days is available for the mortar/concrete mix.

2807.9 The defective concrete shall be cut out to the full depth till sound concrete surface is reached. Under no circumstances should the thickness of concrete to be removed be less than clear cover to the main reinforcement. No square shoulders shall be left at the perimeter of the cut-off portion and all edges shall be tapered. Thereafter, all loose and foreign materials should be removed and the surface sand blasted to make it rough to receive shotcrete after applying a coat of epoxy bonding as per recommendation of the manufacturer at the rate of 1.0 kg per 1.5 sq.m. of surface area.

2807.10 The exposed reinforcement shall be thoroughly cleaned free of rust, scales etc. by wire brushing. Wherever the reinforcements have been corroded, the same shall be removed and replaced by additional reinforcement. Before application of gunite, a coat of neat cement slurry should be applied on the surface of the reinforcement.

2807.11 Sufficient clearance shall be provided around the reinforcement to permit encasement with sound gunite. Care shall be taken to avoid sand pockets behind the reinforcement.

2807.12 A thickness of 25 mm to 40 mm of gunite can normally be deposited in one operation. If, for some reason, the total thickness is to be built up in successive operations, the previous layer should be allowed to set but not become hard before the application of the subsequent layer. Guniting shall always be done on a damp concrete surface.

2807.13 Where required, welded wire fabrics 50 mm x 50 mm x No. 10 gauge shall be provided in the first layer of guniting. The fabric shall be tied properly. In case the damage to the concrete member is very deep, the specifications for guniting as well as requirement of placement of wire mesh, has to be decided as per field conditions.

2807.14 The stipulations given in IS:9012 regarding application of gunite should be followed so as to keep the rebound to the minimum. The quality of guniting and workmanship shall be such that the percentage of rebound mentioned in IS:9012 can be adhered to. In no circumstances shall the rebound material be re-used in the work.

2807.15 It would be desirable that green gunite is moistened for at least 7 days. Guniting work shall not be done during windy or rainy conditions.

2808 PROTECTIVE SURFACE COATING OF CONCRETE BY ACRYLIC ELASTOMERIC COATING

2808.1 The acrylic elastomeric coating shall be water based (solvent free), modified with selected mineral fillers applied over the prepared surface. The coating should have anti-carbonation and water vapor diffusion property and should be resistant to action of ultra violet (UV) radiation. It should be waterproof and capable of bridging crazings and cracks. The shelf life for such coatings shall not be more than 6 months.

2808.2 It is necessary that the system should be capable of protecting the surfaces of pre-stressed and reinforced concrete members from all deleterious elements such as chlorides and sulphates. The protective treatment should allow excess water vapour in the concrete to evaporate out (breathing) without rupturing itself due to vapour pressure. The protective system itself should not deteriorate from exposure to UV rays and weathering.

The acrylic elastomeric coating system shall satisfy the requirements given in Table 2800-2.

Table 2800-2: Properties of Acrylic Elastomeric Coating

Sl.No.	Parameter	Requirement	Reference
1)	Specific Gravity	1.4±0.05	IS:345
2)	Solid contents	70±3%	IS:345
3)	UV resistance	No colour change	ASTM-G-53/DIN-EN-150-105

Sl.No.	Parameter	Requirement	Reference
4)	IR-Spectrum	As per Acrylic Polymer	IR-Spectrometer standards
5)	Adhesion with concrete	1.5 N/m ²	ASTM-D-4541-02/ DIN500014
6)	Dry film thickness	200-225 Microns (for minimum 2 coats)	
7)	Coverage	400-450 gm /m ² (2 Coats)	
8)	Physical properties Diffusion resistance against carbon dioxide	Equivalent air layer thickness S _D CO ₂ shall be >50 m	DIN 53122 Part -I
9)	Diffusion resistance against water vapour	Equivalent air thickness S _D H ₂ O <4 m	DIN 52615
10)	Water proofing characteristics	Percentage reduction in flux should be >50%	
11)	Re-coatability	Min. 2h to 72 h or as per manufactures specification with the approval of the Engineer in charge.	

The primer shall satisfy the following requirements

- i) System : Single component universal polymer primer
- ii) Base : Acrylic Resin dispersion
- iii) Curing : Air Curing
- iv) Colour : Milk white, transparent application
- v) Shelf life : 6 months from date of manufacturing in tightly sealed container.
- vi) Coverage : 75 gm/m² to 100 gm/m² (depending upon smoothness and absorption of concrete surface)

2808.3 Quality Assurance

The Acrylic elastomeric material should be tested in GOI accredited laboratories where such laboratories are available, otherwise in other standard laboratories where similar facilities exist for properties specified above. Random samples during execution shall be taken from consignments brought to site to verify that the test results match with the earlier certificates produced before approval of the product. Both the test results (prior to approval and during execution), shall conform to the requirements as per Table 2800-1, failing which the consignment shall be rejected. It shall be made mandatory that the stock register for the materials are maintained at site and signed by the Engineer periodically.

2808.4 Surface Preparation

The work shall commence after carrying out any repair to the concrete surface as directed by the Engineer. The concrete surface shall be free from all adhesion inhibiting substances such as oil, grease release agents as well as laitance and dust. The surface shall be cleaned by wire brushing, mechanical scraping and any loose material shall be removed by chiseling with small hammer and washed with clean water. The substrata shall be structurally sound for effective bond of the acrylic polymer with the concrete surface. All pin holes shall be filled with non-shrink polymer modified fine repair mortar.

2808.5 Application

After preparing the surface and filling the pin holes, primer coat (75-100 gm/sq.m.) shall be applied with brush/lambskin roller/spray gun and shall be cured for 60 minutes or as specified by the manufacturer.

Subsequently, 1st and 2nd coats of polymer coating shall be applied with brush/spray gun/roller keeping the time between coats not less than 2 h and not more than 72 h. Consumption per coat shall be 200-225 gm/m². The total dry film thickness of the protective coating for all coats shall be in the range of 200-225 microns. The wet film thickness shall be measured at a number of selected locations at the time of application with painting gauges. For measuring the dry film thickness, suitably located painting gauge shall be used. At least one gauge shall be located on each face of superstructure in each span but not less than one gauge/100 sqm. For the given solid content in the application, the dry film thickness to wet film thickness ratio should be established by prior testing in the laboratory using appropriate panels like glass plates, flat concrete, steel plates (300 x 300 mm) with similar coatings. Alternatively, the dry film thickness may be calculated from the measured wet film thickness by multiplying with the solid contents per unit volume.

2808.6 Performance Guarantee

This type of protective coating shall be executed only through authorized technical applicators of standard manufactures who have requisite work experience for having carried out similar type coating works. The Engineer shall take performance guarantee from the agency responsible for the execution of the work for a minimum period of 5 years.

2809 PROTECTIVE SURFACE COATING OF CONCRETE BY PATENTED SYSTEMS OF COATING

Patented system of protective coating like epoxy polyurethane painting system, epoxy phenolic protective system and other systems shall be used only with the approval of Engineer after the assessment of the performance of the product, backed by certificates from users, acceptance tests as per published standards, pertinently to cover the material, processes,

carbonation resistance, water vapour diffusion property, crack bridging properties, and UV resistance. The Engineer shall take performance guarantee from the agency responsible for the execution of the work for a minimum period of 5 years.

2810 REPLACEMENT OF BEARINGS

2810.1 Necessary repair/replacement of bearings shall be carried out as indicated in the repair plan or as directed by the Engineer. Care shall be taken to plan the execution of repair in the shortest possible time.

2810.2 Lifting of superstructure spans may be carried out by jacking up from below or by lifting the span from top. Where jacks are employed, their location/number and size shall be selected in such a manner so that no undue stresses are created in the structure. Jacks may be placed on piers/pier caps or specially erected trestles in accordance with the approved methodology for lifting of superstructure. All jacks shall be operated from one control panel by a single control lever. The system shall have provision for manual override to control the loads of any particular jack. The jacks should be so synchronized that differential lift between individual jacks does not exceed 1 mm.

2810.3 Precautions during Lifting of Girders for Rectification of Bearings

Walkie talkie system or similar audio arrangements should be available for communicating instructions during lifting of girders for rectification/replacement of bearings. In the event of replacement it shall be ensured that the new bearing fits into the available space.

2811 REPAIR AND REPLACEMENT OF WEARING COAT

2811.1 Repair of Wearing Coat

Repair of bituminous and cement concrete wearing coat shall be as per **Section 3000** of these Specifications.

2811.2 Replacement of Wearing Coat

- i) The existing wearing coat shall be dismantled before laying fresh wearing coat.
- ii) Overlay shall not be provided on existing wearing coat on bridge decks unless its structural adequacy to carry extra load of overlay is assured and certified by the Engineer.
- iii) Before commencing dismantling, the nature and condition of the wearing coat shall be ascertained.
- iv) Dismantling of wearing coat shall be carried out using jack

hammers or suitable manual/mechanical methods as approved by the Engineer. Care should be taken to avoid any damage to the existing structure including concrete, reinforcement or pre-stressing anchorages for cables, if any, located in the deck slab.

- v) The existing expansion joint assemblies shall be removed carefully along the entire width of the carriageway if included under the scope of work or as directed by the Engineer. In such cases, the deck slab for a width of 400 mm on either side should be removed for placing of reinforcement, anchor rods, anchor bolts and other fixing assemblies for the new expansion joints and pouring of fresh concrete. The gap between the girders over the piers should be cleared of all debris. A temporary platform under the gap at the end of girders shall be erected to collect the materials falling down during concreting and fixing of expansion joints.
- vi) After dismantling the existing wearing coat fresh wearing coat shall be provided as per Section 2700 of these Specifications. The expansion joint assembly, wherever dismantled shall also be fixed in position true to lines and levels.

2811.3 Precautions during Dismantling Work

For general guidelines, reference may be made to **Section 100** of these Specifications.

Dismantling work shall not be carried out at night, or during storm or heavy rain. A warning device shall be installed in the area for warning the workers in case of mishap/emergency.

Safety helmets conforming to IS:2925 shall be used by the workmen engaged in dismantling work. The sheds and tool boxes should be located away from the work site. To protect eyes and face from injuries from flying pieces, dirt, dust etc., celluloid goggles and gas masks shall be worn at the time of dismantling, especially where tools like jack hammers are deployed. Leather or rubber gloves shall be worn by the workers during the demolition of RCC work. Screens made of GI sheets shall be placed wherever necessary to prevent flying pieces from injuring the workers.

Water should be sprayed to reduce the dust while removing concrete wearing course with jack hammer. No work shall be taken up under the span when dismantling work is in progress.

2812 EXTERNAL PRESTRESSING

2812.1 Material

H.T. Strands/wires shall conform to **Section 1000** of these Specifications.

HDPE Sheathing shall conform to IS:4984 suitable for a working pressure of 6 bars. Its density shall be 955 kg/cu.m, shore hardness D63, yield stress 24 MPa and ultimate tensile strength 35 MPa.

As necessitated by the profile of the external cable, suitable strand/wire deviator block fabricated from M.S. sections shall be provided and securely fixed at the required locations. The block shall be sand blasted and given a coat of suitable paint (preferably epoxy based).

Depending upon the pre-stressing force, suitable anchorages and wedges shall be used conforming to relevant codes and Section 1800 of these Specifications.

2812.2 Workmanship

- a) Stressing of cables shall be carried out as per instruction given in the drawings, and conforming to Section 1800 of these Specifications.
- b) Care should be taken to avoid any damage to the existing structure by way of stress concentration or any other reason during fixing of the deviator blocks and after stressing of cable. The deviator blocks shall be so fixed as not to allow any movement due to pre-stressing forces. Radius of curvature of the surface of the deviator block interfacing with the cable shall be minimum one metre.
- c) The anchorages shall be sealed with suitable epoxy mortar system after the stressing of cables. A minimum cover of 50 mm shall be provided for the anchor plates and anchorages.
- d) Suitable grouting inlet points and vent points shall be provided by way of HDPE "T" vent connections to the sheathing.
- e) Grouting of cables shall be carried out as per provisions of Section 1800 of these Specifications.

2812.3 It shall be ensured that no part of the existing structure is damaged/distressed due to the external pre-stressing.

The behaviour of the girder shall be monitored by measurement of deflection so that only required amount of external pre-stressing is imparted to the girder. Care shall be taken to avoid excess pre-stressing and impairment of the girders.

2813 TESTS AND STANDARDS OF ACCEPTANCE

The material shall be tested in accordance with these Specifications and shall meet the prescribed criteria.

The work shall conform to these Specifications and shall meet the prescribed standards of acceptance.

2814 MEASUREMENTS FOR PAYMENT

- a) For epoxy grouting measurement for sealing of cracks and injection shall be made by weight of epoxy consumed in kg for epoxy grouting. For provision of nipples required for grouting, the payment shall be for number of nipples inserted.
- b) For cement grouting measurement for sealing of cracks and injection shall be made by weight of cement consumed in kg.
- c) Measurement for application of epoxy mortar/protective surface coating of concrete for specified thickness shall be in square metre of surface area of application.
- d) Bonding of old and new concrete by epoxy mortar shall be measured in square metre of surface area of interface.
- e) Guniting/shotcreting shall be measured in square metre of surface area of application.
- f) Replacement/rectification of bearings shall be measured in number of bearing assembly replaced/rectified.
- g) Dismantling of wearing coat shall be measured in square metre of area of wearing course dismantled.

External pre-stressing shall be measured in tones of H.T. steel strand/wire measured from anchorage to anchorage before stressing.

2815 RATE

The contract unit rate for sealing of cracks and injection of cement grout shall include cost of all materials, labour, tools and plant, placing in position, testing, curing and other incidental expenses for the satisfactory completion of the work as per these Specifications.

The contract unit rate for application of epoxy mortar/protective surface coating for specified thickness shall include cost of all materials, labour, tools and plant, placing in position, testing and other incidental expenses including surface preparation for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

The contract unit rate for guniting/shotcreting shall include cost of all materials, labour, tools and plant, placing in position, testing, curing, surface preparation and other incidental expenses including the provision of nipples for the satisfactory completion of the work as per these Specifications.

The contract unit rate for replacement/rectification of bearings shall include cost of all materials, labour, tools and plant, placing in position, site welding/riveting/bolt connections, operation of jacks and other incidental expenses for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

The contract unit rate for dismantling of wearing coat shall include cost of all materials, labour, tools and plant, traffic management, signages, safety precautions and other incidental expenses including removal of existing expansion joints, if included as a part of the work by the Engineer for the satisfactory completion of the work as per these Specifications.

The contract unit rate for external pre-stressing shall include cost of all materials, labour, tools and plant, temporary works, testing, curing and other incidental expenses including careful monitoring of the deflection of girders being externally pre-stressed for the satisfactory completion of the work as per these Specifications and as shown on the drawings.

2900

PIPE CULVERTS

2901 SCOPE

This work shall consist of furnishing and installing reinforced cement concrete pipes, of the type, diameter and length as per design and details and at locations shown on the drawings or as ordered by the Engineer and in accordance with the requirements of these Specifications.

2902 MATERIALS

All materials used in the construction of pipe culverts shall conform to the requirements of **Section 1000**.

Each consignment of cement concrete pipes shall be inspected, tested, if necessary, and approved by the Engineer either at the place of manufacture or at the site before their incorporation in the works.

2903 EXCAVATION FOR PIPE

The foundation bed for pipe culverts shall be excavated true to the lines and grades shown on the drawings or as directed by the Engineer. The pipes shall be placed in shallow excavation of the natural ground or in open trenches cut in existing embankments, taken down to levels as shown on the drawings. In case of high embankments where the height of fill is more than three times the external diameter of the pipe, the embankment shall first be built to an elevation above the top of the pipe equal to the external diameter of the pipe, and to width on each side of the pipe of not less than five times the diameter of pipe, after which a trench shall be excavated and the pipe shall be laid.

Where trenching is involved, its width on either side of the pipe shall be a minimum of 150 mm or one-fourth of the diameter of the pipe whichever is more and shall not be more than one-third the diameter of the pipe. The sides of the trench shall be as nearly vertical as possible.

The pipe shall be placed where the ground for the foundation is reasonably firm. Installation of pipes under existing bridges or culverts shall be avoided as far as possible. When during excavation the material encountered is soft, spongy or other unstable soil, and unless other special construction methods are called for on the drawings or in special provisions, such unsuitable material shall be removed to such depth, width and length as directed by the Engineer. The excavation shall then be backfilled with approved granular material which shall be properly shaped and thoroughly compacted upto the specified level.

Where bed-rock or boulder strata are encountered, excavation shall be taken down to atleast 200 mm below the bottom level of the pipe with prior permission of the Engineer and all rock/ boulders in this area be removed and the space filled with approved earth, free from stone or fragmented material, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Trenches shall be kept free from water until the pipes are installed and the joints have hardened.

2904 BEDDING FOR PIPE

The bedding surface shall provide a firm foundation of uniform density throughout the length of the culvert, shall conform to the specified levels and grade, and shall be of one of the following two types as specified on the drawings :

- i) **First Class Bedding** : Under first class bedding, the pipe shall be evenly bedded on a continuous layer of well compacted approved granular material, shaped concentrically to fit the lower part of the pipe exterior for atleast ten percent of its overall height or as otherwise shown on the drawings. The bedding material shall be well graded sand or another granular material passing 5.6 mm sieve suitably compacted/rammed. The compacted thickness of the bedding layer shall be as shown on the drawings and in no case shall it be less than 75 mm.
- ii) **Concrete Cradle Bedding** : When indicated on the drawings or directed by the Engineer, the pipe shall be bedded in a cradle constructed of concrete having a mix not leaner than M 15 conforming to Section 1700. The shape and dimensions of the cradle shall be as indicated on the drawings. The pipes shall be laid on the concrete bedding before the concrete has set.

2905 LAYING OF PIPE

No pipe shall be laid in position until the foundation has been approved by the Engineer. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm.

The arrangement for lifting, loading and unloading concrete pipes from factory/yard and at site shall be such that the pipes do not suffer any undue structural strain, any damage due to fall or impact. The arrangement may be got approved by the Engineer.

Similarly, the arrangement for lowering the pipe in the bed shall be got approved by the Engineer. It may be with tripod-pulley arrangement or simply by manual labour in a manner that the pipe is placed in the proper position without damage.

The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. In case of use of pipes with bell-mouth, the belled end shall face upstream. The pipes shall be fitted and matched so that when laid in work, they form a culvert with a smooth uniform invert.

Any pipe found defective or damaged during laying shall be removed at the cost of the Contractor.

2906 JOINTING

The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of RCC 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipe. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with caulking irons. Before caulking, the collar shall be so placed that its center coincides with the joint and an even annular space is left between the collar and the pipe.

Flush joint may be internal flush joint or external flush joint. In either case, the ends of the pipes shall be specially shaped to form a self centering joint with a jointing space 13 mm wide. The jointing space shall be filled with cement mortar, 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed.

For jointing pipe lines under light hydraulic pressure, the recess at the end of the pipe shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method.

All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

2907 BACKFILLING

Trenches shall be backfilled immediately after the pipes have been laid and the jointing material has hardened. The backfill soil shall be clean, free from boulders, large roots, excessive amounts of sods or other vegetable matter, and lumps and shall be approved by the Engineer. Backfilling upto 300 mm above the top of the pipe shall be carefully done and the soil thoroughly rammed, tamped or vibrated in layers not exceeding 150 mm, particular care being taken to thoroughly consolidate the materials under the haunches of the pipe. Approved pneumatic or light mechanical tamping equipment can be used.

Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur.

In case of high embankment, after filling the trench upto the top of the pipe in the above said manner, a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layers are added and compacted.

2908 HEADWALLS AND OTHER ANCILLARY WORKS

Headwalls, wing walls, aprons and other ancillary works shall be constructed in accordance with the details shown on the drawings or as directed by the Engineer. Masonry for the walls shall conform to Sections 1300, 1400 or 1700 as applicable. Aprons shall conform to Section 2500.

2909 OPENING TO TRAFFIC

No traffic shall be permitted to cross the pipes unless height of filling above the top of the pipes is atleast 600 mm.

2910 MEASUREMENTS FOR PAYMENT

RCC pipe culvert shall be measured as complete work in linear metres along its length between the inlet and outlet ends. Culverts with multiple rows of pipes shall be measured as one unit, irrespective of the number of rows.

2911 RATE

The Contract unit rate for the pipe culvert shall include the cost of pipes including loading, unloading, hauling, handling, storing, laying in position and jointing and all ancillary works such as excavation, bedding for pipes, backfilling, concrete, masonry and aprons and incidental costs to complete the work as per these Specifications.

3000

**MAINTENANCE OF
ROAD**

3001 GENERAL

The Specifications shall apply to all items of road maintenance works as required to be carried out under the Contract or as directed by the Engineer. The works shall be carried out in conformity with the relevant Specifications to the required level, grade and lines using approved materials. The works shall be carried out using appropriate machinery. Wherever the Specifications are not given for an item, sound engineering practice shall be adopted to the satisfaction of the Engineer.

3002 RESTORATION OF RAIN CUTS**3002.1 Scope**

The work shall consist of earthwork for restoration of rain cuts in the embankment and shoulders, using suitable material, and compacting the same.

3002.2 Materials

The material used for restoration of rain cuts shall consist of soil conforming to Clause 305.2.

3002.3 Construction Operation

The area affected by rain cuts shall be cleared of all loose soil and benched. The width of the benches shall be at least 300 mm and they shall extend continuously for a sufficient length. The height of the benches shall be in the range of 150-300 mm.

Fresh material shall be deposited in layers not exceeding 250 mm loose thickness and compacted so as to match with the benching at a moisture content close to the optimum. Compaction shall be carried out using suitable equipment such as plate compactors and rammers or by suitable implements handled manually. The finished work shall conform to alignment, levels and slopes as indicated in the drawing or as directed by the Engineer.

3002.4 Measurements for Payment

The earthwork for restoration of rain cuts shall be measured in cubic metres.

3002.5 Rate

The Contract rate for the item of earthwork for restoration of rain cuts shall be payment in full

for carrying out the required operation including full compensation for:

- i) Supply of labour, equipment and material including all leads and lifts and the cost of arranging land for borrow pits;
- ii) Setting out;
- iii) Removal of loose material from the rain cuts;
- iv) Benching of old earthwork; and
- v) Compacting after adding required quantity of water.

3003 MAINTENANCE OF EARTHEN SHOULDER

3003.1 Scope

The work of maintenance of earthen shoulder shall include making up the irregularities/loss of material on shoulder to the design level and cross-fall by adding fresh approved soil and compacting it with appropriate equipment or to strip excess soil from the shoulder surface as per the requirement of these Specifications.

3003.2 Material

The material to be added to the shoulder, if required, shall be a select soil conforming to Clause 305.

3003.3 Construction Procedure

This work shall involve:

- i) Making up of the earthen shoulder by adding extra soil and compacting the same; and/or
- ii) Stripping a layer of soil to achieve the required grade and level.

Wherever extra earth is required to be added, the earthen shoulder shall be stripped and loosened to receive fresh soil. The deficiency of thickness shall be made up in layers of loose thickness not exceeding 250 mm. Water shall be added, if required, to attain the optimum amount and the layer compacted by a smooth wheel roller, vibratory roller, hand roller, plate vibrator or hand rammer to obtain atleast 97 percent of the maximum dry density in accordance with IS:2720 (Part 8). The finished surface shall have the specified cross slope and line in accordance with the drawing or as directed by the Engineer. The side slopes shall be trimmed to the required slope with the help of grader or manual methods using hand tools.

Wherever the earth is required to be stripped from the shoulder, this shall be done either using equipment like grader or by manual means using hand tools. The resulting surface shall be uniform and have a field density of atleast 97 percent of maximum density obtained

in accordance with IS:2720 (Part 8). If the surface is not uniformly compacted, it shall be excavated to a depth of 150 mm and the soil mixed with water if required and compacted at a moisture content close to the optimum to achieve 97 percent of maximum density as stated above.

3003.4 Measurement for Payment

Maintenance of earthen shoulder shall be measured in sq. metres.

3003.5 Rate

The Contract unit rate for maintenance of earthen shoulder shall be payment in full compensation for :

- i) furnishing earth required for making up of shoulders including all leads and lifts, compaction to the required density and cost of arranging land for borrow pits;
- ii) excavation and stripping of earth as required and disposal of the earth at the location approved; and
- iii) all labour, tools, equipment and incidentals to complete the work in accordance with these Specifications.

3004 BITUMINOUS WORK IN CONNECTION WITH MAINTENANCE AND REPAIR

3004.1 General

The scope and type of maintenance work to be carried out shall be in accordance with the provisions of the Contract or as instructed by the Engineer.

Maintenance treatments required under the Contract or instructed by the Engineer may include pothole and patch repair, crack-sealing, fog spray, dusting, slurry sealing, surface dressing, overlays and specialist repairs.

The materials (particularly patching and overlay materials) used in maintenance operations shall be of a standard not less than those specified for the original construction.

Traffic control during maintenance operations shall conform to the requirements of the Contract and Section 100.

3004.2 Filling Potholes and Patch Repairs**3004.2.1 Scope**

This work shall include repair of potholes and patching of all types of bituminous pavement and paved shoulders.

The work shall include the removal of all failed material, in the pavement courses and, if necessary, below the pavement, until the root cause of the failure is removed, the trimming of the completed excavation to provide firm vertical faces; the replacement of material of at least as high a standard as that which was originally specified for the pavement layer; the application of tack coat on to the sides and base of excavations prior to placing of any bituminous materials and the compaction, trimming and finishing of the surfaces of all patches to form a smooth continuous surface, level with the surrounding road.

3004.2.2 Materials

All materials used for the pothole and patch repair of bituminous surface and underlying layers shall be in accordance with these Specifications and shall be of the same type as specified for the original construction. A mix superior to the one on the existing surface may also be used for repair work. An emulsified bitumen/modified bitumen mix compatible with the existing layer shall also be considered appropriate.

Materials used for patching shall not be of lesser bearing capacity nor of a greater porosity than the adjacent previous construction. Non-bituminous material shall not be used for patching bituminous materials.

Ready patch mix material can also be used with the specific approval of the Engineer.

3004.2.3 Preparation of the Area for Pothole and Patch Repair

Each pothole and patch repair area shall be inspected and all loose and defective material removed. The area shall be cut/trimmed to a regular shape either with jack hammers or with hand tools suitable for the purpose.

The edges of the excavation shall be cut vertically. The area shall be thoroughly cleaned with compressed air or any appropriate method approved by the Engineer to remove all dust and loose particles. Layers below the level of the bituminous construction shall be filled using material of the equivalent specification to the original construction, which shall particularly include the specified standards of compaction. The area and sides for bituminous construction shall be applied with a tack coat conforming to Clause 503 of these Specifications before back filling operation.

3004.2.4 Backfilling Operation

The mixture to be used in bituminous patching shall be either a hot mix or a cold mix in accordance with the appropriate Clauses of these Specifications or any other approved patching material. Mixing shall be done in a plant of suitable capacity. The bituminous mixture shall be placed in layers of thickness not more than 100 mm (loose) and shall be compacted in layers with roller/plate compactor/hand roller/rammer to the compaction standards defined in the appropriate Clauses of these Specifications. While placing the final layer, the mix shall be spread slightly proud of the surface so that after rolling, the surface shall be flush with the adjoining surface. If the area is large, the spreading and levelling shall be done using appropriate tools and equipment. During the process of compaction, the surface levels shall be checked using a 3 m straight edge.

3004.2.5 Measurement for Payment

Filling of potholes and patch repair shall be measured in sq m or by weight in tonnes.

3004.2.6 Rate

The contract unit rate for filling of potholes and patch repair shall be payment in full for :

- i) furnishing all materials required;
- ii) all works involved including excavation, trimming, filling with any non-bituminous layers required, applying tack coat, and back filling with bituminous materials;
- iii) all labour, tools, equipment and incidentals to complete the work in accordance with the Specifications.

3004.3 Crack Sealing**3004.3.1 General**

Crack sealing shall consist of one or more of the following operations as instructed under the Contract :

- i) fog seal
- ii) filling cracks with a binder, or a combination of crusher dust and a binder
- iii) by treating the crack sealing as a patch repair.

3004.3.2 Fog Seal**3004.3.2.1 Scope**

Fog seal for use in maintenance work shall conform to the requirements of Clause 513 of

these Specifications, and shall consist of an application of emulsified bitumen, without any aggregate cover for sealing fine hair-cracks or for rejuvenating oxidised bituminous surfaces. Areas having cracks with less than 3 mm width shall be considered for this treatment, unless otherwise instructed by the Engineer.

3004.3.2.2 Material

Bituminous emulsion for fog seal shall conform to the requirements of Clause 513 of these Specifications.

3004.3.2.3 Application

The area to be treated with fog seal shall be thoroughly cleaned using compressed air, scrubbers, etc. The cracks shall be cleaned with a compressed air jet to remove all dirt, dust, etc. The fog seal shall be applied at the rate of 0.5-1.0 litre/sq.m of emulsion, or as otherwise instructed by the Engineer, using equipment, such as, a pressure tank, flexible hose and spraying bar or lance. Traffic shall be allowed on to the surface only after the seal has set to a non-tacky and firm condition so that it is not picked up by the traffic.

3004.3.2.4 Measurement for Payment

The fog seal work shall be measured in sq. metres, calculated from the dimensions of work instructed in the Contract or by the Engineer.

3004.3.2.5 Rate

The contract unit rate for application of fog seal shall be payment in full for :

- i) supplying of fog seal material and all the operations for applying it; and
- ii) all the labour, tools, equipment and incidentals to complete the work in accordance with these Specifications.

3004.3.3 Crack Filling

3004.3.3.1 Scope

Crack filling shall be carried out using a binder of a suitable viscosity, normally a slow-curing bitumen emulsion, as instructed by the Engineer. For wider cracks, in excess of an average of 3 mm in width, the application of emulsion shall be preceded by an application of crusher dust, or other fine material or a suitable premix acceptable to the Engineer.

3004.3.3.2 Materials

Bitumen for use in crack sealing shall be of a slow curing type as instructed by the Engineer. Dust for crack sealing, when used, shall be crusher dust or some other suitable fine material approved by the Engineer, passing the 2.36 mm sieve but with a maximum of 10 percent passing the 0.075 mm sieve.

3004.3.3.3 Construction

If crusher dust or other graded fine material is to be used it shall be placed in the cracks before the application of binder and the cracks filled to a level approximately 5 mm below road surface level. The surface of the road shall be swept clear of dust prior to the application of binder or premix. Binder shall be poured into the cracks, taking care to minimise spillage. If spillage onto the road surface does occur, dust shall be applied to the excess bitumen until it is blotted up. Where a crack-filling mix is used, a squeegee shall be used to force the premix into the cracks wider than 10 mm.

3004.3.3.4 Measurement

The work of crack sealing in areas where patching is to be done subsequently shall be measured in sq.m. Isolated cracks where no patching is to be done subsequently shall be measured in linear metre.

3004.3.3.5 Rate

The contract unit rate for crack sealing shall be payment in full for :

- i) supplying all necessary materials and for the work of applying them;
- ii) all labour, tools, equipment and all incidentals necessary to complete the work according to these Specifications.

3004.3.4 Crack Prevention Courses

Where specified crack prevention courses shall conform to Clause 517.

3004.4 Dusting**3004.4.1 Scope**

Dusting shall consist of the application of crusher dust or other fine graded material approved by the Engineer to areas of road where bleeding of excess bitumen is occurring.

3004.4.2 Material

Dust shall consist of crusher dust or other graded fine material acceptable to the Engineer, and shall generally be finer than 2.36 mm with not more than 10 percent passing the 0.075 mm sieve.

3004.4.3 Dust shall be spread by manual application, to the areas of road defined by the Engineer. Dust shall generally be applied during the hottest part of the day and, when so instructed by the Engineer, surplus dust displaced by passing traffic shall be manually swept back onto the area where further bleeding of excess bitumen is apparent. Dust shall be applied at a nominal rate of 2.5 kg per square metre.

3004.4.4 Measurement

Dusting shall be paid for by the square metre of road surface instructed to be dusted by the Engineer.

3004.4.5 Payment

The Contract unit rate for dusting shall be payment in full for :

- i) supplying all necessary materials and for the work of applying them;
- ii) all labour, tools, equipment and all incidentals necessary to complete the work according to the Specifications.

3004.5 Slurry Seal

Slurry seal for use in maintenance work shall conform to the requirements of Clause 512.

3004.6 Surface Dressing for Maintenance Work

Surface dressing for maintenance applications shall be carried out in conformity with the requirements of **Clause 509**, except that the use of small and portable equipment shall be permitted provided that it can be demonstrated, to the satisfaction of the Engineer, that it can produce work consistently in accordance with the requirements of these Specifications.

3004.7 Special Treatments

3004.7.1 Special treatments include repairs of localized areas of damage to materials for which repairs using normal hot-mix or cold-mix patching materials are inappropriate. Such special treatments will include repairs to mastic asphalt and stone matrix asphalt.

3004.7.2 In such cases, pothole and patch repairs shall be carried out in accordance

with the provisions of Clause 3004.2 above, except that the treatment to the mastic asphalt, stone mastic asphalt or other special material layer shall be carried out in accordance with the provisions of the appropriate Clauses of these Specifications.

3005 MAINTENANCE OF CEMENT CONCRETE ROAD

3005.1 Repair of Joint Grooves with Epoxy Mortar or Epoxy Concrete

3005.1.1 Scope

The work shall consist of repair of spalled joint grooves of contraction joints, longitudinal joints and expansion joints in a concrete pavement using epoxy mortar or epoxy concrete.

3005.1.2 Materials

The type/grade of epoxy compatible with the coefficient of thermal expansion of concrete shall be used with either processed fine aggregate or fine stone chips to produce a dry mix for repairing spalled or damaged edges.

3005.1.3 Repairing Procedure

Spalled or broken edges shall be shaped neatly with a vertical cut with chisels into the shape of rectangle. Small pneumatic chisels also may be used, provided the cutting depth can be controlled. The depth of the cut shall be the minimum to effect repair. After shaping the spalled area, it shall be cleaned and primed. The epoxy mortar/concrete is then applied using hand tools like trowels, straight edges, brushes etc. The repaired edge shall be in line with the joint groove and shall be flush with the concrete slabs. During the repair work, any damage noticed to the joint sealant shall be made good by raking out the affected portion and resealing.

3005.1.4 Traffic

Although the epoxy mixes set in 2-3 hours time, it is desirable to divert the traffic for 12 hours or as per the recommendation of the manufacturer.

3005.1.5 Measurements for Payment

Repair of joint grooves shall be measured in linear metres.

3005.1.6 Rate

The Contract unit rate for repair of joint grooves with epoxy mortar or epoxy concrete shall be in full compensation for :

- i) supply and application of epoxy primer, epoxy mortar or epoxy concrete;

- ii) all tools, equipment and incidentals to complete the work in accordance with the Specifications.

3005.2 Repair Involving Removal of Old Joint Sealant and Sealing with Fresh Sealant in Cement Concrete Pavements

3005.2.1 Scope

The repair of sealant of contraction, longitudinal or expansion joints shall include removal of the existing sealant and resealing the joint with fresh sealant material.

3005.2.2 Material

Sealant material to be replaced shall be either hot poured rubberised bitumen or cold-poured polysulphide or silicone sealant as per Clause 602.2.10. As per the recommendation of the manufacturer, appropriate type of primer shall be applied.

3005.2.3 Repairing procedure

The existing sealant shall be raked out with the help of a metal raker such that most of the sealant is removed. Subsequently, the sealant stuck to the sides of the grooves shall be removed thoroughly either by using saw cutting machine so that grooves may be widened by 1 mm or by sand blasting. In no case the old sealant shall be present during resealing operation. If joint grooves are found inadequate in depth, they shall be deepened as directed by the Engineer. The edges of the groove shall be chamfered. Any spalls of the joint shall be made good by epoxy mortar.

Before commencing the sealing operation, compressed air shall be used to clean the joint grooves. A heat resistant, paper backed compressible debonding strip or tape and backer rod should be inserted in accordance with the requirement of Clause 602.10.2. Sealant may be poured either using hand held pourer or using mechanized sealing machines. Sealants should not be heated directly but in double jacketed machine. All precautions and arrangements shall be taken not to spill the sealant on the concrete pavement. The sealant may be poured to a depth of 3 mm from the pavement surface.

3005.2.4 Measurements for Payment

Repair of joint sealant shall be measured in linear metres.

3005.2.5 Rate

Contract unit rate for repair of joint sealant shall be in full compensation for :

- a) removal of old sealant, regrooving or sand blasting the sealing groove and placing of debonding strip or tape.
- b) all tools, equipments and incidentals to complete the work in accordance with the Specifications.

3100

REINFORCED SOIL

3101 SCOPE

The work covers construction of reinforced soil structures together with the construction of earthwork in layers, assembly and placing of reinforcing elements and fascia elements during the construction process and all associated works.

The work shall include the design and construction of the reinforced soil structure and ground improvement measures required, if any.

The reinforced soil retaining structures can be used as, (i) Reinforced soil retaining wall, (ii) Reinforced soil abutment, (iii) Reinforced soil slope

Reinforced soil structures with slope face angles steeper than 70° are categorized as reinforced soil walls and those with slope face angle less than 70° are considered as reinforced soil slopes.

3102 DESIGN

Guidelines for design are given in Annexure-1.

3103 REINFORCING ELEMENT

3103.1 The reinforcing element shall be metallic in the form of strips (aluminum alloy strip, copper strip, carbon steel strip, galvanised steel strip, stainless steel strip, ladder) or mats of metal (steel grids, woven and welded steel wire meshes) or synthetic (PET, HDPE, PVA, PP) reinforcement in the form of grid or strip or strap or combination of metallic or synthetic or any other proprietary material which may be approved by the Engineer and shown on the drawings

3103.2 Aluminum alloy strip shall comply with BS:1470 quality 5454 in the H 24 condition.

3103.3 Copper strip shall comply with BS:2870 quality C 101 or C 102 in the ½ H condition and shall have 0.2 percent proof stress of not less than 180 N/mm².

3103.4 Carbon steel strip shall comply with BS EN 10025 or IS:2062 and have a silicon content of not more than 0.55 percent. The fabricated element shall be galvanized in accordance with IS:4759 and IS:2629 and the minimum zinc coating weight shall not be less than 1000gm/sq.m

The steel strips with minimum bearing and shear strength of 490N/mm² shall comply with the requirements of BS EN 10025, Grade S 355 JR, or IS:2062 grade Fe 490, except the elongation (on base metal) for which minimum 22 percent is acceptable.

The panel lugs shall be manufactured from hot-rolled steel strips with the same steel quality and grades as specified above, except that the minimum zinc coating weight not less than 600 gm/sq.m.

All permanent metallic connectors (exposed to soil), tie strips and lugs shall be hot dip galvanized. Nuts/ bolts (fasteners) shall be galvanized as per requirements of IS: 1367-Part 3. Nuts/ bolts (fasteners) shall be of grade 10.9.

For all metallic components, where holes or penetrations are made through the reinforcing elements to accommodate connection such as bolts, pins, or other, the cross section thickness and/or width of metallic component shall be increased to account for section loss caused by the hole or penetration.

3103.5 Stainless steel strip shall comply with BS: 1449 (Part 2) quality 315 S 31 or 3/6 S 33 except that the material shall be cold rolled to provide a 0.2 percent proof stress of not less than 400 N/mm² and the tensile strength shall not be less than 540 N/mm².

3103.6 All metallic components buried in soil shall be of electrolytically compatible materials.

3103.7 Geotextile, Geogrids and other Geosynthetic Materials used as Reinforcing Elements

3103.7.1 Geotextile

High strength high tenacity geotextile fabrics used as reinforcement in the construction of reinforced slopes or in the base of reinforced soil structure as reinforcement, shall be considered as reinforcing element and shall satisfy all the requirements stipulated for geosynthetic reinforcing elements, in Clause 3103.7.2.

Geotextile fabric used for separation, filtration and/ or drainage shall satisfy the requirements given in relevant Clauses of Section 700 Geosynthetics.

3103.7.2 Geogrids

The manufacturer of geogrids, geotextiles, geostrips, polymeric strips or straps, polymeric ties or any other geosynthetic material, including any proprietary geosynthetic material, for use as reinforcing element shall fulfill the following requirements:

- a) Shall have ISO (ISO-9001) or CE Certification for manufacturing process and quality control, and
- b) The product shall have certification for use as soil reinforcing material from an agency accredited for certifying geosynthetic reinforcement products.

- c) The manufacturer shall provide test reports from an independent laboratory with valid accreditation, for all the tests needed to establish all the reduction factors listed below

RF_{CR}	-	Reduction factor for creep.
RF_{ID}	-	Reduction factor for installation damage
RF_W	-	Reduction factor for weathering
RF_{CH}	-	Reduction factor for chemical/ environmental effects.
f_s	-	Factor for the extrapolation of data

All the above factors shall be determined in accordance with the provisions of ISO/TR 20432- "Guide to the determination of long-term strength of geosynthetics for soil reinforcement."

Project Specific Tests/Data

Test for the ultimate tensile strength shall be carried out on a random sample for each grade of reinforcement as per ISO-10319. The test results shall be accompanied by stress-strain curves showing strength at 2% and 5% strain and strain/elongation at failure.

The manufacturer shall also provide the results of ultimate tensile strength for each lot and all grades of reinforcement proposed for use in the project.

Annual Average Daily Temperatures (AADT)/design temperature of the project site shall be worked out and values of reduction factor for creep RF_{CR} and for RF_{CH} shall be provided as per procedures given in ISO/TR-20432.

Tests shall be carried out to provide values of

- i) Pull-out coefficient as per ASTM D 6706 "Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil" and
- ii) Coefficient of interaction between reinforced fill soil and geogrids as per ASTM D 5321-"Standard Test method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear method" or as per IS: 13326: Part 1-1992 "Method of test for the evaluation of interface friction between geosynthetics and soil: Part 1 Modified direct shear technique" for all types of geogrids.

One set of project specific tests shall be conducted at third party accredited laboratory or at a reputed institute.

Each roll shall have at least one identification label with roll number and product type.

3104 EARTH FILL

The fill material in the reinforced soil zone shall have drained or effective angle of friction not less than 30°, measured in accordance with IS:2720 (Part 13), by conducting a drained direct shear test. In case the fill material has 25 percent or more particles of 4.75 mm or larger, drained shear test using large shear box may be conducted (IS:2720:Part 39:Section 1). The gradation of fill soil shall be as per following limits.

Sieve Size	Percentage Passing
75 mm	100%
425 micron	0-60%
75 micron	less than 15
PI ≤6	

Materials with more than 15 percent passing 75 micron sieve, but less than 10 percent of particles smaller than 15 microns are acceptable provided PI is less than 6 and angle of friction is not less than 30°.

Fly ash may be used as fill material in reinforced soil walls provided its angle of internal friction is not less than 30° and PI is less than 6. Gradation requirements need not be completely satisfied. Reference may be made to IRC Guide lines on Use of Flyash in Road Embankments (IRC:SP-58). Fly ash shall also satisfy requirements concerning pH and environmental conditions of the fill vis-à-vis the reinforcement type as specified in Clause 3014.1.

The fill material used in the reinforced soil zone shall be free from organic or other deleterious materials and shall not react adversely (chemically, electrically or biologically) with the reinforcement material and/or facing material.

Properties of fill soil in the reinforced zone, unreinforced zone (or retained/back fill) soil and the foundation soil shall be determined accurately during the construction phase, as per quality assurance plans and directions of Engineer so as to ensure that these are the same as those considered in the design phase.

The fill soil in the unreinforced zone shall conform to the requirements specified in the design.

3104.1 Environmental Conditions of Fill**3104.1.1 Steel Reinforcement**

Where galvanized steel reinforcement is used, the fill material shall be free draining granular material and shall meet the following requirements as per Table 3100.1.

Table 3100.1 : Recommended Limits of Electrochemical Properties for Reinforced Fills with Steel Reinforcement

Property	Criteria	Test Method
Resistivity	> 3000 ohm-cm	AASHTO T-288
pH	> 5 and < 10	AASHTO T-289
Chlorides	< 100 PPM	ASTM D 4327
Sulphates	< 200 PPM	ASTM D 4327

3104.1.2 Geosynthetic Reinforcement

Where geosynthetic reinforcement is used for reinforcing elements manufactured from polyester yarn, pH value of the fill material shall be between 3 and 9, and for reinforcing elements manufactured from PVA, PP and HDPE, the pH value shall be greater than 3.

3105 FACIA MATERIAL

3105.1 The facing system shall be one of the following

- a) Precast reinforced concrete panels
- b) Precast concrete blocks and precast concrete hollow blocks.
- c) Gabion facing
- d) Wrap around facing using geosynthetics
- e) Metallic facing, prefabricated in different shapes including welded wire grid and woven steel wire mesh
- f) Other proprietary and proven systems

Facing shall be sufficiently flexible to withstand any deformation of the fill and foundations.

The facia units to be adopted in the project shall be shown in the drawings and shall be approved by the Engineer.

3105.1.1 Precast Reinforced Concrete Panels

The minimum thickness of precast concrete panels shall be 180 mm including facing textures, logos and embellishments. The grade of concrete shall be minimum M35. The concrete shall conform to the requirements of Section 1700 of these Specifications.

Facia panel systems shall have provision of both horizontal and vertical gaps to prevent concrete to concrete contact. The horizontal gap between the facing elements shall be maintained by provision of Ethylene Propylene Diene Monomer (EPDM) pad. Bedding

material shall consist of either cement mortar or a durable gasket seating such as resin bonded cork, bitumen bonded cork or EPDM.

The joints between the panels shall be covered from inside with non-woven geotextile strips glued to the facing element ensuring full coverage of joints. Synthetic glue shall be used for this purpose. The width of the geotextile strip shall not be less than 100 mm.

3105.1.2 Precast Concrete Blocks/Segmental Blocks/Modular Blocks

Precast concrete blocks are dry cast and shall be manufactured from fully automatic block making machines. The minimum grade of concrete shall be M 35 for all kinds of modular blocks. In case of hollow blocks, the hollow area shall not exceed 40 percent of the cross sectional area of the block. The outer side of the block shall have minimum thickness of 100 mm.

3105.1.3 Gabion Facia

Where gabion facia is used, it shall conform to the provisions of BS 8006-1:2010 and EN 14475 and made of mechanically fabricated and selvedged double twisted hexagonal mesh. Wire used for the double twisted mesh shall be hot dip galvanized as per IS:4826 – heavily coated and soft type, with wire and mesh properties in accordance with EN-10223 with minimum Zn or Zn + alloy coating as per EN-10244 and 0.5 mm thick PVC coating as per EN-10245 and ISO-527.

3105.1.4 Wrap Around Facing using Geosynthetics

Where geosynthetics, including geogrids are used as wrap around facia, these shall form a part of the reinforcing element. The wrap around shall have adequate length to resist pull out and the wrap around length shall be calculated on the basis of safety in pull out. Wrap around facia shall be protected by suitable means, against adverse effects of natural forces.

3105.1.5 Metallic Facing, Prefabricated in Different Shapes Including Welded Wire Grid, Steel Sheet and Woven Steel Wire Mesh

Where steel sheet and steel grids facings are used for facing, steel for steel sheet shall be as per BS:1449-Part 1 and steel grids shall conform to BS:4482, BS:4483 and BS:4489.

Where mechanically woven steel wire mesh in wrap around form is used for facing, the steel wire mesh (IS:4826, IS:280, IS:13360, EN:10218, EN:10223, EN:14475) shall be with mechanical selvedging and bottom panel shall continue as an integrated tail mesh.

Where welded steel wire mesh units in wrap around form (EN:10079, EN:10080, and EN:ISO 1461, EN:14475) are used as facing, the bottom panel shall continue as an integrated tail mesh.

3105.2 Facia type adopted shall be given in the design and shown with complete details in the drawings. The system supplier shall provide any test data to satisfy the Engineer regarding the properties and suitability of the facia system adopted, if so required.

Where facia such as wrap around or gabion or welded wire and woven steel wire mesh facings have been used and where climate conditions are appropriate, a green finish shall be provided where specified.

3105.3 Connection between the Facia and Reinforcement

Connection between the facia panels and the reinforcing element shall be by using either nut or bolt, HDPE inserts with bodkin joint, hollow embedded devices, polymeric/steel strips/rods/pipes, fibre glass dowels or any other material shown in the drawings. The connection between the panel and the reinforcement shall provide for 100 percent of the long term design strength of the reinforcing element in continuity.

In case of modular block facia and other type of facia such as gabion facia, where the reinforcement is held by friction between the facia block and the reinforcement, the connection strength shall be determined as per ASTM D 6638 "Standard Method of Test for Determining Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units."

The available connection strength shall satisfy the design requirements and shall not be less than the maximum possible tensile force that the reinforcement layer under consideration may be subjected to.

3106 CONSTRUCTION DETAILS

3106.1 Depth of Foundation

A strip footing, minimum 350 mm wide and 150 mm thick in M15 grade plain concrete, shall be provided at founding level to receive the facia or the bottom most reinforcement.

The depth of embedment below the finished ground level at the foot of the wall shall not be less than 1000 mm. In case rock is met above founding level, the depth of embedment shall be adjusted as per ground conditions.

3106.2 Laying of Reinforcement

The reinforcing elements shall be placed at right angles to the face of the wall or design axis, with greater cross-sectional dimension in the horizontal plane and the length shall be as shown in the drawings. Reinforcing elements such as geogrids, shall be stretched and held

taut by driving nails or pegs at the farther end.

3106.3 Facing Batter

It may be necessary to set facing unit at an additional batter than as provided in the drawings since there is a tendency for initially positioned units of facia to lean outward as the fill material is placed and compacted. Care and caution shall be taken to accommodate this phenomenon. At the end of the construction, the face may have a slight residual inward batter.

3106.4 Drainage

Drainage bay shall be provided as shown in the drawings. The width of the drainage bay shall be 600 mm behind the facing element.

The drainage material shall conform to the specifications of the filter media as per Clause 2504.2.2 of these Specifications.

3106.5 Laying and Compaction

The reinforcing elements shall be laid free from all kinks, damage and displacement during placing, spreading, leveling and compaction of the fill. The programme of filling shall be such that no construction plant moves directly on the reinforcement.

All construction plant having a mass exceeding 1500 kg shall be kept at least 2.0 m away from the face of slope or wall.

In the area up to 2.0 m from the face of slope or wall, the following compaction plant shall be used:

- i) Vibratory roller having a weight per metre width not exceeding 1300 kg with total weight not exceeding 1500 kg
- ii) Vibratory plate compactor of maximum weight 1000 kg
- iii) Vibro tamper having a weight not exceeding 75 kg

Before allowing the movement of vehicles over the reinforcement, a minimum compacted thickness of 150 mm shall be provided over the reinforcement and the speed of the vehicles shall be restricted to 10 km/hr.

During construction of reinforced fill, the retained material beyond the reinforcement at the rear of the structure shall be maintained at the same level as reinforced fill.

Fill shall not be placed on surface that contains mud, organic soil or area that have not met compaction requirement.

The thickness of compacted layer shall not be more than 200 mm, compacted to 97 percent of maximum laboratory density measured as per IS:2720 (Part 8).

3106.6 Construction and Serviceability Tolerances

The construction tolerances shall be as per the following:

Casting of pre-cast RCC panels: All elements shall be manufactured within the following tolerances:

- All dimensions within ± 5 mm
- Evenness of the front face: ± 5 mm over 1500 mm
- Difference between lengths of two diagonals: 5 mm max.
- Thickness: + 5 mm (-) 0 mm

Table 3100.2 : Tolerances for Faces of Retaining Walls and Abutments

	Tolerance
Location of plane of structure	± 50 mm – metallic reinforcement ± 75 mm – synthetic reinforcement
Bulging (Vertical) and Bowing (Horizontal)	± 20 mm in 4.5 m template (Metallic) ± 30 mm in 4.5 m template (Synthetic)
Steps at joints	± 10 mm

Dimensional Tolerances for Modular Blocks

Dimensions of modular concrete blocks shall not differ more than ± 2.5 mm for length and width and ± 1.5 mm in height.

Minimum Vertical Movement Capacities of Facing Systems

Minimum vertical movement capacities required for facing systems to cope with vertical internal settlement of reinforced fill shall be as below:

Table 3100.3: Minimum Vertical Movement Capacities of Facing Systems

Structural Form	Minimum Vertical Movement Capacity of System
Discrete panels	Joint closure of 1 in 150 relative to panel height
Full height panels	Vertical movement capacity of connections 1 in 150 relative to panel height
Semi-elliptical facings	Vertical distortion of 1 in 150 relative to panel height
Geotextile/ Geogrid wrap-around facings	No specific limit except for appearance or serviceability considerations

3106.7 Capping Beam, Crash Barrier and Friction Slab

Capping beam, crash barrier and friction slab shall be provided as per the design and drawings.

3107 REINFORCED SOIL SLOPES

This section deals with construction of reinforced soil structures that have a slope face angle flatter than 70°.

3107.1 Reinforcing Elements

Any type of material used as reinforcing element for the construction of a reinforced soil slope shall meet all the requirements provided in the Clause 3103. Any Geosynthetic material used as reinforced element of the construction of a reinforced soil slope shall meet all the requirement in Clause 3103.7.

3107.2 Fill Material

The fill material used as the reinforcing fill in the reinforced soil slope shall meet all the requirements for fill material specified in Clause 3104. However the friction angle of the fill material in this case shall not be less than 28°.

3107.3 Facia for Reinforced Soil Slope

Facia of reinforced soil slope shall be one of the following types

- a) Wrap around facing using geosynthetics
- b) Gabion facing
- c) Metallic facing, prefabricated in different shapes including welded wire grid and woven steel wire mesh.

- d) Precast reinforced concrete panels
- e) Precast concrete blocks and precast concrete hollow blocks.

The specifications for the materials used for above facing types shall be as provided in **Clause 3105.1**.

3107.3.1 Wrap Around Facia using Prefabricated Geosynthetic Bags

Where specified wrap around facia using prefabricated geosynthetic bags shall be used in the construction of reinforced soil slopes for slope angles less than 45°. Such type of facia shall conform to the provisions in EN:14475.

3107.4 Connection between the Facia and Reinforcement

Connection between facia and reinforcement in the reinforced soil slope shall satisfy the design requirements.

3107.5 Facia type adopted shall be given in the design and shown with complete details in the drawings. The system supplier shall provide any test data to satisfy the Engineer regarding the properties and suitability of the facia system adopted, if so required by the Engineer.

Where facia such as wrap around or gabion or welded wire and woven steel wire mesh facings have been used and where climate conditions are appropriate, a green finish shall be provided where specified.

3107.6 Laying and Compaction

Laying of the reinforcement in the reinforced soil slope and the compaction of the fill shall conform to the provisions of Clause 3106.5.

3108 SYSTEM RESPONSIBILITY, PERFORMANCE BOND

3108.1 System Responsibility

If specified in the contract, the system supplier shall provide performance bond in conformance with the contract requirements. The performance bond shall be valid for atleast 20 years.

3109 MEASUREMENT FOR PAYMENT**3109.1 Reinforced Soil Wall**

The measurement for payment for reinforced soil wall shall be in square metres of finished work of each face and shall be measured in the plane of final inclination specified in the drawings. The measurement of length shall be the finished work along the length of the road. The measurement of height along the slope shall be done from the top level of the footing on which the fascia element is placed to the top of the capping beam.

Measurement for friction slab and crash barrier shall be in linear metres.

3109.2 Reinforced Soil Slope

The measurement for payment for reinforced soil slope shall be in square metres of finished work of each face and shall be measured in the plane of final inclination specified in the drawings. The measurement of length shall be the finished work along the length of the road. The measurement of height along the slope shall be done from the top of the leveling pad, where provided, to the top of the embankment. Where leveling pad is not provided, the height shall be measured, in the final plane of inclination specified in the drawings, from the bottom of the slope face.

3110 RATES

The rate shall include cost of material, labour, plant, royalties, handling, storage and transportation expenses, cost of bed block, leveling pad, fascia elements, capping beam, connectors, reinforcing elements, scaffolding, supply of the specified filter media material, supply of soil fill for the reinforced as well as unreinforced zone of the quality specified in the contract, placing, spreading and compaction through mechanical means.

The rate shall include full compensation for design, drawings and testing of materials.

The rate shall include the cost of investigations, design and construction of ground improvement measures.

The payment for friction slab and crash barrier shall be made separately.

ANNEXURE TO SECTION 3100

A1 DESIGN AND DRAWINGS

A1-1.1 Where the contract provides for the design of reinforced soil structure, the same shall be carried out in accordance with the following standards as applicable

1.1.1 BS:8006-1-2010 "Code of Practice for Strengthened/Reinforced Soils and other Fills"

1.1.2 AFNOR NF-P94-270-"Geotechnical Design - Retaining Structures-Reinforced and Soil Nailing Structures".

1.1.3 FHWA-NHI-10-024 and FHWA-NHI-10-025 -"Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes"

A1-1.2 The long term allowable design strength (T_a) of the geosynthetic reinforcement is defined by the following relationship

$$T_a = \frac{T_{ult}}{RF_{CR} \times RF_{ID} \times RF_W \times RF_{CH} \times f_s}$$

Where,

T_{ult} is the ultimate tensile strength (also called characteristic or short term strength)

RF_{CR} - Reduction factor for creep.

RF_{ID} - Reduction factor for installation damage

RF_W - Reduction factor for weathering

RF_{CH} - Reduction factor for chemical/ environmental effects.

f_s - Factor for the extrapolation of data

The cumulative reduction factor obtained as $RF_{CH} \times RF_W$ is also referred to as reduction factor for durability.

The value of RF_{CR} and RF_{CH} corresponding to the Average Annual Daily Temperature (AADT)/ design temperature of the project area shall be used in the design.

The stresses calculated for any reinforcement layer as per the design method adopted shall be compared with the long term allowable design strength (T_a) to check for adequacy. Connection strength and Pullout safety shall also be checked.

A1-1.3 The design shall conform to loadings of IRC:6 or as per contract. Earthquake loadings shall be considered as per IS:1893-Part 1-2002. Checks shall be made for seismic conditions also as per provisions of documents listed in 1.1.2 or 1.1.3 as applicable.

A1-1.4 The allowable bearing capacity of the ground shall be checked as a part of the design process and for ensuring the safety of the structure. Where necessary, measures

to improve the bearing capacity shall be worked out and included in the design, based on adequate subsurface investigation and testing.

The design for ground improvement shall be in accordance with the relevant IS/IRC guidelines.

A1-1.5 Where modular block walls are used in zones with seismic intensity of greater than zone 3, connection strength shall be reduced to 80 % of its static values as per FHWA NHI-10-024 guidelines Clause No 4.4.8.a. Further, the blocks above the uppermost layer of soil reinforcement must be secured against toppling under all seismic events.

A1-1.6 **Crash Barrier** : Horizontal impact load of 29 kN/m shall be considered in the design of crash barrier, which load shall be resisted by the upper two layers of the reinforcement over the full length.

A1-1.7 Where the height of reinforced soil wall exceeds 10 m, the designer may consider providing a berm. The minimum width of such berm shall be 1.5 m.

A1-1.8 Drawings showing layout of the reinforcing elements in the cross section shall be provided for every 1 m change of height or such height where change in the layout of reinforcements occurs. Complete plan and profile drawings shall also be provided.

A1-1.9 Design and drawings shall be submitted for approval of the Engineer at least 3 weeks before the proposed date of commencement of construction of the reinforced soil wall/ structure.

Table A1 : Indicative Range of Reduction Factor Values

Polymer Type	RF_{CR}	RF_{ID}	$RF_{CH} RF_W = RF_D$	f_s
PET	1.36-1.59	1-1.31	1-1.3	1-1.37
PVA	1.42	1.06-1.31	1-1.3	1-1.37
HDPE	2.59-2.63	1.02-1.12	1-1.3	1-1.37

Note :

- These values are the indicative range for different reduction factors for geogrids made by using different types of materials and various manufacturers. The value of reduction factors may differ from product to product. **However, actual certified values shall be used in the design.**
- RF_{CR} and RF_{CH} values mentioned in the above table are for 20°C.

A2 SPACING AND LAYOUT OF REINFORCEMENT IN REINFORCED SOIL WALLS

A2-1.1 The spacing of reinforcement shall be established based on the design principles and standards as per provisions of Clause A1. However, in the actual layout of

reinforcing elements, the following shall be adhered to as provided in the guidelines of FHWA NHI-10-025.

- i) To provide a coherent reinforced soil mass, the vertical spacing of primary reinforcement shall not exceed 800 mm, in all types of reinforcement.
- ii) For walls constructed with modular blocks and deriving their connection capacity by friction, and also for any other facia configurations, where connection capacity is by friction, the maximum vertical spacing of reinforcement shall be two times the block width (measured from front face to back face of the block). Further, the maximum spacing of reinforcing elements shall not exceed 800 mm in all cases.
The maximum height of facing left unreinforced a) above the uppermost reinforcing layer and b) below the lowest reinforcing layer, shall not exceed the width of the block (measured from the front face to back face of the block.)
- iii) In case modular blocks are used for facia, no more than one intervening block shall be left without having primary reinforcement.
- iv) In case of wraparound facings for walls, the maximum spacing of reinforcing elements shall not exceed 500 mm, to protect against bulging.
- v) Where panels are used, the maximum spacing of reinforcement shall not exceed 800 mm. The spacing of nearest reinforcing element shall be such that maximum height of facing above uppermost reinforcement layer and below the lower most reinforcement layer does not exceed 400 mm.
- vi) Reinforcement spacings worked out from the design procedures shall be configured to fit the above parameters.

A2-1.2 Where as the role of the primary reinforcement is to carry the tensile forces in the reinforced fill, secondary reinforcement may be required to protect the slope face from local sloughing and instability depending upon the facia configuration adopted. Where secondary reinforcement is used, stability of the area near the slope face shall be checked separately.

Where metallic type facia elements are used, the lower part of the facia element may be extended into the fill to serve as a secondary reinforcement. In other types of facia, geogrids may also be used as a secondary reinforcement. The length of the secondary reinforcement shall be adequate to provide local stability in the vicinity of the slope face.

A3 REINFORCED SOIL SLOPES

A3-1.1 Reinforced Soil Slopes

Reinforced soil slopes are used in a wide variety of situations, such as

- a) Construction of new embankments
- b) Widening of existing slopes.
- c) To construct a reinforced slope above a reinforced soil wall.

Reinforced slopes with face angle between 70° and 45° are classified as steep slopes and those with face angle flatter than or equal to 45° are classified as shallow slopes.

Design: The design and spacing of reinforcement shall be established based on the design principles of Clause A1 and per the provisions in standards BS:8006-1-2010, FHWA-NHI-10-024 and FHWA-NHI-10-025. The design is mainly based on rotational stability analysis.

Steep slopes require a suitable facing to hold the reinforcement in-place as well as to protect the slope from local instability adjacent to the face. In the case of flatter slopes also, facing may be called for. Depending upon the properties of the fill and local climatic conditions of the area, suitable slope protection measures need to be adopted.

Where wrap around facia, gabion facia, woven and welded wire mesh facia are used suitable batter needs to be given. This batter may also be achieved by means of providing stepped offsets in placing the facia elements.

A3-1.2 Facia

Facing shall enable the construction within specified tolerances of vertical and horizontal alignment and it should perform over the design life. The facing system should be able to meet the functional requirements such as rigidity, flexibility, aesthetics, environmental considerations etc. depending on location, purpose and use of structure.

For reinforced soil slopes of permanent nature, the durability of basic material for facing shall be ensured. A suitable filter should be provided behind the woven or welded steel wire mesh elements when they are provided in wrap around form. For steeper slopes in high rainfall intensity and/or high seismicity areas, combination of woven and welded steel wire mesh elements with additional stiffening elements and filter cloth shall be used to achieve flexibility, erosion prevention and stiffness requirements.

Where geosynthetics are used as facing for permanent reinforced slope structures, outer facia elements are required to be protected against UV degradation from sunlight. When vegetation is used as the facia cover, the face should provide a suitable medium like coir or jute for the establishment and continued growth of vegetation. For a vegetated face, several interrelated aspects need to be considered, including the climate, water requirements of plants and water availability, site location aspect, altitude, amount and frequency of precipitation, exposure, form of facing and erosion resistance capability to ensure permanent vegetative covering throughout the design life. If the characteristics of back fill soil are not adequate to support vegetation, suitable top soil material may be placed at the front face separated from the fill by an appropriate separator.

The contractor shall provide facing for the reinforced soil slope as approved by the designer and shown in the drawing plan.

ANNEXURE TO SECTION 3100**LIST OF CODES USED IN THE TEXT**

S. No	Code	Description
1)	BS:8006-1:2010	Code of practice for strengthened/reinforced soils and other fills
2)	FHWA-NHI-10-024-Vol I & Vol II	Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes
3)	AFNOR NF-P94-270	Geotechnical Design-“Retaining structures-Reinforced and Soil nailing structures”
4)	IS:1893-Part 1:2002	Criteria for Earthquake resistant design of structures-Part 1: General provisions and buildings
5)	IS:13360:Part 3.	Plastics - Methods of Testing - Part 3 : Physical and Dimensional Properties - Section 1
6)	IS:280	Specification for Mild steel wire for general engineering purposes
7)	IS:2720 (Part 8)	Determination of water content-dry density relation using heavy compaction
8)	IS:2720 (Part 13)	Methods of test for soils part 13 : Direct Shear Test
9)	IS:2720 : Part 39 : Section 1	Direct shear test for soils containing gravel, Section 1 Laboratory test
10)	IS:13326-Part 1	Method of test for the evaluation of interface friction between geosynthetics and soil: Part 1 modified direct shear technique” for all types of geogrids
11)	IRC:6	Standard specifications and code of practice for road bridges
12)	IRC:SP:58-2001	Guidelines on Use of Flyash in Road Embankments
13)	ASTM 974	Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic-Coated or Poly(Vinyl Chloride) (PVC) Coating)
14)	ASTM 975	Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)
15)	ASTM D 6706	Standard Test Method for Measuring Geosynthetic Pullout Resistance in soil

16)	ASTM D 6638	Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)
17)	ASTM D 5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear method
18)	EN 10218	Steel Wire and Wire products- General Part 2- Wire Dimensions and Tolerances
19)	EN 10223	Steel Wire and Wire Products for Fences- Hexagonal Steel Wire Netting for Engineering Purposes
20)	EN 10244	Steel and Wire Products – Non Ferrous Metallic Coating on Steel Wire
21)	EN 10245	Steel and Wire Products – Organic Coatings on Steel Wire
22)	EN 10079	Definition of Steel Products
23)	EN 10080	Steel for the Reinforcement of Concrete — Weldable Reinforcing Steel — General
24)	EN 1461	Hot Dip Galvanized Coatings on Fabricated Iron And Steel Articles- Specifications and Test Methods
25)	EN 10025-2	Hot Rolled Products of Structural Steels - Part 2-Technical Delivery Conditions for Non-Alloy Structural Steels
26)	EN-14475	Execution of Special Geotechnical Works- Reinforced Fill
27)	BS:1470	Specification for Wrought Aluminium and Aluminium Alloys for General Engineering Purposes
28)	BS:2870	Specification for Rolled Copper and Copper Alloys: Sheet, Strip and Foil.
29)	ISO-10319	Geosynthetics - Wide-Width Tensile Test
30)	ISO/TR 20432	Guide to the Determination of Long-Term Strength of Geosynthetics for Soil Reinforcement
31)	ASTM D 4327	Standard Test Method for Anions in Water by Chemically Suppressed Ion Chromatography
32)	AASHTO T-288	Standard Method of Test for Determining Minimum Laboratory Soil Resistivity
33)	AASHTO T-289	Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing

3200

SOIL NAILING

3201 SCOPE

The specifications shall apply to soil nailing works as required to be carried out under the Contract or as directed by the Engineer.

3202 NAIL INSTALLATION METHODS

3202.1 Generally used soil nail installation techniques in practice are: (i) drilled and grouted soil nails, and (ii) driven soil nails. Grouted nails are recommended for all types of soil nail walls applications; and in particular, for walls with vertical height more than 7 m. Driven nails shall only be used when wall heights are smaller (less than or upto 7.0 m). The major difference between the two is the pullout resistance of the soil nails and grouted soil nails are expected to have higher pull out resistance. Pull out test is desirable to check the values of pullout resistance which is useful in soil nail design.

3202.2 Drilled and grouted soil nails (or simply grouted nails), are approximately 75 mm to 200 mm diameter nail holes drilled in the soil mass to be retained, which shall be followed by placing of steel reinforcement bars (tendon) and the grouting of the drill hole.

3202.3 Driven soil nails are relatively small in diameter (20 mm to 25 mm) and are mechanically driven into the ground. They are usually spaced approximately 0.5 m to 1.0 m apart.

3203 CONSTRUCTION MATERIALS

Following covers the general materials required for the construction of typical soil nailing structure.

3203.1 Reinforcement Bar (Nail or Tendon)

The reinforcing element (tendon) shall be high strength steel reinforcing bar conforming to IS:1786 with a characteristic tensile strength of 415 MPa or higher which may be threaded at one end. Minimum recommended diameter of reinforcement bar (tendon) is 16 mm.

3203.2 Nail head

The nail head shall comprise of following main components: the bearing-plate, hex nut, and washers; and the headed-stud. The bearing plate with a central hole (with diameter greater than reinforcement bar) shall be of minimum Fe250 grade steel, typically square in shape with 200 to 250 mm side dimension and 19 mm thickness. Washers and nuts shall be made of steel with a grade consistent with that of the nail bar commonly of 415 MPa or higher. Nuts may be tightened with a hand-wrench. The headed-stud connection may consist of four headed studs welded near the four corners of the bearing plate to provide anchorage of the

nail head into the permanent facing. For temporary walls, the bearing plate shall be on the outside face of the shotcrete facing.

3203.3 Grout

Grout for soil nails is required to fill the annular space between the nail bar and the surrounding ground, and for shotcreting of the temporary facing. Grout for soil nail walls is commonly a neat cement grout with the water/cement ratio typically ranging from 0.4 to 0.5. Grout mix shall be prepared in accordance with IS:9012. Grout shall have a minimum 28 days characteristic strength of 20 MPa. For filling up nail holes, grout shall be pumped shortly after the nail bar is placed in the drillhole to reduce the potential for hole squeezing or caving. In solid nail bar applications, the grout may be injected by tremie methods through a grout pipe, which is previously inserted to the bottom of the drillhole, until the grout completely fills the drillhole.

3203.4 Centralizers

Centralizers are devices made of polyvinyl chloride (PVC) or other synthetic materials that are installed at various locations along the length of each nail bar to ensure that a minimum thickness of grout completely covers the nail bar. Centralizers shall be installed at regular intervals, typically not exceeding 2.5 m, along the length of the nail and at a distance of about 0.5 m from each end of the nail.

3204 FACING TYPES

Soil nail walls are generally provided with two types of facings: (a) temporary facing and (b) permanent facing.

3204.1 Temporary Facing

Temporary facing shall be constructed by providing reinforcement in the form of welded wire mesh (conforming to IS:1566) throughout the wall face, and by additional bearing plates (see **Clause 3203.2.**) and waler bars (rebars of smaller lengths placed in the vicinity of nail head) at the nail heads; which is, subsequently shotcreted in accordance with IS:9012. Overall temporary facing thickness shall vary from 75 mm to 200 mm.

3204.2 Permanent Facing

Permanent facing may be constructed as cast-in-place reinforced cement concrete conforming to IS:456, precast concrete or any suitable material to achieve desired strength and aesthetics. Reinforcement in the permanent facing may be adopted in the form of welded wire mesh or reinforcement bars in either direction. Permanent facing shall be connected to the temporary facing by means of headed-studs (usually four numbers per plate) welded on the bearing plates installed during construction temporary facing. Minimum thickness of permanent facing shall not be less than 200 mm.

3205 CONSTRUCTION SEQUENCE

3205.1 Typical sequence of construction of a soil nail wall shall be in accordance with following steps:

- Step 1: Excavation of initial cut of 1.0 m to 2.0 m depending upon the capacity of in-situ soil to stand unsupported for about 12-24 hrs;
- Step 2: Drilling hole for nail;
- Step 3: Installation of nails followed by grouting and placing of drainage strip;
- Step 4: Placing of construction facing and installation of bearing plates;
- Step 5: Repetition of process till final level is reached; and
- Step 6: Placing of final facing.

3206 GEOTECHNICAL ASPECTS**3206.1 Soil Investigation**

For soil nail walls more than 30 m long, exploratory borings should be spaced between 30 to 60 m along the proposed centerline of the wall. For walls less than 30 m long, at least one boring is necessary along the proposed centerline of the wall. Borings are also necessary in front and behind the proposed wall. Borings behind the wall should be located within a distance up to 1 to 1.5 times the height of the wall behind the wall and should be spaced up to 45 m along the wall alignment. Borings in front of the wall should be located within a distance up to 0.75 times the wall height in front of the wall and should be spaced up to 60 m along the wall alignment. The depth of borings should extend at least one full wall height below the bottom of the excavation.

3206.2 Bond Strength

The bond strength is the mobilized shear resistance along the soil-grout interface. The bond strength adopted for the design of soil nails is commonly based on conservative estimates obtained from field correlation studies and local experience in similar conditions. Consequently, some percentage of the soil nails shall be load tested according to standard procedure (pullout tests) in the field to verify bond strength design.

3206.3 Suitable In-Situ Ground Conditions

Following are the in-situ conditions considered favorable for the prospective use of soil nailing technique.

- a) Soil shall be able to stand unsupported to a depth of about 1 m – 2 m high vertical or nearly vertical cut for 12-24 hours.

- b) Groundwater table shall be sufficiently below level of the lowermost soil nail at all cross-sections.
- c) Favorable soils: Stiff to hard fine –grained soils, dense to very dense granular soils with some apparent cohesion, weathered rock with no weakness planes and glacial soils.

3207 ANALYSIS OF FAILURE MODES

3207.1 Analysis of various failure modes of soil nail structures shall be performed using allowable stress design methodology in accordance with IRC publication “*Interim Guidelines for Soil Nailing Technique in Highway Engineering Applications*” or any other state-of-art standard for analysis, design and construction of soil nail walls. For rigorous analyses, use of computational tools based on advanced numerical techniques such as finite element method, is strongly recommended.

3208 INITIAL DESIGN CONSIDERATIONS

3208.1 Wall layout

Establish the layout of the soil nail wall, including: (1) wall height; (2) length of the wall; (3) backslope; and (4) wall face batter. Wall face batter typically ranges from 0° to 10°. The evaluation of the wall layout also includes developing longitudinal profile of the wall, locating wall appurtenances (e.g., traffic barriers, utilities, and drainage systems), and establishing ROW limitations.

3208.2 Soil Nail Vertical and Horizontal Spacing

Typically, same nail spacing can be adopted in both horizontal S_h and vertical S_v directions. Nail spacing ranges from 1.25 to 2 m (commonly 1.5 m) for conventional drilled and grouted soil nails, and as low as 0.4 m for driven nails. As a general rule, soil nail spacing in horizontal and vertical direction must be such that each nail has an influence area $S_h \times S_v \leq 4m^2$.

3208.3 Soil Nail Pattern on Wall Face

The soil nail pattern on wall face may be adopted as one of the following: (1) square (or rectangular); (2) staggered in a triangular pattern; and (3) irregular (at limited locations) depending upon the ease of construction and site-specific constraints.

3208.4 Soil Nail Inclination

Soil nails are typically installed at an inclination ranging from 0 to 30 degrees from horizontal with a typical inclination of 10-25 degrees.

3208.5 Soil Nail Length and Distribution

The distribution of soil nail lengths in a soil nail wall can be selected as either uniform (i.e., only one nail length is used for the entire wall), or variable, where different nail lengths may be used for individual soil nail levels within a wall cross section. Uniform nail pattern is recommended for most applications.

3209 OTHER DESIGN CONSIDERATIONS**3209.1 Loads and Load Combinations**

Soil nail walls used on typical highway projects are typically subjected to the following different loads during their service life: (i) Dead loads DL (e.g., weight of the soil nail wall system, lateral earth pressure, weight of a nearby above-ground structure); (ii) Live loads LL (e.g., traffic loads); (iii) impact loads IL (e.g., vehicle collision on barriers above soil nail wall); and (iv) earthquake loads EQ. Following load combinations are recommended to assess the most critical loading condition:

- (a) DL + LL
- (b) DL + LL + IL
- (c) DL + EQ

For earthquake loads, allowable stresses shall be increased by 133 percent from the values obtained with factors of safety for static loads.

3209.2 Permissible Soil Nail Wall Deformations

The maximum permissible lateral deformation at the top of the soil nail walls constructed in weathered rock and stiff soils is 0.1%H; sandy soils is 0.2%H and for fine-grained soils is 0.3%H. Under no circumstances maximum permissible lateral deformation shall exceed 0.3%H, where: H is the vertical height of the soil nail wall. Permissible vertical deformation (i.e., settlement) shall be considered to be same as the permissible horizontal deformation.

3209.3 Drainage Measures**3209.3.1 Short Term Drainage Measures**

Surface water and groundwater must be controlled both during and after construction of the soil nail wall. A surface water interceptor ditch, excavated along the crest of the excavation and lined with concrete, is a recommended element for controlling surface water flows. Additionally, if ground water impacts are temporary or localized, suitable dewatering measures may be taken for lowering the groundwater table:

3209.3.2 Long Term Drainage Measures

Long term drainage shall be provided by means of the drainage system comprising of: (i) vertical geo-composite drain strips placed suitably along the face of wall; (ii) weep holes in the form of perforated PVC pipes of typical diameter as 50-100 mm and 300- 600 mm length, placed through the face at the location of expected localised seepage; (iii) provision of horizontal or slightly inclined drain pipes of typical diameter 50 mm installed at the locations where it is necessary to control the groundwater pressures imposed on the retained soil mass; (iv) installation of permanent interception ditch behind the wall at its crest to prevent surface water runoff from infiltrating behind the wall or flowing over the wall edge; and (v) provision of a vegetative protective cap/cover to reduce or prevent water infiltration into the soil.

3209.4 Corrosion Protection

Corrosion potential of the soil must be evaluated for all permanent soil nail walls and, in some cases, for temporary walls.

Corrosion protection measures: (a) Specify a minimum grout cover of 25 mm between the reinforcement nail bar and the soil; (b) recommend epoxy coating of minimum thickness 0.4 mm on the nail bars shall be applied by the manufacturer prior to shipment of nails to the construction site, which is, subsequently to be encased in grout cover; and (c) adopt other site-specific suitable corrosion protection measures.

3210 FIELD PULLOUT TESTING

3210.1 Field pullout testing of soil nails shall be conducted (a) to verify that the nail design loads can be carried without excessive movements and with an adequate safety factor for the service life of the structure, and (b) to verify the adequacy of the contractor's drilling, installation, and grouting operations prior to and during construction of production soil nails.

3210.2 Types of Field Pullout Tests

Depending upon the type of test being performed, the maximum test load, the load increments, and the time that each load increment is held shall be determined. To prevent chances of explosive failure of the steel, in no case, the soil nail tendon be stressed to more than 80 percent of its minimum ultimate tensile strength for grade Fe415 steel, or more than 90 percent of the minimum yield strength for grade Fe500 steel.

3210.2.1 Verification Test

A verification test on soil nail is performed: (a) to determine the ultimate bond capacity (if carried to pullout failure); (b) verify the design bond factor of safety, and (c) to determine the soil nail load at which excessive creep occurs. Verification tests are generally conducted on non-production "sacrificial" nails as a **first order of work prior to construction**.

3210.2.2 Proof Test

A proof test is typically performed on a specified number of the total number of production soil nails installed. Typically, successful proof tests shall be performed on 5 percent of the production nails in each row or a minimum of 1 test per row. Proof tests provide information necessary to evaluate the ability of production soil nails to safely withstand design loads without excessive structural movement or long-term creep over the structure's service life.

3210.2.3 Creep Test

Creep tests are generally performed as part of a verification or proof test to ensure that nail design loads can be safely carried throughout the structure service life.

3211 MEASUREMENT FOR PAYMENT

Measurements for earthwork shall conform to IS:1200(Part I), concrete work shall conform to IS:1200(Part II) and steelworks shall conform to IS:1200(Part VIII). Measurement of facia shall be in sq. metres.

3212 RATES

Rates for labour, machinery and various structural components shall conform to the local schedule of rates in practice.

3213 REFERENCES

IS:1200(Part I)-1992 Method of Measurement of Building and Civil Engineering Works – EARTHWORK (Fourth Revision).

IS:1200(Part II)-1974 Method Of Measurement of Building and Civil Engineering Works – CONCRETE WORKS (Third Revision).

IS:1200(Part VIII)-1993 Method of Measurement of Building and Civil Engineering Works – STEELWORK AND IRONWORK (Fourth Revision).

IS:1566-1982 Specification for Hard-Drawn Steel Wire Fabric for Concrete Reinforcement (Second Revision Incorporating Amendments Nos. 1, 2 and 3).

IS:1786-1985 Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement (Third Revision).

IS:456-2000 Plain and Reinforced Concrete – Code of Practice (Fourth Revision).

Is:9012-1978 Recommended Practice for Shotcreting (Fourth Reprint).

IRC publication “Interim Guidelines for Soil Nailing Technique in Highway Engineering Applications” (to be published).

APPENDICES

Appendix-1
(Refer Clause 101)

LIST OF IRC PUBLICATIONS REFERRED TO IN THE SPECIFICATIONS

Number Designation	Title
(A) INDIAN ROADS CONGRESS	
IRC:5-1998	Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design (Seventh Revision)
IRC:8-1980	Type Designs for Highway Kilometre Stones (Second Revision)
IRC:15-2011	Standard Specification and Code of Practice for Construction of Concrete Roads (Fourth Revision)
IRC:25-1967	Type Designs for Boundary Stones
IRC:26-1967	Type Designs for 200–Metre Stones
IRC:27-2009	Specifications for Bituminous Macadam (First Revision)
IRC:35-1997	Code of Practice for Road Markings (First Revision)
IRC:38-1988	Guidelines for Design of Horizontal Curves for Highways and Design Tables (First Revision)
IRC:44-2008	Tentative Guidelines for Cement Concrete Mix Design for Pavements (Second Revision)
IRC:57-2006	Recommended Practice for Sealing of Joints in Concrete Pavements (First Revision)
IRC:67-2012	Code of Practice for Road Signs (Third Revision)
IRC:75-1979	Guidelines for the Design of High Embankments
IRC:76-1979	Tentative Guidelines for Structural Strength Evaluation of Rigid Airfield Pavement
IRC:78-2000	Standard Specifications and Code of Practice for Road Bridges, Section VII - Foundations & Sub-structure (Second Revision)
IRC:79-1981	Recommended Practice for Road Delineators
IRC:81-1997	Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique (First Revision)
IRC:83-1999(Part-I)	Standard Specifications and Code of Practice for Road Bridges, Section IX – Bearings, Part I : Metallic Bearings (First Revision)
IRC:83-1999 (Part-II)	Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part II: Elastomeric Bearings

IRC:83-2002 (Part-III)	Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part III: POT, POT-CUM-PITE, PIN AND METALLIC GUIDE BEARINGS
IRC:87-2011	Guidelines for Formwork, False Work and Temporary Structures (First Revision)
IRC:89-1997	Guidelines for Design and Construction of River Training & Control Works for Road Bridges (First Revision)
IRC:93-1985	Guidelines on Design and Installation of Road Traffic Signals
IRC:112-2011	Code of Practice for Concrete Road Bridges
IRC:SP:16-2004	Guidelines for Surface Evenness of Highway Pavements (First Revision)
IRC:SP:20-2002	Rural Roads Manual
IRC:SP:34-1989	General Guidelines About the Equipment for Bituminous Surface Dressing
IRC:SP:42-1994	Guidelines on Road Drainage
IRC:SP:46-1997	Steel Fibre Reinforced Concrete for Pavements
IRC:SP:47-1998	Guidelines on Quality Systems for Road Bridges (Plain, Reinforced, Prestressed and Composite Concrete)
IRC:SP:48-1998	Hill Road Manual
IRC:SP:49-1998	Guidelines for the Use of Dry Lean Concrete as Sub-base for Rigid Pavement
IRC:SP:53-2002	Guidelines on Use of Modified Bitumen in Road Construction (Second Revision)
IRC:SP:55-2001	Guidelines for Safety in Construction Zones
IRC:SP:57-2000	Guidelines for Quality Systems for Road Construction
IRC:SP:74-2007	Guidelines for Repair and Rehabilitation of Steel Bridges
IRC:SP:76-2008	Tentative Guidelines for Conventional, Thin and Ultra-Thin Whitetopping
IRC:SP:79-2008	Tentative Specifications for Stone Matrix Asphalt
IRC:SP:80-2008	Guidelines for Corrosion Prevention, Monitoring and Remedial Measures for Concrete Bridge Structures
IRC:SP:81-2008	Tentative Specification for Slurry Seal and Microsurfacing
IRC:SP:83-2008	Guidelines for Maintenance, Repairs & Rehabilitation of Cement Concrete Pavements

Appendix-2
(Refer Clause 103)

**LIST OF INDIAN AND FOREIGN STANDARDS
REFERRED TO IN THE SPECIFICATIONS**

Number Designation	Title
(A) INDIAN STANDARDS	
IS:73-1992	Paving Bitumen Specification (Second Revision)
IS:77-1976	Specification for Linseed Oil;, Boiled, for Paints(Second Revision)
IS:102-1962	Ready Mixed Paint, Brushing, Red Lead, Non Setting, Primming
IS:104-1979	Ready Mixed Paint, Brushing, Zinc Chrome, Primming (Second Revision)
IS:123-1962	Specification for Ready Mixed Paint, Brushing, Finishing, Semi-Gloss. For General Purposes, to Indian Standard Colours (Revised Revision)
IS:164-1981	Specification for Ready Mixed Paints for road marking (First Revision)
IS:217-1988	Specification for Cutback Bitumen (Second Revision)
IS:226-1975	Structural Steel (Standard Quality) (Fifth Revision)
IS:269-1989	Specification for 33 Grade Ordinary Portland Cement (Fourth Revision)
IS:278-2009	Galvanized Steel Barbed Wire for Fencing-Specification
IS:280-2006	Mild Steel Wire for General Engineering Purposes (Fourth Revision)
IS:345-1952	Wood Filter Transparent Liquid
IS:356-1991	Ester Gum (Second Revision)
IS:383-1970	Specification for Coarse and Fine aggregates from Natural Sources for Concrete (Second Revision)
IS:460-1985 (Part 3)	Specification for Test Sieves: Part III Methods of Examination of Apertures of Test Sieves (Third Revision)
IS:503-1963	Alloy Austenitic Manganese Steel Castings
IS:516-1959	Methods of Test for Strength of Concrete
IS:712-1984	Specifications for Building Limes(Third Revision)
IS:736-1986	Wrought Aluminum and Aluminum Alloys, Plates for General Engineering Purposes (Fourth Revision)

IS:783-1985	Code of Practice for Laying of Concrete Pipes (First Revision)
IS:784-2001	Prestressed Concrete Pipes (Including Fittings) – Specifications (Second Revision)
IS:814-2004	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel (Fifth Revision)
IS:816-1969	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel (First Revision)
IS:817-1966	Code of Practice for Training and Testing of Metal Arc Welders (Revised Revision)
IS:822-1970	Code of Procedure for Inspection of Welds
IS:877-1989	Methods of Sampling and Test for Activated Carbons, Powdered and Granular (Second Revision)
IS:919-1993(Part-1)	ISO Systems of Limits and Fits Part 1 Bases of Tolerance, Deviation and Fits (Second Revision)
IS:919-1993(Part-2)	ISO Systems of Limits and Fits Part 2 Tables of Standard Tolerance Grades and Limit Deviations for Holes and Shafts (First Revision)
IS:961-1975	Structural Steel (High Tensile) (Second Revision)
IS:1077-1992	Common Burnt Clay Building Bricks (Fifth Revision)
IS:1079-1994	Hot Rolled Carbon Steel Sheets and Strips-Specifications (Sixth Revision)
IS:1124-1974	Method of Test for Water Absorption, Apparent Specific Gravity and Porosity of Natural Building Stones (First Revision)
IS:1129-1972	Recommendation for Dressing of Natural Building Stones (First Revision)
IS:1148-1982	Hot Rolled Rivet Bars(upto 40 mm dia) for Structural Purposes (Third Revision)
IS:1149-1982	Hot Tensile Steel Rivet Bars for Structural Purposes (Third Revision)
IS:1182-1983	Recommended Practice for Radiographic Examination of Fusion Welded Butt Joints in Steel Plates(Second Revision)
IS:1199-1959	Method of Sampling and Analysis of Concrete
IS:1203-1978	Determination of Penetration
IS:1205-1978	Determination of Softening Point
IS:1212-1978	Determination of Loss on Heating
IS:1216-1978	Determination of Solubility in Carbon Disulphide Trichloroethylene

IS:1217-1978	Determination of Mineral Matter
IS:1239:(Part 1)-1990	Steel Tubes, Tubulars and Other Wrought Steel Fittings-Specification: Part 1 Steel Tubes
IS:1363-2002 (Part 1,2 & 3)	Hexagonal Head Bolts, Screws and Nuts of Product Grade 'C'
IS:1364-2002 (Part 1,2 & 3)	Hexagonal Head Bolts, Screws and Nuts of Product Grade 'A' & 'B'
IS:1365-2005	Slotted Countersunk, Flat Head Screws (Common Head Style)-Product Grade A (Fourth Revision)
IS:1367-1997	Technical supply conditions for Threaded Steel Fasteners
IS:1393-1961	Code of Practice for Training and Testing of Oxy Acetylene Welders
IS:1477-1971 (Parts 1 & 2)	Code of Practice for Painting of Ferrous Metals in Buildings
IS:1489-1991 (Part 1) (Part 2)	Specification for Portland pozzolana Cement(Third Revision) Flyash Based (Third Revision) Calcined Clay Based (Third Revision)
IS:1498-1970	Classification and Identification of Soils for General Engineering Purposes (First Revision)
IS:1514-1990	Methods of Sampling and Test for Quick Lime and Hydrated Lime (First Revision)
IS:1597-1992 (Part 1)	Construction of Stone Masonry - Code of Practice - Part 1 - Rubble Stone Masonry (First Revision)
IS:1732-1989	Dimensions for Round and Square Steel Bars for Structural and General Engineering Purposes (Second Revision)
IS:1745-1978	Specification for Petroleum Hydrocarbon Solvent(Second Revision)
IS:1785-1983(Part-1)	Specification for Plain, Hard Drawn Steel Wire for Prestressed Concrete:Part 1 Cold Drawn Stress Relieved Wire(Second Revision)
IS:1785-1983(Part-II)	Specification for Plain, Hard Drawn Steel Wire for Prestressed Concrete:Part 2 As Drawn Wire(First Revision)
IS:1786-1985	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement (Third Revision)
IS:1834-1984	Specification for Hot Applied Sealing Compounds for Joints in Concrete (First Revision)
IS:1838-1983(Part 1)	Specification for Preformed Filler for Expansion Joint in Concrete Pavement and Structures (Non-Extruding and Resilient Type):Part 1 Bitumen Impregnated Fibre (First Revision)

IS:1838-1984(Part 2)	Specification for Preformed Filler for Expansion Joint in Concrete Pavement and Structures (Non-Extruding and Resilient Type):Part 2 CNSL Aldehyde Resin and Coconut Pith
IS:1852-1985	Rolling and Cutting Tolerances for Hot Rolled Steel Products(Fourth Revision)
IS:1875-1992	Carbon Steel Billets, Blooms, Slabs and Bars for Forgings (Fifth Revision)
IS:1888-1982	Method of Load Test on Soils(Second Revision)
IS:1892-1979	Code of Practice for Sub Surface Investigation for Foundations (First Revision)
IS:1966-2003	Laboratory Glassware-Straight Bore Glass Stopcocks for General Purposes(First Revision)
IS:1977-1996	Low Tensile Structural Steels –Specifications(Third Revision)
IS:1995-1984	Overall Internal Heights for Lathe Tool Posts (First Revision)
IS:2004-1991	Carbon Steel Forgings for General Engineering Purposes (Third Revision)
IS:2016-1967	Specification for Plain Washers (First Revision)
IS:2062-2006	Hot Rolled Low, Medium and High Tensile Structural Steel (Sixth Revision)
IS:2090-1983	Specifications for High Tensile Steel Bars used in Prestressed Concrete(First Revision)
IS:2116-1980	Specification for Sand for Masonry Mortars (First Revision)
IS:2131-1981	Method for Standard Penetration Test for Soils (First Revision)
IS:2132-1986	Code of Practice for Thin Walled Tube Sampling of Soils (Second Revision)
IS:2185-2005(Part-1)	Concrete Masonry Units-Specification: Part 1-Hollow and Solid Concrete Blocks
IS:2250-1981	Code of Practice for Preparation and Use of Masonry Mortars (First Revision)
IS:2269-2006	Hexagon Socket Head Cap Screws (Fifth Revision)
IS:2339-1963	Aluminum Paint for General Purposes in Dual Container
IS:2386-1963	Methods of Test for Aggregates for Concrete
(Part 1)	Particle size and shape
(Part 2)	Estimation of Deleterious Materials and Organic Impurities
(Part 3)	Specific Gravity, Density, Voids, Absorption and Bulking

(Part 4)	Mechanical Properties
(Part 5)	Soundness
(Part 6)	Measuring Mortar Making Properties of Fine Aggregates
(Part 7)	Alkali Aggregate Reactivity Test
(Part 8)	Petrographic examination
IS:2502-1963	Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
IS:2506-1985	General Requirements for Screed Board Concrete Vibrators(First Revision)
IS:2514-1963	Specification for Concrete Vibrating Tables
IS:2720	Methods of Test for Soils
(Part 1)-1983	Preparation of Dry Soil Samples for Various Tests (Second Revision)
(Part 2)-1973	Determination of Water Content (Second Revision)
(Part 4)-1985	Grain Size Analysis (Second Revision)
(Part 5)-1985	Determination of Liquid and Plastic Limits (Second Revision)
(Part 8)-1983	Determination of Water Content Dry Density Relation using Heavy Compaction (Second Revision)
(Part 16)-1987	Laboratory Determination of CBR
(Part 27)-1977	Determination of Total Soluble Sulphates(First Revision)
(Part 28)-1974	Determination of Dry Density of Soils in-place by the Sand Replacement Method(First Revision)
(Part-37)-1976	Determination of Sand Equivalent Values of Soils and Fine Aggregates
(Part 40)-1977	Determination of Free Swell Index of Soils
IS:2751-1979	Code of Practice for Welding of Mild Steel Plain and Deformed Bars for Reinforced Concrete Construction (First Revision)
IS:2911 (Part-1) (Sec-3) -1979	Code of Practice for Design and Construction of Pile Foundations Concrete Piles, Section 3 Driven Precast Concrete
IS: 2925-1984	Specification for Industrial Safety Helmets (Second Revision)
IS:3025:(Part 17)-1984	Methods of Sampling and Test (Physical And Chemical) for Water and Waste water: Part 17 Non-Filterable Residue (Total Suspected Solids) (First Revision)

- IS:3025:(Part 18)-1984 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water- Part 18 Volatile and Fixed Residue (Total Filterable and Non-Filterable) (First Revision)
- IS:3025:(Part 22)-1986 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water- Part 22 : Acidity (First Revision)
- IS:3025:(Part 23)-1986 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water- Part 23: Alkalinity (First Revision)
- IS:3025:(Part 28)-1984 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water- Part 28: Sulphite (First Revision)
- IS:3025 (Part 32)-1988 Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water- Part 32: Chloride (First Revision)
- IS:3073-1967 Assessment of Surface Roughness
- IS:3138-1966 Specifications for Hexagonal Bolts and Nuts
- IS:3400 (Part 3)-2004 Methods of Test for Vulcanized Rubbers: Part 3 Abrasion Resistance Using a Rotating Cylindrical Drum Device (First Revision)
- IS:3400 (Part 2)-2004 Methods of Test for Vulcanized Rubbers: Part 2 Rubber Vulcanized or Thermoplastic-Determination of Hardness (Hardness between 10 IRHD and 100 IRHD) (Third Revision)
- IS:3400 (Part 4)-2004 Methods of Test for Vulcanized Rubbers: Part 4 Accelerated Ageing (Second Revision)
- IS:3400 (Part 10)-2004 Methods of Test for Vulcanized Rubbers: Part 10 Compression Set at Constant Strain (First Revision)
- IS:3400 (Part 14)-1984 Methods of Test for Vulcanized Rubbers: Part 14 Adhesion of Rubber to Metal (First Revision)
- IS:3400 (Part 20)-2004 Methods of Test for Vulcanized Rubbers: Part 20 Resistance to Ozone Cracking-Static Strain Test (First Revision)
- IS:3589-2001 Steel Pipes for Water and Sewage (168.3 to 2540 mm Outside Diameter)-Specification (Third Revision)
- IS:3613-1974 Acceptance Tests for Wire Flux Combination for Submerged Arc Welding (First Revision)
- IS:3658-1999 Code of Practice for Liquid Penetrant Flaw Detection (Second Revision)
- IS:3764-1992 Code of Safety for Excavation Work (First Revision)
- IS:3784-1994 Textiles –Cloth, Cotton Khadi Bleached for General Purposes-Specification (First Revision)
- IS:3812:1981 Specification for Fly Ash for Use as Pozzolana and Admixture (First Revision)

IS:4031:(Part 5)-1988	Methods of Physical Tests for Hydraulic Cement: Part 5 Determination of Initial and Final Setting Times (First Revision)
IS:4078-1980	Code of Practice for Indexing and Storage of Drill Cores (First Revision)
IS:4081-1986	Safety Code for Blasting and Related Drilling Operations (First Revision)
IS:4138-1977	Safety Code for Working in Compressed Air (First Revision)
IS:4260-1986	Recommended Practice for Ultrasonic Testing of Butt Welds in Ferritic Steel (Second Revision)
IS:4434-1978	Code of Practice for In-Situ Vane Shear Test for Soils (First Revision)
IS:4453-2009	Subsurface Exploration by Pits, Trenches, Drifts and Shafts-Code of Practice (Second Revision)
IS:4656-1968	Specification for Form Vibrators for Concrete
IS:4826-1979	Hot Dipped Galvanised Coating on Round Steel Wires (First Revision)
IS:4853-1982	Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints in Steel Pipes (First Revision)
IS:4923-1997	Hollow Steel Sections for Structural Use(Second Revision)
IS:4925-2004	Concrete Batching and Mixing Plant-Specification (First Revision)
IS:4926-2003	Ready Mixed Concrete – Code of Practice(Second Revision)
IS:4968-1976 (Part-1,2 &3)	Method for Subsurface Sounding for Soils
IS:4984-1995	Specification for High Density Polyethylene Pipes for Potable Water Supplies (Fourth Revision)
IS:5334-2003	Magnetic Particle Flaw Detection of Welds-Code of Practice (Second Revision)
IS:5435-1987	General Requirements For Cold Bituminous Macadam Mixing Plants (First Revision)
IS:5640-1970	Method for Determining the Aggregate Impact Value of Soft Coarse Aggregate
IS:6003-1983	Specification for indented Wire for Prestressed Concrete (First Revision)
IS:6006-1983	Specification for Uncoated Stress Relieved Strand for Prestressed Concrete (First Revision)

IS:6241-1971	Methods of test for Determination of Stripping Value of Road Aggregates
IS:6603-2001	Stainless Steel Bars and Flats - Specification (First Revision)
IS:6610-1972	Specification for Heavy Washers for Steel Structures
IS:6639-1972	Specification for Hexagonal Bolts for Steel Structures
IS:6761-1994	Fasteners-Countersunk Head Screws with Hexagonal Socket-Specification (First Revision)
IS:6909-1990	Specification for Supersulphated cement
IS:6911-1992	Stainless Steel Plate, Sheet and Strip (First Revision)
IS:6925-1973	Methods of Test for Determination of Water in Concrete Admixtures
IS:7205-1974	Safety Code for Erection of Structural Steelwork
IS:7269-1974	Numbering of Aircraft Engines, Engine Cylinders, Combustion Chambers and Direction of Rotation of Engines and Propellers
IS:7273-1974	Method of Testing Fusion Welded Joints in Aluminium and Aluminium Alloys
IS:7292-1974	Code of Practice for In-Situ Determination of Rock Properties by Flat Jack
IS:7293-1974	Safety Code for Working with Construction Machinery
IS:7307 (Part 1)-1974	Approval Tests for Welding Procedures Part-1 Fusion Welding of Steel
IS:7308-1999	Non Coniferous Logs-Specification (First Revision)
IS:7310(Part-1)-1974	Approval Tests for Welders Working to Approved Welding Procedures-Part1: Fusion Welding of Steel
IS:7317-1993	Code of Practice for Uniaxial Jacking Test for Deformation Modulus of Frock (First Revision)
IS:7573-1975	Hockey Shoes
IS:7746-1991	Code of Practice for In-Situ Shear Test on Rock (First Revision)
IS:7966-1976	Specification for Dental Modelling Wax
IS:8500-1991	Structural Steel- Microalloyed (Medium and High Strength Qualities)-Specification
IS:8812-1978 (Part1)	Methods for Chemical Analysis of Hard Solders for Jointing Aluminium and Aluminium Alloys Part 1 Determination of Silver, Copper, Zinc, Antimony, Iron and Bismuth
IS:8812-1982 (Part2)	Methods for Chemical Analysis of Hard Solders for Jointing Aluminium and Aluminium Alloys Part 2 Determination of Aluminium

IS:9000-2005	Quality Management Systems-Fundamentals and Vocabulary (Third Revision)
IS:9012-1978	Recommended Practice for Shotcreting
IS:9437-2008	Specification for Fixed Precision Resistors
IS:9565-1995	Acceptance Standards for Ultrasonic Inspection of Steel Castings (Second Revision)
IS:9595-1996	Metal Arc Welding of Carbon and Carbon Manganese Steels –Recommendations (First Revision)
IS:9862-1981	Ready Mixed Paint, Brushing, Bituminous, Black, Lead Free, Acid, Alkali, Water and Chlorine Resisting
IS:10433(Part 1)-1983	Specification for Male Stud Tee Body (Stud Run) for Oil –Hydraulic Coupling- Part-1: Made form Forging
IS:11587-1986	Structural Weather Resistant Steels
IS:12063-1987	Classification of Degrees of Protection provided by Enclosures of Electrical Equipment
IS:12089-1987	Specification for Granulated Slag for Manufacture of Portland Slag Cement
IS:12119-1987	General Requirements for Pan Mixers for Concrete
IS:12269-1987	Specification for 53 Grade Ordinary Portland Cement
IS:12330-1988	Specification for Sulphate Resisting Portland Cement
IS:12594-1988	Hot Dip Zinc Coating on Structural Steel Bars for Concrete Reinforcement-Specification
IS:13162(Part-4)-1992	Geotextiles- Methods of Test-Part 4: Determination of Puncture Resistance by Falling Cone Method
IS:13162(Part-5)-1992	Geotextiles- Methods of Test-Part 5: Determination of Tensile Properties using a Wide Width Strip
IS:13360-1992	Plastics-Methods of Testing
IS:13620-1993	Fusion Bonded Epoxy Coated Reinforcing Bars-Specification
IS:13757-1993	Burnt Clay Fly Ash Building Bricks- Specifications
IS:13759-1993	Polyurethane Primer Zinc Phosphate (Two Pack) for Exterior Painting of Railway Coaches
IS:14293-1995	Geotextiles- Method of Test for Trapezoid Tearing Strength
IS:14294-1995	Geotextiles-Method for Determination of Apparent Opening Size by Dry Sieving Technique

IS:14324-1995	Geotextiles –Methods of Test for Determination of Water Permeability-Permimittivity
IS:14589-1999	Zinc Priming Paint, Epoxy Based Two Pack-Specification
IS:14700 (Part 6 Sec 3)	Electromagnetic Compatibility (EMC)- Part 6 Generic Standards- Sec 3: Emission Standards for Residential, Commercial and Light Industrial Environments
IS:14925-2001	Epoxy Resin for Paints-Specification
IS:15284 (Part 1)-2003	Design and Construction for Ground Improvement-Guidelines: Part 1 Stone Columns
(Part 2)-2004	Design and Construction for Ground Improvement-Guidelines: Part 2 Preconsolidation using Vertical Drains
IS:15388-2003	Silica Fume-Specification
IS:15462-2004	Polymer and Rubber Modified Bitumen-Specification
IS:15809-2008	High Visibility Warning Clothes-Specification
IS:SP:23-1982	Handbook on Concrete Mixes (Based on Indian Standards)

(B) FOREIGN STANDARDS

ASTM E8	Standard Test Methods for Tension Testing of Metallic Materials
ASTM:E-11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM 36	Standard Specification for Carbon Structural Steel
ASTM:D-297	Standard Test Methods for Rubber Products-Chemical Analysis
ASTM-C 309-81,	Standard Practice Standard Specification for Architectural Flat Glass Clad Polycarbonate
ASTM 393	Standard Test Method for Core Shear Properties of Sandwich Constructions by Beam Flexure
ASTM- D:412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM-D: 471	Standard Test Method for Rubber Property-Effect of Liquids
ASTM-D:573	Standard Test Method for Rubber-Deterioration in an Air Oven
ASTM 711	Standard Specification for Steel Forging Stock
ASTM 732	Standard Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures

ASTM 788	Standard Specification for Steel Forgings, General Requirements
ASTM E-809	Standard Practice for Measuring Photometric Characteristics of Retro-reflectors
ASTM E 810	Standard Test Method for Coefficient of Retro-reflection of Retro-reflective Sheeting Utilizing the Coplanar Geometry
ASTM D-903	Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM-D:1149	Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
ASTM 1264	Standard Classification for Acoustical Ceiling Products
ASTM 1475	Standard Test Method For Density of Liquid Coatings, Inks, and Related Products
ASTM D-1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM F1553-06	Standard Guide for Specifying Chain Link Fence
ASTM 1644	Standard Test Methods for Non-volatile Content of Varnishes
ASTM F1647-11	Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes
ASTM D-1693	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D: 2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM 2172	Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures
ASTM-D:2240	Standard Test Method for Rubber Property-Durometer Hardness
ASTM-D:2628	Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
ASTM D-2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM D-3776	Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
ASTM D 3786	Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D 4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

ASTM 4280	Standard Specification for Extended Life Type, Non-plowable, Raised Retro-reflective Pavement Markers
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D-4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D: 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D-4716	Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
ASTM D-4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D:4873	Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D-4956	Standard Specification for Retro-reflective Sheeting for Traffic Control
ASTM D- 5035	Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM 5199	Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
ASTM D-5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles
ASTM D:5581	Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)
ASTM-C:5893-04	Specification for Cold Applied, Single Component
ASTM D 6241	Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products using a 50-mm Probe
ASTM 6390	Standard Test Method for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
ASTM D 6637	Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
ASTM D-6525	Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products
AASHTO M P8	Standard Specification for Designing Stone Matrix Asphalt (SMA)

AASHTO PP41	Standard Practice for Designing Stone Matrix Asphalt (SMA)
AASHTO T 245	Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures using Marshall Apparatus
AASHTO M-249	Specifications (White & Yellow Reflective Thermo-Solid Form)
AASHTO T 283	Standard Method of Test for Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage
BS EN 169:2002.	Personal Eye-Protection Filters for welding and related Techniques. Transmittance Requirements and Recommended Use
BS EN ISO 175:2010	Plastics. Methods of Test for the Determination of the Effects of Immersion in Liquid Chemicals
BS EN 397:2012	Industrial Safety Helmets
BS EN 471:2003	High-Visibility Warning Clothing for Professional Use-Test methods and requirements
BS:812-1975 Part-114	Testing aggregates method for determination of the polished stone value
BS 873-4:1973	Specification for the Construction of Road Traffic Signs and Internally Illuminated Bollards & Road Studs
BS:1047	Specification for Air-cooled Blast Furnace Slag Aggregate for Use in Construction
BS:1377	Methods of Test for Soils for Civil Engineering Purposes
BS 1449-2:1983	Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip
BS EN ISO 3262-12:2001	Extenders for Paints.Specifications and Methods of Test. Muscovite-Type Mica
BS 4482	Specification for Cold Reduced Steel Wire for the Reinforcement of Concrete
BS 4483	Specification for Steel Fabric for the Reinforcement of Concrete.
BS:5212	Specification for Cold Poured Joint Sealants for Concrete Pavements
BS 6088:1981	Specification for Solid Glass Beads for Use with Road Marking Compounds and for other Industrial Uses
BS:7542	Method of Test for Curing Compounds for Concrete
BS EN ISO 9863-1:2005	Geosynthetics. Determination of Thickness at Specified Pressures. Single Layers
BS EN ISO 9864:2005	Geosynthetics. Test Method for the Determination of Mass per Unit Area of Geotextiles and Geotextile-Related Products

BS EN ISO 10319:2008	Geosynthetics. Wide-width Tensile Test
BS EN ISO 12236:2006	Geosynthetics. Static Puncture Test (CBR Test)
BS EN ISO 12966-2:2011	Animal and Vegetable Fats and Oils. Gas Chromatography of Fatty Acid Methyl Esters. Preparation of Methyl Esters of Fatty Acids
BS EN ISO 12958:2010	Geotextiles and Geotextile-related products. Determination of Water Flow Capacity in their Plane
BS EN 13422:2004	Vertical Road Signs. Portable Deformable Warning Devices and Delineators. Portable Road Traffic Signs. Cones and Cylinders
BS EN 50128:2011	Railway Applications. Communication, Signalling and Processing Systems. Software for Railway Control and Protection Systems

Appendix 3**(Refer Clause 402.3.2 and 403.3.2)****METHOD OF SIEVING FOR WET SOILS TO
DETERMINE THE DEGREE OF PULVERISATION**

1. A sample of pulverised soil approximately 1kg in weight should be taken and weighed (W_1).
2. It should be spread on the sieve and shaken gently, care being taken to break the lumps of soils as little as possible. Weight of soil retained on the sieve should be recorded (W_2). Lumps of finer soils in the retained material should be broken until all the individual particulars finer than the aperture size of the sieve are separated.
3. The soil should again be placed on the sieve and shaken until sieving is complete. The retained material should be weighed (W_3).
4. Weight of soil by percent passing the sieve can then be calculated from expression:

$$\frac{(W_1 - W_2) \times 100}{(W_1 - W_3)}$$

Appendix 4

(Refer Clause 509.2.4)

Anti-Stripping Agents Used for Bituminous Materials and Mixes

1 Scope

1.1 Anti-stripping agents are used for bituminous materials and mixes to ensure adhesion between aggregates (hydrophilic in nature) and bitumen, even under submergence in water. Prior approval of the Engineer shall be taken in respect of both qualitative and quantitative use of a particular product.

2 Materials

2.1 The anti-stripping agents shall be fatty acid amines having a long hydrocarbon chain.

2.2 **Physical and Chemical Requirements:** The anti-stripping agents shall conform to the physical and chemical requirements as detailed in Table A4-1.

2.3 **Storage and Handling:** Anti-stripping agents shall be properly stored in closed containers made of steel or aluminium. Containers made of zinc, copper, polythene PVC and most types of rubber are not suitable for use. As most of the anti-stripping agents cause irritation when in contact with human skin and are also irritating to the eyes, protective gloves for hands and goggles for the eyes shall be used while handling them, specially in case of liquid anti-stripping agents.

3 Use in Sprayed Work

3.1 **Additive Dosage:** The dosage shall be determined depending on the nature (stripping value) of the aggregate and the size of aggregate. While the recommended minimum dose of anti-stripping agent for sprayed work is given in Table A4-2, the actual dosage shall be determined in the laboratory as directed by the Engineer.

3.2 **Mixing Procedure During Construction:** The anti-stripping agent supplied in liquid, solid or concentrate form shall be thoroughly mixed with liquid bituminous material or with straight run bitumen. When used with straight run bitumen, the correct dose of anti-stripping agent shall be mixed in a hot bitumen tank boiler.

The two constituents shall be agitated till the anti-stripping agent is thoroughly mixed. The dose of anti-stripping agent shall suitably be increased if the binder is to remain in bitumen boiler for a longer period.

4 Use in Premix Work

4.1 **Additive Dosage:** The dosage shall be determined depending on the nature (stripping value) of the aggregate and the percent voids in the mix. While the recommended minimum doses for different types of bituminous premix materials in terms of voids content are given in Table A4-3, the actual dosage shall be determined in the laboratory as directed by the Engineer.

Table A4-1 Specification for Antistripping Compound

S.No.	Test	Method	Limit
1.	Appearance	Visual	Liquid/Solid
2.	Odour	Smelling	Agreeable
3.	Specific gravity 27°C	IS:1202-1978	0.860-1.03
4.	Pour point °C Maximum	IS:1448	42
5.	Flash Point °(COC) Minimum	IS:1448	150
6.	Water Content percent Vol. Maximum	IS:1448	1.0
7.	Solubility in diesel oil (HDO or LDO) in the ratio of 2:98 at 50°C	As given at the end of Appendix	Complete
8.	Total base value mg KOH/g minimum	ASTM D 664	200
9.	Nitrogen content percent Wt. minimum	Elemental Analyser	7.0
10.	Stripping value with bitumen containing 1 percent Wt. antistripping compound at 40°C 24 hours	IS:6241 As given at the end of Appendix	No stripping
11.	Under water coating test	- do -	Complete Coating
12.	Thermal stability at 163°C 5 hours	- do -	Should not lose its efficacy
13.	Boiling water test percent minimum coating	ASTM D 3625	95
14.	Retained Marshall Stability percent minimum	As given at the end of appendix	75

Table A4-2 Tentative Recommended Minimum Dose of Antistripping Agent for Sprayed Work

Aggregate stripping value	Dose of antistripping agent in percent by weight of bitumen			Liquid seal coat
	Surface dressing with precoated aggregate	Penetration Macadam/Built up spray grout	Surface Dressing with uncoated aggregate	
0-25	0.5	0.6	0.7	0.8
25-50	0.6	0.7	0.8	1.0
50-100	0.75	1.0	1.0	1.0

4.2 Mixing Procedure During Construction : The required dose of the anti-stripping agent shall be poured into hot bitumen tank and allowed 15 to 30 minutes of circulation or stirred to ensure a homogeneous mix. It is necessary to use a stable antistripping agent or increase the dose according to expected degradation. Alternatively, the correct dose shall be injected into the bitumen line by means of a pump. The agent is fed into the bitumen first before it is sprayed on the aggregate in the mix; thus, no separate mixing time for mixing the agent with bitumen is required. In rolled asphalt and bitumen mastic surfacing works, precoated chippings are pressed into the hard surface while the mix is still hot to make the newly laid surface skid resistant. These chippings shall be precoated with bitumen treated with antistripping compound.

Table A4-3 Tentative Recommended Minimum Dose of Antistripping Compound in Bitumen Premix Works

Stripping value of aggregate	Dose of antistripping agent in percent by weight of bitumen		
	Voids content 3-5 percent	Voids content 5-10 percent	Voids content 10-15 percent
0-25	0.3	0.4	0.5
25-50	0.4	0.5	0.6
50-100	0.6	0.8	1.0

Annexure to the Appendix 4

TESTING PROCEDURE FOR SOLUBILITY OF ANTISTRIPPING AGENT IN DIESEL OIL

Procedure: 98 ml of diesel oil (HDO or LDO) and 2 ml of antistripping agent shall be taken in a measuring cylinder with stopper. The cylinder along with its contents shall be kept in water bath, maintained at $50^{\circ} + 1^{\circ}\text{C}$ for half an hour. It shall then be taken out from water bath and shaken vigorously for 10 minutes. The stopper shall be removed and the cylinder kept in water bath for half an hour and examined for separation or settlement.

Reporting of Results: An antistripping agent is reported to be completely soluble in diesel oil if no separation or settlement is observed for half an hour.

TESTING STRIPPING VALUE OF AGGREGATES USING BITUMEN WITH VARYING PERCENTAGES OF ANTISTRIPPING AGENT

Procedure: Coarse aggregate passing 19 mm sieve and retained on 13.2 mm sieve shall be washed and dried in an oven for 24 hours at 110°C . Such dried 200 gms of coarse aggregates shall be heated at 149°C and then mixed with 80/100 penetration grade bitumen 5 percent by weight of coarse aggregate heated upto 163°C . The mixture shall be mixed thoroughly for uniform coating of aggregates by bitumen. The mix shall then be transferred to a 500 ml beaker and allowed to cool to room temperature. Distilled water shall be added in the beaker, which shall be placed in a water bath maintained at $40^{\circ} \pm 1^{\circ}\text{C}$ for 24 hours. The percentage degree of stripping shall be assessed visually. The test shall also be conducted with water containing 1 percent Sodium Chloride, as a precautionary measure to eliminate water contamination. The test is repeated using bitumen containing upto one percent of antistripping agent in stages of 0.25 percent.

TESTING EFFICACY OF ANTISTRIPPING AGENT TO COAT AGGREGATES WITH BITUMEN IN PRESENCE OF WATER

Procedure: The antistripping agent shall be added in percent contents of 0.0, 0.25, 0.50., 0.75, 1.00 and 1.25 to cutback bitumen MC3 (4 parts of bitumen 80/100 and 1 part of kerosene oil). The blends shall be used for testing their ability to coat the road aggregates under water.

- (a) 100 gm of clean and dry stone dust conforming to following gradation shall be taken:

Sieve Size	Percent Passing
2.36 mm	100
1.18 mm	80

600 mic.	75
300 mic.	45

The bottle shall be filled to 3/4 of its volume with distilled water at 40°C. The bitumen-antistripping agent blend shall be added in the bottle at the rate of 7.5 percent by weight of stone dust. The stopper shall be replaced and the bottle shall be vigorously shaken for two minutes. The water shall be then drained off and the stone dust shall be transferred to a piece of paper and examined visually for satisfying complete coating. The minimum percent content of antistripping agent at which the stone dust sample is thoroughly coated shall be recorded. The test shall be repeated at 60°C in water as well as 1 percent solution of Sodium Chloride in water for both the testing temperatures.

- (b) The under water coating test further be conducted with coarse aggregate, passing 19 mm sieve and retained on 13.2 mm siee. In this case, the percent content of the cutback-antistripping agent blend shall be kept at 5 percent by weight of coarse aggregate. In order to take care of contamination in water, the test shall also be carried out in the 1 percent Sodium Chloride in water.

The minimum percent content of antistripping agent at which stone dust/coarse aggregate is thoroughly coated as per (a) and (b) shall be taken as the dose of antistripping agent.

TESTING FOR THERMAL STABILITY OF ANTISTRIPPING AGENT

Procedure: Blends of antistripping agent and bitumen of 80/100 grade shall be prepared with 0.00, 0.25, 0.50, 0.75 and 1.00 percent contents of antistripping agent and kept in oven at 163°C for five hours. After the heat exposure, the blend samples are fluxed with kerosene oil to obtain the consistency of MC 3 and tested for under water coating test.

Reporting of Test Results: An antistripping agent shall be deemed to be heat resistant if the dose requirement before and after heat exposure remains unchanged.

QUANTITATIVE EVALUATION OF RETAINED MARSHALL STABILITY VALUES AFTER IMMERSION IN WATER

Procedure: For Quantitative evaluation, the tests shall be carried out as stipulated in ASTM D1075 (Effect of Water on Cohesion of Compacted Bituminous Mixtures). The gradation of aggregates shall be such as to give sufficient voids in the compacted bituminous mix to bring out the effects of stripping. The gradation of aggregates shall be as under:

Appendix – 1500/I**(Refer Clause 1503.2)****INFORMATION TO BE SUPPLIED BY THE
MANUFACTURERS OF PROPRIETARY SYSTEMS****1 GENERAL**

1.1 The information which the manufacturer is required to supply shall be in such detail as to obviate unsafe use of the equipment due to the intention of the manufacturer not having been made clear or due to wrong assumptions on the part of the user.

1.2 The user shall refer unusual problem or problems of erection/assembly not in-keeping with the intended use of the equipment, to the manufacturer of the equipment.

2 INFORMATION REQUIRED

2.1 The manufacturers of proprietary systems shall supply the following information:

- a) Description of basic functions of equipment
- b) List of items of equipment available, giving range of sizes, spans and such like, with the manufacturer's identification numbers or other references.
- c) The basis on which the safe working loads have been determined and whether the factor of safety given applies to collapse or yield.
- d) Whether the supplier's data is based on calculations or tests. This shall be clearly stated as there may be wide variations between results obtained by either method.
- e) Instructions for use and maintenance, including any points which require special attention during erection, especially where safety is concerned.
- f) Detailed dimensional information, as follows :
 - (i) Overall dimensions and depth and widths of members;
 - (ii) Line drawings including perspectives and photographs showing normal uses;
 - (iii) Self weight;
 - (iv) Full dimensions of connections and any special positioning arrangements;

- (v) Sizes of members, including tube diameters and thicknesses of materials;
 - (vi) Any permanent camber built into the equipment; and
 - (vii) Sizes of holes and dimensions giving their positions.
- g) Data relating to strength of equipment as follows :
- (i) Average failure loads as determined by tests;
 - (ii) Recommended maximum working loads for various conditions of use;
 - (iii) Working resistance moments derived from tests;
 - (iv) Working shear capacities derived from tests;
 - (v) Recommended factors of safety used in assessing recommended loads and deflections based on test results;
 - (vi) Deflections under load together with recommended pre-camber and limiting deflections;
 - (vii) If working loads depends on calculations, working stresses should be stated. If deflections depend on the theoretical moments of inertia or equivalent moments of inertia rather than tests, this should be noted;
 - (viii) Information on the design on the loading against wind and other horizontal loadings; and
 - (ix) Allowable loading relating to maximum extension of bases and/or heads.

Appendix-1700/I**(Refer Clause 1717.7.5)****SPECIFICATION FOR CONSTRUCTION JOINTS****Location**

The location of construction joint shall be as shown on the drawing or as approved by the Engineer. If additional/new joints are approved by the Engineer, the following considerations for their location shall be taken into account:

- (i) Joints shall be provided in non-aggressive zones or in non-splash zones. If not feasible, the joints shall be sealed.
- (ii) Joints should be positioned where they are readily accessible for preparation and concreting, such as location where the cross-section is relatively small, and where reinforcement is not congested.
- (iii) In beams and slabs, joints should not be near the supports. Construction Joints between slabs and ribs in composite beams should be avoided.
- (iv) For box girders, it is preferable to cast the soffit and the webs without any joint.
- (v) Location of joints shall minimize the effects of the discontinuity on the durability, structural integrity and the appearance of the structure.

Preparation of Surface of the Joint

Laitance shall be removed before fresh concrete is cast. The surface shall be roughened. Care shall be taken that they should not dislodge the coarse aggregates. Concrete may be brushed with a stiff brush soon after casting while the concrete is still fresh.

If the concrete has partially hardened, it shall be treated by wire brushing or with a stiff water jet followed by drying with air jet immediately.

Fully hardened concrete shall be treated with mechanical hand tools or grit blasting, taking care not to split or crack aggregate particles.

Before further concrete is cast, the surface should be thoroughly cleaned to remove debris and accumulated rubbish, one effective method being by air jet.

Where there is likely to be a delay before placing the next concrete lift, protruding reinforcement shall be protected. Before the next lift is placed, rust, loose mortar or other contamination shall be removed from the reinforcements. In aggressive environment, the concrete shall be cut back to expose the reinforcements for a length of about 50 mm to ensure that contaminated concrete is removed.

The joint surface shall not be contaminated with release agents, dust or curing membrane.

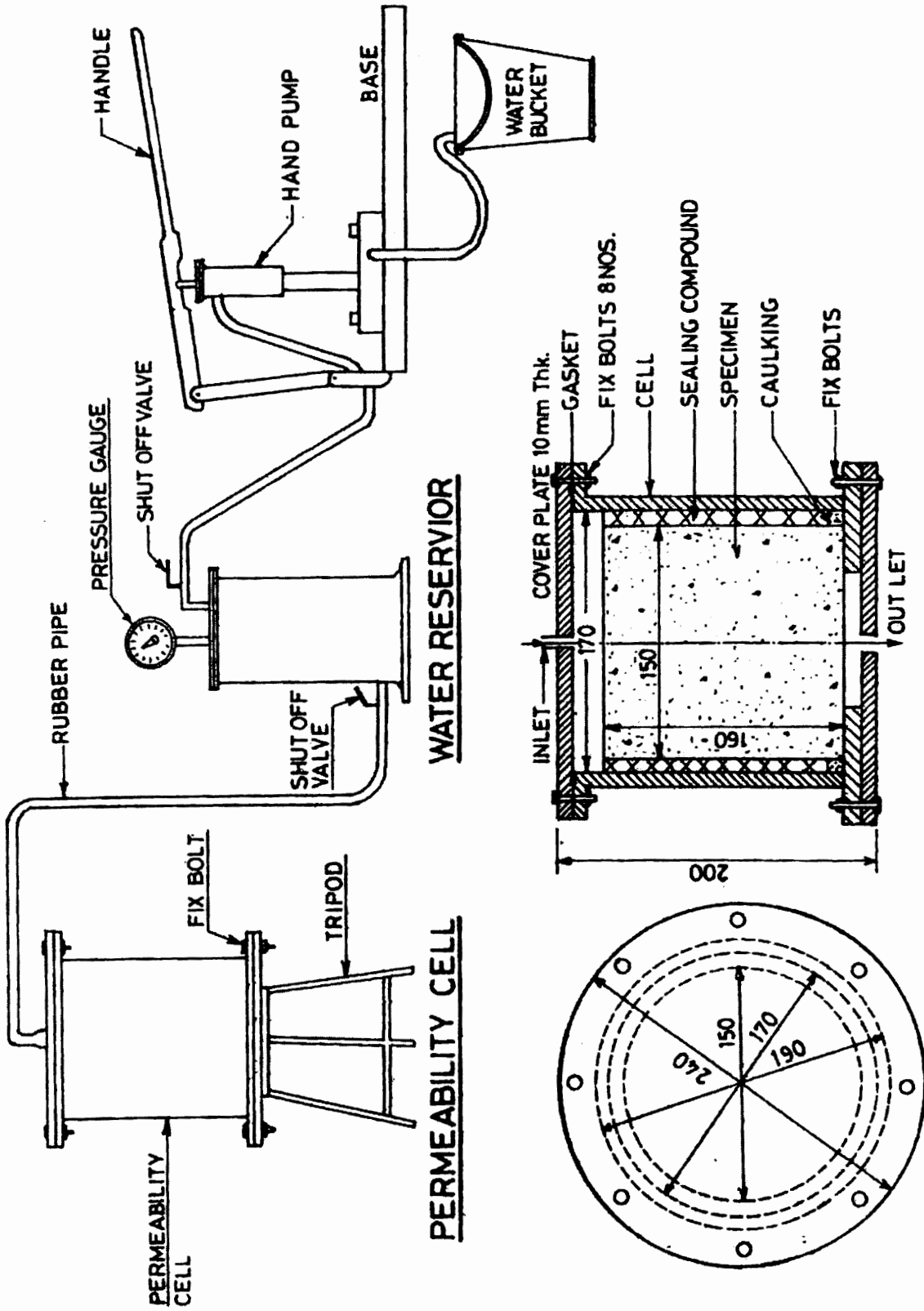
Concreting of Joints

The old surface shall be thoroughly cleaned and soaked with water. Standing water shall be removed shortly before the new concrete is placed and the new concrete shall be thoroughly compacted. Concreting shall be carried out continuously upto the construction joints.

Surface retarders may be used to improve the quality of construction joints.

For a vertical construction joint, a stopping board shall be fixed previously at the predetermined position and shall be properly stayed to prevent its displacement or bulging when concrete is compacted against it. Concreting shall be continued right upto the board.

Appendix-1700-I : Permeability Test



Appendices

Appendix-1800/I

(Refer Clause 1805.6.2)

TESTS ON SHEATHING DUCTS

All tests specified below shall be carried out on the same sample in the order given below.

At least 3 samples for one lot of supply (not exceeding 7000 metre length) shall be tested.

The tests are applicable for sheathing transported to site in straight lengths when the prestressing cable is threaded inside the sheathing prior to concreting. These tests are not applicable for sheathing not for coiled cable and transported to site as an assembled unit, nor for sheathing ducts placed in position without threading of prestressing cable prior to concreting.

(A) WORKABILITY TEST

A test sample 1100 mm long is soldered to a fixed base plate with a soft solder (**Fig.1800/I-1**). The sample is then bent to a radius of 1800 mm alternately on either side to complete 3 cycles.

Thereafter, the sealing joints will be visually inspected to verify that no failure/opening has taken place.

(B) TRANSVERSE LOAD RATING TEST

The test ensures that stiffness of the sheathing is sufficient to prevent permanent distortion during site handling.

The sample is placed on a horizontal support 500 mm long so that the sample is supported at all points of outward corrugations.

A load as specified in **Table 1** is applied gradually at the centre of the supported portion through a contact surface 12 mm long. It shall be ensured that the load is applied approximately at the centre of two corrugations, **Fig. 1800/I-2**. The load as specified is applied in increments.

Table-1

Dia 25 mm To 35 mm	more than 35 mm up to 45 mm	more than 45 mm up to 55 mm	more than 55 mm up to 65 mm	more than 65 mm up to 75 mm	more than 75 mm up to 85 mm	more than 85 mm up to 90 mm
Load:250 N	400 N	500 N	600 N	700 N	800 N	1000 N

The sample is considered acceptable if the permanent deformation is less than 5 percent.

(C) TENSION LOAD TEST

A test specimen is subjected to a tensile load. The hollow core is filled with a wooden circular piece having a diameter of 95 percent of the inner dia of the sample to ensure circular profile during test loading, **Fig. 1800/I-3**.

A coupler is 'Screwed on and the sample loaded in increments, till reaching the load specified in **Table 2**. If no deformation of the joints nor slippage of couplers is noticed, the test shall be considered satisfactory.

Table-2

Dia in mm	Load
25 upto 35	300 N
More than 35 upto 45	500 N
More than 45 upto 55	800 N
More than 55 upto 65	1100 N
More than 65 upto 75	1400 N
More than 75 upto 85	1600 N
More than 85 upto 90	1800 N

(D) WATER LOSS TEST

The sample is sealed at one end. The sample is filled with water and after sealing the end is connected to a system capable of applying a pressure of 0.05 MPa, **Fig. 1800/I-4**. and kept constant for 5 minutes using a hand pump with pressure gauge or stand pipe system can be used.

The sample is acceptable if the water loss does not exceed 1.5% of the volume.

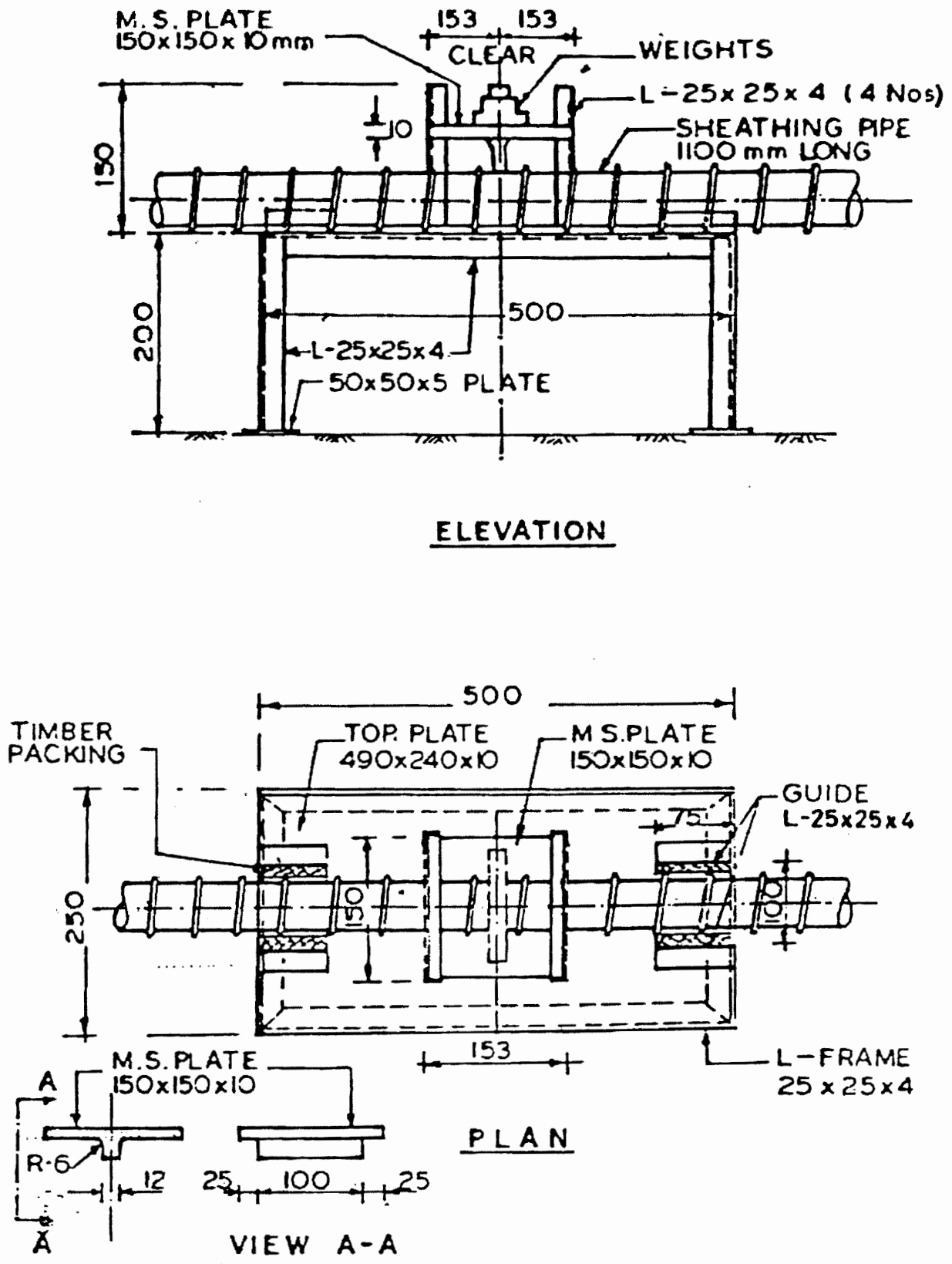


Fig. 1800/I-2 : Dimensions are in mm.

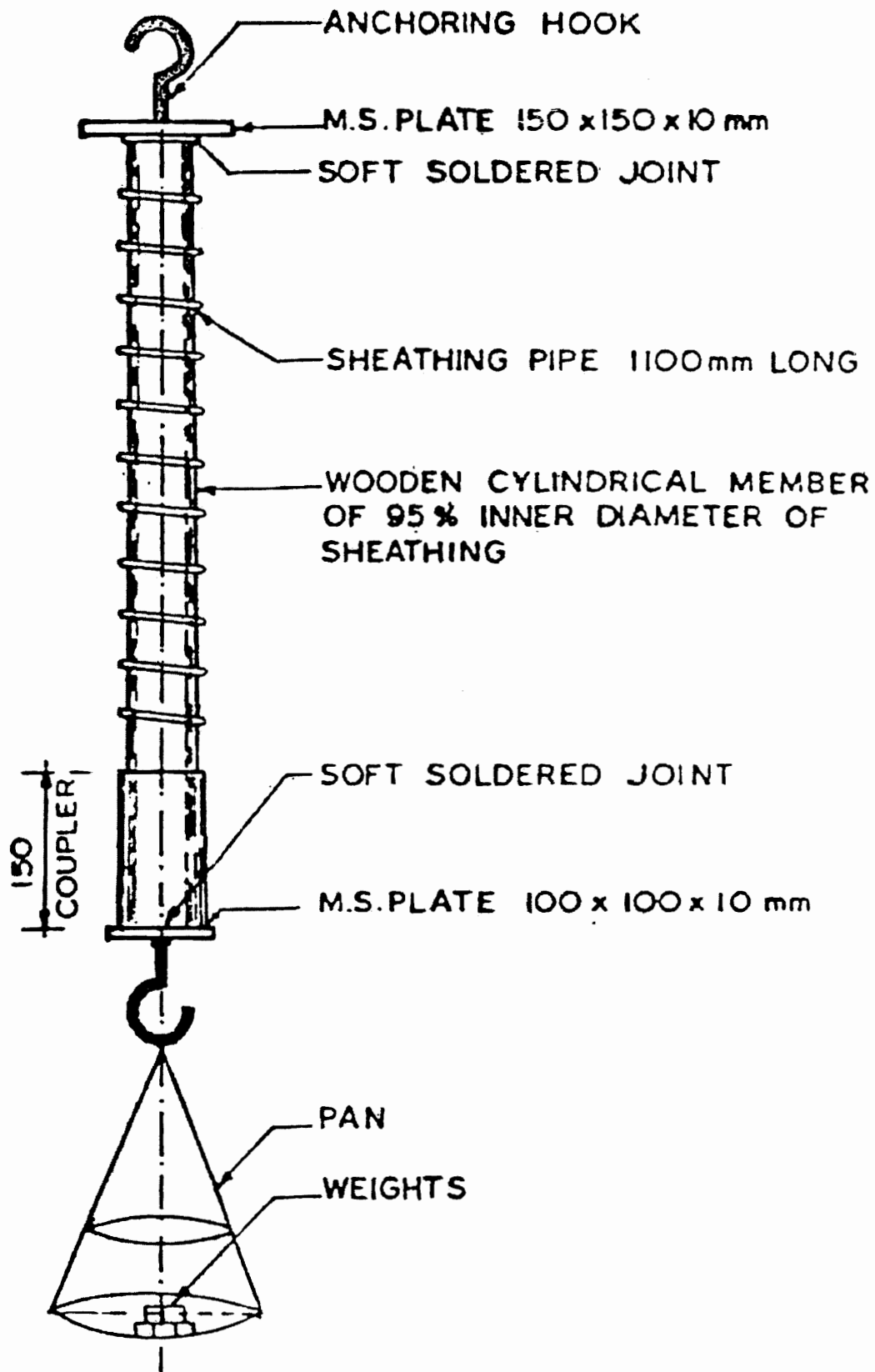


Fig. 1800/I-3 : Dimensions are in mm.

Appendix-1800/III**(Refer Clause 1809)****SPECIFICATIONS FOR GROUTING OF POST-TENSIONED
CABLES IN PRESTRESSED CONCRETE BRIDGES****1 GENERAL**

1.1 The recommendations cover the cement grouting of post-tensioned tendons of prestressed concrete members of bridges. This also covers some of the essential protective measures to be adopted for minimising corrosion in PSC bridges.

1.2 The purpose of grouting is to provide permanent protection to the post-tensioned steel against corrosion and to develop bond between the prestressing steel and the surrounding structural concrete. The grout ensures encasement of steel in an alkaline environment for corrosion protection and by filling the duct space, it prevents water collection and freezing.

2 MATERIALS**2.1 Water**

Only clean potable water free from impurities conforming to **Section 1000** shall be permitted. No sea or creek water is to be used at all.

2.2 Cement

Ordinary Portland cement should be used for preparation of the grout. It should be as fresh as possible and free of any lumps. Pozzolana cement shall not be used.

2.3 Sand

It is not recommended to use sand for grouting of prestressing tendons. In case the internal diameter of the ducts exceeds 150 mm, use of sand may be considered. Sand used, shall conform to IS:383 and shall pass through IS Sieve No. 150. The weight of sand in the grout shall not be more than 10 percent of the weight of cement, unless proper workability can be ensured by addition of suitable plasticizers.

2.4 Admixtures

Acceptable admixtures conforming to IS:9102 may be used if tests have shown that their use improves the properties of grout, i.e. increasing fluidity, reducing bleeding, entraining air or expanding the grout. Admixtures must not contain chlorides, nitrates, sulphides, sulphites or

any other products which are likely to damage the steel or grout. When an expanding agent is used, the total unrestrained expansion should not exceed 10 percent. Aluminum powder as an expanding agent is not recommended for grouting because its long term effects are not free from doubt.

2.5 Sheathing

2.5.1 For specifications of sheathing, **Section 1800** may be referred

2.5.2 Grout openings or vents

- a) All ducts should have grout openings at both ends. For this purpose special openings should be provided where such openings are not available at end anchorages. For draped (curved) cables vents shall be provided at all crown and valley points. It is a good practice to provide additional air vents at suitable intervals not exceeding 20 m. All grout openings or vents should include provisions for preventing grout leakage.
- b) Standard details of fixing Couplers, inlets, outlets and air vents to the duct anchorage shall be followed as recommended by the supplier of the prestressing system.

2.5.3 Ducts should be securely fastened at close intervals. All un-intended holes or openings in the duct must be repaired prior to concrete placing, The joints of the couplers and the sheathing should be made water proof by use of adhesive tape or similar suitable system capable of giving leak proof joints, Grout openings and vents must be securely anchored to the duct and to either forms or to reinforcing steel to prevent displacement during concreting operations due to weight, buoyancy and vibrations.

2.5.4 Ducts require very careful handling as, being of thin metal, they are susceptible to leakage due to corrosion in transit or storage, by tearing/ripping in handling particularly when placed adjoining to reinforcing steel, by pulling apart at joints while inserting tendons prior to concreting, or by accidental puncturing while drilling for form ties/inserts. Ducts are also liable to damage by rough use of internal vibrator and sparks from welding being done close by.

3 EQUIPMENT

3.1 Grout Mixer and Agitator

It is essential that the grout is maintained in a homogeneous State and of uniform consistency so that there is no separation of cement. Use of grout mixers to obtain a colloidal grout is essential. The mixer should have an additional storage device with an agitator to keep the

grout moving continuously before it is pumped in the duct. Positive reciprocating type grout pumps should be used.

3.2 Grout Pump

The pump should be a positive displacement type and should be capable of ejecting the grout in a continuous operation and not by way of pulses. The grout pump must be fitted with a pressure gauge to enable pressure of injection to be controlled. The minimum pressure at which grout should be pumped shall be 0.3 MPa and the Grout Pump must have a relief arrangement for bypass of the grout in case of build up of pressure beyond 1 MPa. The capacity of the grout pump should be such as to achieve forward speed of grout of around 5 to 10 metres per minute. The slower rates are preferable as they reduce the possibility of occurrence of voids. If the capacity of the pump is large, it is usual to grout two or more cables simultaneously through a common manifold.

Use of hand pumps for grouting is not recommended. Use of Compressed air operated equipment for injection is prohibited, as it is likely that there will be some air trapped in grout.

3.3 Water Pump

Before commencement of grouting, a stand by direct feed high pressure water pump should be available at site for an emergency. In case of any problem in grouting the ducts, such pump shall immediately be connected to the duct and all grout flushed by use of high pressure water flushing. It is, therefore, necessary to have adequate storage of clean potable water for operation of the water pump for such emergencies.

3.4 Grout Screen

The grouting equipment should contain a screen having a mesh size of IS:106 (IS:105 if sand is used). Prior to introduction into the grout pump, the grout should be passed through such screen. This screen should be easily accessible for inspection and cleaning.

3.5 Connections and Air Vents

Standard details of fixing inlets, outlets and air vents to the sheathing and/or anchorage should be followed as recommended by specialist supplier of the system of prestressing. In general, all connections are to be of the "Quake couple" type and at change of diameters suitable reducers are to be provided.

4 PROPERTIES OF THE GROUT

4.1 Water/Cement ratio should be as low as possible, consistent with workability. The ratio should not normally exceed 0.45. The temperature of the grout shall not exceed 25°C.

4.2 Before grouting, the properties of the grout mix should be tested in a laboratory depending on the facilities available. Test should be conducted for each job periodically. The recommended tests are described below:

1) **Deleterious Materials**

No chloride, sulphates shall be separately added to the grout. The constituent may contain chlorides/sulphates. However, its net effect should not exceed the following limits in the grout:

- Chlorides (Cl) not more than 0.1 percent by weight of cement.
- Sulphate (SO₃) not more than 4 percent by weight of cement.

Sulphide-ions(s) not more than 0.01 percent by weight of cement

2. **Compressive Strength**

The compressive strength of 100 mm cube of the grout shall not be less than 27 MPa at 7 days or 30 MPa at 28 days. Cubes shall be cured in a moist atmosphere for the first 24 hours and subsequently in water. These tests shall be conducted in advance to ascertain the suitability of the grout mix. The 7 day strength is not mandatory if the 28 day strength requirement is met.

1) **Setting Time**

Initial setting time of grout shall be more than three hours and less than 12 hours. The final setting time shall not be less than 24 hours.

2) **Bleeding**

Bleeding is the separation of free water from the grout mix. It includes the filtering effect of strands where the cavities between the wires constituting the strand, block cement particles and permit water under pressure to move ahead of the grout in the direction of general flow of grout. The bleeding shall be sufficiently low to prevent excessive segregation and sediment of the grout material. The bleeding shall not exceed 0.3 percent of volume of the initial volume of grout after three hours kept at rest.

3) **Volume Change**

The volume change of grout kept at rest for 24 hours and tested as per ASTM C 1090 shall be within range of 1% and 5 % of the original volume.

4) Fluidity

Fluidity is tested as per ASTM C 939 standard using standard flow cone.

Note: The fluidity of grout changes from time of mixing to time of setting in the ducts. The requirement given above may be modified as per the specific application, depending upon the total temperature, length of tendons, head of pumping, requirement of simultaneous grouting of closely spaced tendons etc. provided that other specifications and functions are satisfied.

5 MIXING OF GROUT

5.1 Proportions of materials should be based on field trials made on the grout before commencement of grouting, but subject to the limits specified above. The materials should be measured by weight.

5.2 Water should be added to the mixer, first, followed by Portland cement and sand, if used. Admixture if any, may be added as recommend by the manufacturer.

5.3 Mixing time depends upon the type of the mixer, but will normally be between 2 and 3 minutes. However, mixing should be for such a duration as to obtain uniform and thoroughly blended grout, without excessive temperature increase or loss of expansive properties of the admixtures. The grout should be continuously agitated until it is injected.

5.4 Once mixed, no water shall be added to the grout to increase its fluidity.

5.5 Hand mixing is not permitted.

6 GROUTING OPERATIONS

6.1 General

- a) Grouting shall be carried out as early as possible but not later than 2 weeks of stressing a tendon. Whenever this stipulation cannot be complied with for unavoidable reason, adequate temporary protection of the steel against corrosion by methods or products which will not impair the ultimate adherence of the injected grout should be ensured till grouting. The sealing of the anchorage ends after concreting is considered to be a good practice to prevent ingress of water. For structures in aggressive environment, sealing of the anchorage ends is mandatory.

Notes :

- i) Application of some patented water soluble oils for coating of steel/VPI powder injection/ sending in of hot, dry, oil-free compressed air through the vents at frequent intervals have shown good results.

- ii) Some of the methods recommended for sealing of anchorages are to seal the openings with bitumen impregnated gunny bag or water proof paper or by building a brick pedestal plastered on all faces enclosing the exposed wires outside the anchorages.
- iii) Any traces of oil if applied to steel for preventing corrosion should be removed before grouting operation.
- iv) Ducts shall be flushed with water for cleaning as well as for wetting the surfaces of the duct walls. Water used for flushing should be of same quality as used for grouting. It may, however, contain about 1 percent of slaked lime or quick lime. All water should be drained thorough the lowest vent pipe or by blowing compressed air through the duct.
- v) The water in the duct should be blown out with oil free compressed air.
Blowing out water from duct for cables longer than 50 m draped up at both ends by compressed air is not effective. Outlet/ vent provided at or near the lowest point shall be used to drain out water from duct.
- vi) The connection between the nozzle of the injection pipe and duct should be such that air cannot be sucked in.
- vii) All outlet points including vent openings should be kept open prior to commencement of injection grout.
- viii) Before grouting, all air in the pump and hose should be expelled. The suction circuit of the pump should be air-tight.

6.2

Injection of Grout

- a) After mixing the grout should be kept in continuous movement.
- b) Injection of grout must be continuous and should not be interrupted.
- c) For vertical cable or cables inclined more than 60 degrees to the horizontal, injection should be effected from the lowest anchorage or vent of the duct.
- d) The method of injection should ensure complete filling of the ducts. To verify this it is advisable to compare the volume of the space to be filled by the injected grout with the quantity of grout actually injected.
- e) Grouting should be commenced initially with a low pressure of injection of upto 0.3 MPa increasing it until the grout comes out at the other end. The grout should be allowed to flow freely from the other end until the consistency of the grout at this end is the same as that of the grout at the injection end. When the grout flows at the other end, it should be closed off and building up of pressure commenced. Full injection pressure at about 0.5 MPa shall be maintained for at least one minute before closing the injection pipe. It is recommended practice to provide a stand pipe at the highest point of the tendon profile to hold all water displaced by sedimentation or bleeding. If there is a built up of pressure much in excess of 1 MPa without flow of grout coming at the other end; the grouting operation should be discontinued and the entire duct flushed with high pressure water. Also, the bypass system indicated in para 3.2 above is essential for further safety.

- f) In the case of cables draped downwards e.g. in cantilever construction simultaneous injection from both ends may be adopted. **Fig. 1800/III-1.**
- g) Grout not used within 30 minutes of mixing should be rejected.
- h) Disconnection is facilitated if a short length of flexible tube connects the duct and injection pipe. This can be squeezed and cut off after the grout has hardened.

7

PRECAUTIONS AND RECOMMENDATIONS FOR EFFECTIVE GROUTING

- a) In cold and frosty weather, injection should be postponed, unless special precautions are taken. If frost is likely to occur within 48 hours after injection, heat must be applied to the member and maintained for at least 48 hours after injection so that the temperature of the grout does not fall below 5 degrees Celsius. Prior to commencement of grouting, care must be taken to ensure that the duct is completely free of frost/ice by flushing with warm water, but not with steam.
- b) The temperature of the grout shall not exceed 25 degrees Celsius. For increasing the workability of grout, its temperature may be lowered by use of chilled water or by putting ice outside the grout storage container.
- c) When the cables are threaded after concreting, the duct must be temporarily stiffened during concreting by inserting bunch of strands, Wires or reinforcement or a rigid PVC pipe or any other suitable method.
- d) During concreting, care shall be taken to ensure that the sheathing is not damaged. Needle vibrators shall be used with extreme care by well experienced staff only, to ensure against such damage.
- e) It is a good practice to move the cables in both directions during the concreting operations. This can easily be done by light hammering the ends of the wires/strands during concreting. It is also advisable that 3 to 4 hours after concreting the cable should be moved both ways through a distance of about 20 cms. With such movement, any leakage of mortar which has taken place in spite of all precautions, loses bond with the cables, thus reducing the chance of blockages. This operation can also be done by fixing prestressing jacks, at one end pulling the entire cable and then repeating the operation by fixing the jack at the other end.
- f) The cables to be grouted should be separated by as much distance as possible.

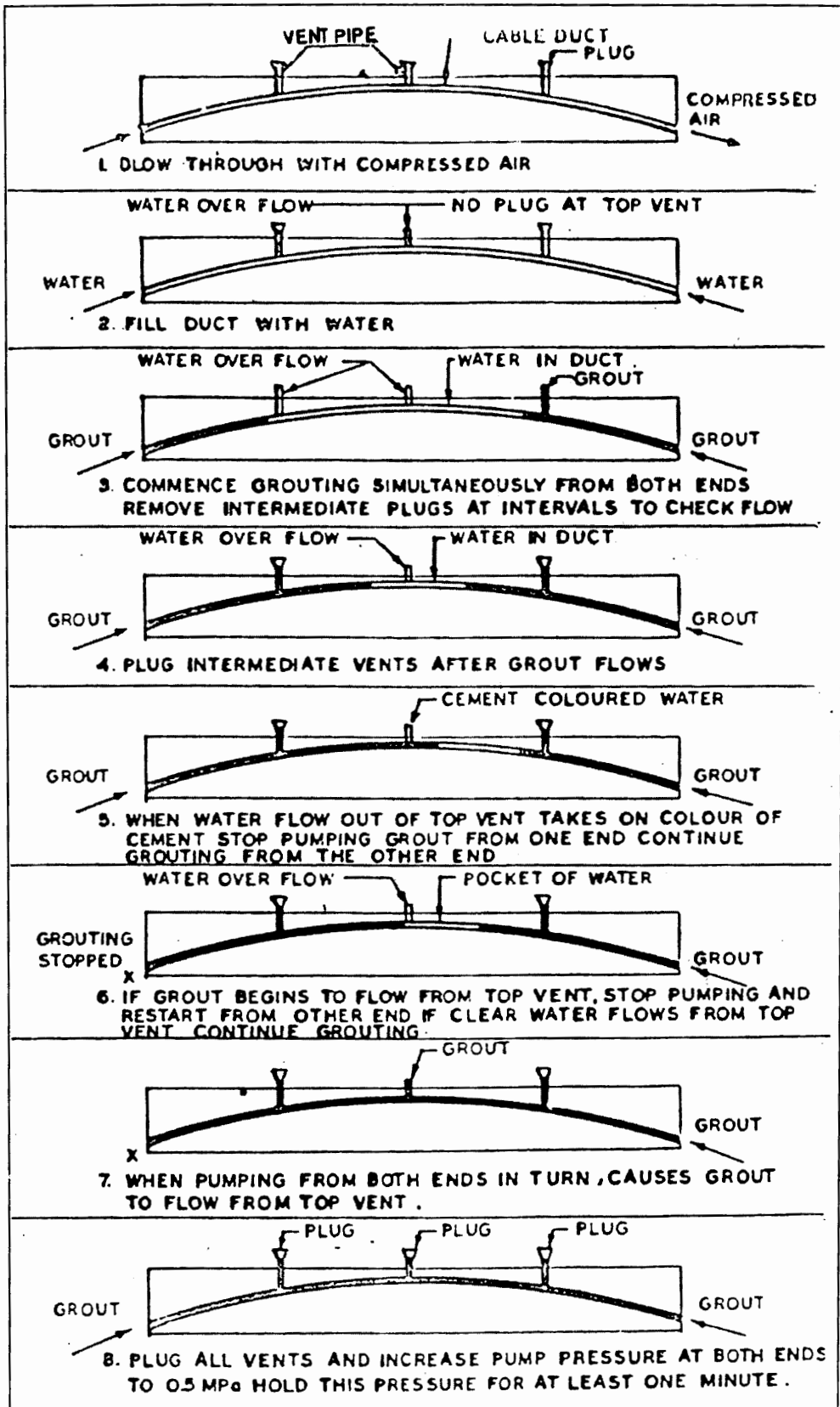


Fig. 1800/III : Procedure for Grouting of Cables Draped Downwards

- g) In case of stage prestressing, cables tensioned in the first stage should not remain ungrouted till all cables are stressed. It is good practice, while grouting any duct in stage prestressing, to keep all the remaining ducts filled up with water containing 1 percent lime or by running water through such ducts till the grout has set. After grouting the particular cable, the water in the other cables should be drained and removed with compressed air to prevent corrosion.
 - h) Care should be taken to avoid leaks from one duct to another at joints of precast members in particular.
 - i) End faces where anchorages are located are vulnerable points of entry of water. They have to be necessarily protected with an effective barrier, Recesses should be packed with mortar concrete and should preferably be painted with water proof paint.
 - j) After grouting is completed, the projecting portion of the vents should be cut off and the face protected to prevent corrosion.
-

**Appendix 1800/IV
(Refer Clause 1809)
GROUTING RECORD**

Job Name:

Span No.

Cable No:

Date of Cable Installation:

Date of Grouting:

Type of Cement : OPC/II ISOPC

Week and Year of Manufacture of
OPC/ IISOPC

W/C Ratio: Name and amount of admixture used. if any

Temperature:	Mixing water	;	Grout
Time:	Start	;	Finish
Equipment:	Grout mixture	;	Grout pump ≈ _____
Cable duct:	Diameter. _____		Length
Volume of grout in litres _____			Regrouting

Grouting pressure :

Cement consumption:	Theoretical	;	Actual
---------------------	-------------	---	--------

Pre-grouting checks:

Free of blockage	Inlet:	Yes/No	;	Outlet:	Yes/No
	Vents:	Yes/No	;	Cable duct:	Yes/No
Leakage observed:	Yes/No			Sealed:	Yes/No

If cable duct blocked: Remedial Measures

Grouting observations:

Passage of grout through vents	:	Yes/No
Passage of grout through outlet	:	Yes/No

Any equipment failure

Post grouting checks :

Probbing by stiffwire :

Remarks

Signatures of officers present during grouting :

Client

Contractor

System Supplier

Appendix 2800
(Refer Clause 2803.9.1)

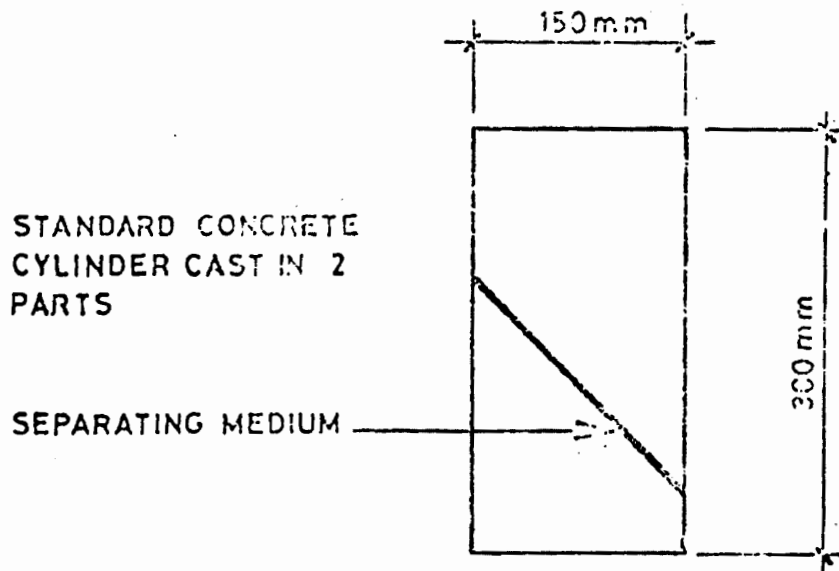


Fig. 2800/I

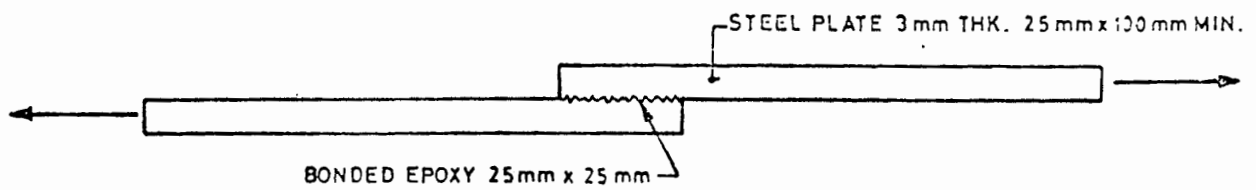


Fig. 2800/II

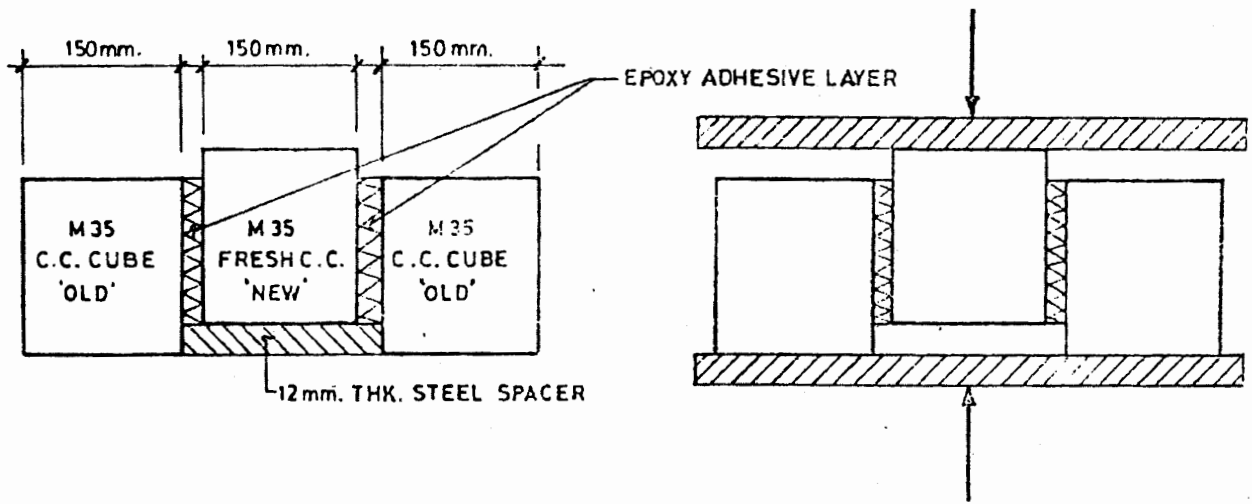


Fig. 2800/III

**GENERAL TECHNICAL
SPECIFICATIONS FOR
ROAD WORKS**

NAME OF WORK :

_____ **DEPARTMENT**
_____ **CIRCLE**
_____ **DIVISION**
_____ **200**

**General Technical
Specifications
for
ROAD WORKS**

General Technical Specifications for Road Works

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GENERAL TECHNICAL SPECIFICATIONS

1.0 General :

All measurements shall be made-in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant sections read in conjunction with General Conditions of Contract. The same shall not however apply in the case of lump-sum items. All measurements and computations; unless otherwise indicated, shall be carried nearest to the following limits :

- (i) length and breadth..... 10mm
- (ii) height, depth or thickness of earthwork,
sub-base, bases, surfacing, and structural members...5mm
- (iii) areas0.01 Sq. Metre
- (iv) cubic contents0.01 cubic metre

in recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

2.0 Measurement of lead for Materials :

Where lead is specified in the contract for construction materials, the same shall be measured as described hereunder.

Lead shall be measured over the shortest practicable route and not the one actually taken and the decision of the Engineer-in-charge in this regard shall be taken as final. Distance upto and including 100 meters shall be measured in units of 50 metres, exceeding 100 metres but not exceeding 1 KM. in units of 100 metres, and exceeding 1 km. in units of 500 metres. The half and greater than half of the units shall be reckoned as one and less than half of the units ignored. In this regard, the source of the material shall be divided into suitable blocks and for each block the distance from the centre of the block to the centre of placing pertaining to that block shall be taken as the lead distance.

3. Surface Regularity of Subgrade & Pavement Courses :

The surface regularity of completed sub-base courses and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table below. The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10 metres.

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sr.	Type of Construction	Longitudinal Profile with 3 metre straight edge					Cross Profile
		Maximum permissible undulation in mm	Maximum number of undulation permitted in any 300 m. length exceeding in mm				Maximum permissible variation from specified profile camber template-mm
1	2	3	4	5	6	7	8
1.	Earth subgrade	36	30	-	-	-	15
2.	Granular / lime / Cement Stabilised sub-base	23	-	30	-	-	12
3.	Water Bound Macadam with nominal size metal (20-50) mm	18	-	-	30	-	8
4.	Semi-Dense Carpet @ @	15	-	-	-	20	6

Notes :

1. @ @ These are for machine laid surfaces. If laid manually, due to unavoidable reason, tolerance upto 50 percent above these values in this column may be permitted. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 in the table.

2. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3. **Rectification** : Where the surface irregularity of subgrade and the various pavement courses fall outside the specified tolerances, the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer-in-charge at his own cost.

(i) **Subgrade** : Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by adding fresh material. The degree of compaction and the type of material to be used shall conform to the specified requirements.

(ii) **Granular/Sub-base** : Same as at (i) above except that the degree of compaction and the type of material to be used shall conform to the specified requirements.

(iii) **Lime/Cement stabilized soil sub-base** : For Lime/Cement treated materials where the surface is high, the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material, is less than 2 hours, the surface shall be scarified to a depth of 50 mm, supplemented with freshly mixed material as necessary and recomposed to the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material, to specification. In either case, the area treated shall not be less than 5 metres long by 2 metres wide. This shall also apply to lime treated material except that the time criterion shall be 3 hours instead of 2 hours.

(iv) **Water Bound Macadam Base** : Where the surface is high or low, the top 75mm shall be scarified, reshaped with added material as necessary and recompacted. The area treated at a place shall not be less than 5 metres long and 2 metres wide.

(v) **Bituminous Constructions** : For bituminous constructions, other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material and recompaction to specifications. Where the surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications in all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 metre long and not less than 1 metre wide.

4. Quality Control Tests During Construction :

The materials supplied and the works carried out by the Contractor shall conform to the enclosed relevant specifications. For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control test as described hereinafter, by the Engineer-in-charge. The testing frequencies set forth are the desirable minimum and the Engineer-in-charge shall have the full authority to carry out test as frequently as he may deem necessary to satisfy that the materials at work comply with the appropriate specifications. Test procedures for the various quality control tests are indicated in the respective sections of the specifications or for certain tests within this section. Where no specific testing procedure is mentioned, the test shall be carried out as per prevalent accepted engineering practice to the directions of the Engineer-in-charge.

5. Tests on Earthwork for Embankment Construction:

5.1 Borrow Material :

(a) Sand Content (IS : 2720 Part IV)
Two test per 8000 Cubic Metres of soil.

(b) Plasticity Test (IS : 2720 Part-V)
Each type to be tested. Two tests per 8000 Cubic Metres of soil.

- (c) Density test (IS : 2720 Part VII)
Each soil type to be tested. Two tests per 8000 Cubic Metres of soil.
- (d) Moisture Content Test (IS : 2720 Part-11)
One test for every 250 Cubic Metres of soil.

5.2 Compaction Control :

Control shall be exercised by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating day's work on statistical basis. The determination of density shall be in accordance with IS. : 2720 (Part XXVIII). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over borrow material and the method of compactions is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increase to 10.. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below 0.08 gm/cc. However for earthwork in shoulders and in top 500 mm portion of the embankment below the subgrade, at least one density measurement shall be taken for every 500 square meters of the compacted area provided further that the number of the tests in each set of measurement shall be at least 10, In other respects, the control shall be similar to that described earlier.

6. Following materials shall conform to the Indian Standards shown against them :

- (1).....Cement..... IS : 269
- (2)..... Sand for masonry..... IS : 2116
- (3)..... Sand for concrete..... IS : 383
- (4)..... Coarse aggregate..... IS : 383
- (5)..... Mild Steel..... IS : 432
- 6)..... High yield strength deformed bars
-(a) Hot Rolled..... IS : 1139
-(b) Cold Twisted.. IS : 1786

7. Barrel thicknesses of pipes of different class shall be as under:

Sr. No	Internal Diametre of pipe in mm	Barrel NP1	thickness NP2	(in mm) NP3
1	80	25	25	-
2	100	25	25	-
3	150	25	25	-
4	250	25	25	-
5	300	30	30	-
6	350	32	32	75
7	400	32	32	75
8	450	35	35	75
9	500	-	35	75
10	600	-	40	80
11	700	-	40	80
12	800	-	45	90
13	900	-	50	100
14	1000	-	55	100
15	1100	-	60	115
16	1200	-	65	115

STANDARD TECHNICAL SPECIFICATIONS FOR ROAD WORKS

ITEM 1 - A Earthwork for embankment including clods, dressing with all lead and lift (including watering and consolidation) (a) From borrow pits within land width.

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30 cm and less, loose stones, vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stacks along the roads boundary or as directed at places within 50 metres lead, and handed over to the department in convenient sections. Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works, property or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner.

2. After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes, grades and sections as shown on then plan or directed by the Engineer-in-charge. The contract^r shall provide all labours and materials such as lime, string, pegs, nails, bamboos, stones, mortar, concrete etc. required for setting out, establishing Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B.M.S. profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may bo restored by the department at the cost of the contractor.

3 When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide, shall be cut into existing slope for ensuring adequate bond with the fresh embankment material to be added. The material obtained from the cutting of benches can be utilised in the widening of the embankment. Where the width of the widened portions is sufficient to permit the use of usual rollers, compactions shall be carried out with the help of tandem/sheetproot rollers, mechanical tampers or other approved, plant. The dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.

4. The soil to be used for embankment shall be tree from trees, stumps, roots, rubbish or any other objectionable materials. Only materials considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable shall be disposed off as directed by him. The selection of materials to be used in the construction of embankment shall be made after soil survey and investigations are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with all lead and lifts.

5. The materials satisfying the density requirements given the table shall be employed for embankment construction.

Type of Work	Laboratory Dry Density when tested as per IS : 2720 (Pt. VII)
- Embankment exceeding 3 metre height	Not less than 1.52 gm/cc
- Embankment exceeding 3 metre height or embankment or any height subject to long period of inundation.	Not less than 1.52 gm/cc
- Top 0.5 metre of embankment below the subgrade level and shoulder Where earth shoulder are specified]	Not less than 1.65 gm/cc

Field density shall be a percentage of laboratory density as recommended by the Gujarat Engineering research institute. Location, shape and size of borrow pits shall be as indicated by the Engineer-in-charge. Pits shall not be dug continuously. Ridges of not less than 8 metres width should be left at intervals not exceeding 300 metre. Small drain shall be cut through the ridges of facilities drainage. The outer edge of borrow pits shall be so regulated that the bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of final section of the bank, the maximum depth in any case being limited to 1.5 metres. Also no pits shall be dug within 5 metres of the tow of the final section of the road embankment.

5.1 No borrow pits shall be allowed at the following sites along the road.

- (i) upto 30 metres on either side of C.D. Works:
- (ii) upto 15 metres on either side of cart track crossing for which approaches are to be constructed
- (iii) in the length in which earth obtained from cutting is specified to be used in the embankment.

5.2 If there is top layer of black cotton or other objectionable soils, the same shall be removed and disposed off elsewhere and usable material found at lower level will only be used in earthen embankment.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment. Unless otherwise directed by The Engineer-in-charge. The consolidation including watering and rolling of earthwork shall be carried out by the Department, The operation of laying the successive layer of earth shall have to be suitably synchronized with the consolidation work. If the soil as delivered to the road is too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm. when being placed in the embankment and a maximum size of 5 cm, when being placed in the top 45 cm. of the embankment. The work of next layers shall be allowed only after the first layer below it has been thoroughly compacted to the density specified.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the step of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing surface, the new material. However when the embankment is to be placed over an old concrete, pavement shall be broken up in pieces not to exceed 0.1 m and may be left under the new-embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt. of the new subgrade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.

8. To avoid interference with construction of abutments, wing walls or return walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference of damage to the bridge work. Unless directed otherwise the filling around culverts, bridge and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be carried out independent of the work on the main embankment. The fill materials shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days. The embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material the material used for the filler shall conform to the requirement rollers or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer-in-charge. Care shall be taken to see that the compaction plant does not hit or come too close to any structural members so as to cause any damage to them.

9. The embankment shall be finished in conformity with the alignment, level, cross sections and dimensions shown on the plans or as directed by the Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulder, road bed and the slopes to conform to the cross section

10. The consolidation of earth work including rolling and watering at O.M.C. as per laboratory requirement shall be carried out by the Department, the field and laboratory investigations and testing of samples shall be carried out by the department. However, the contractor shall give full co-operation and shall bear the charges for layout and collection of samples for testing at authorized Government laboratory. The work of laying of earthwork in layers shall be synchronized with the work of compaction and consolidation of the earth work and the operations shall also be synchronized with the field and laboratory testing. When density measurements reveal any soft areas in the embankment, the Engineer-in-charge shall direct that these areas shall be compacted further. In spite of that, specified compactions is not achieved, the materials in the soft area shall be removed as directed and replaced by the approved materials. Deduction of 15% shall be made for the shrinkage from the sectional measurements to be paid to the contractor, if measured before first monsoon and 10% measured after one or more monsoon have passed over the earth embankment.

11. The earth work measurements shall be paid on cross sectional measurements and computing the volumes of earth-work in cubic metres by average area method. The contractor shall sign day to day levelling work and also original cross sections in token of his acceptance etc. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual earth work is started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily, in token of this acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned of any complaint shall be taken. Merely not signing of the level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts depression due to shrinkage

etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurement shall be taken on compacted earth work, no deduction for shrinkage shall be made from gross measured quantity of compacted earth work. However the contractor shall have to bear loss of quantity due to all settlement as well as other types of deformations etc. if any that might have taken place at the time of taking the final measurement of this item. If the Compaction as stipulated in para-10 is not done by the department in that case shrinkage from such earthwork quantity shall be deducted as per norms, i.e. 10% after monsoon and 15% before monsoon. 12. The rate of earthwork includes clearing jungles, dogbelling, fixing profiles, erecting necessary pillars or stones for bench mark for leveling purpose, excavating earth from borrow pits, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment to the proper profile camber grade and slopes. The rate also includes all labour, materials, tools, equipment and incidentals necessary to complete the work according to the specifications. Cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in that particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour for cutting will be paid as per specifications in the particular item and only balance quantity brought from borrow pits will be paid in this item,

ITEM 1-B Earthwork for embankment including breaking clods, dressing with a) lead and lift (excluding watering and consolidation) (a) From borrow pits within land width.

1. The land width on which the earth work is to be done shall be cleared of all tree having a girth of 30 cm and less, loose, stones, vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section. Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works property or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner.

2. After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes, grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete, etc. required for setting out, establishing. Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B. Ms. profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor,

3. When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment of the embankment. The dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.

4. The soil to be used for embankment shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations carried out by the Department. The embankment shall consist of earth available from road side borrow pits on either side with all lead and all lifts.

5. Location, shape and size of borrowpits shall be as indicated by the Engineer-in-charge. Pits shall not be dug continuously. Ridges of not less than 8 metres width should be left at interval not exceeding 300 metres. Small drain shall be cut through the ridges of facilitate drainage. The outer edge of borrow pits shall be so regulated that the bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of final section of the bank, the maximum depth in any case being limited to 1.5 metres Also no pits shall be dug within 5 metres of the toe of the final section of the road embankment.

5.1 No borrow pits shall be allowed at the following sites along the road.

(i) up to 30 metres on either side of C.D. Works.

(ii) up to 15 metres on either side of cart track crossing for which approaches are to be constructed.

5.2 If there is top layer of black cotton or other objectional soils, the same shall be removed and disposed off elsewhere and usable material found at lower level will only be used in the embankment.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise directed by the Engineer-in-charge. The consolidation including watering and rolling of earth work shall be carried out by the

Department. The operation of Laying the successive layer of earth shall have to be suitably. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm. when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new subgrade level the pavement shall be broken up in pieces not to exceed 0.1 m. and may be left under the new embankment. If the existing road surface is of granulate or bituminous type and lies within 1 mt. of the new subgrade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls or return walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridges and other structures up to a distance of twice the height of the embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given for 14 days, the embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for the filter shall conform to the requirements for filler medium and will be paid extra in the relevant item.

9. The embankment shall be finished in conformity with the alignment, levels, cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method. The contractor shall sign day to day leveling work and also original cross section, longitudinal section etc. in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in charge before the actual work is started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started, no cognizance of any complaint will be taken. Merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify levelling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. If the compaction as stipulated in para above is not done by the department in that case shrinkage from such earth work quantity shall be deducted as per norms i.e. 10 percent after monsoon and 15% before monsoon. However the contractor shall have to bear loss of quantity due to all settlements as well as other types of deformations etc. if any. that might have taken place at the time of taking the final measurements of this item.

11. The rate of earthwork includes, clearing jungles, dogbelling, fixing profiles, erecting necessary pillars for stones for bench marks for levelling purpose, excavating earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in the particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour for cutting will be paid as per specifications in the particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item.

ITEM 1-C Earthwork for embankment for side shoulders including breaking clods, dressing with all lead and lift (excluding watering and consolidation) (b) From borrowpits within __ kms. lead.

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30 cm and less, loose stones, vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will

be the property of Government. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 meters lead, and handed over to the department in convenient section. Unsuitable materials shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works properly or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner.

2. After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes, grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete, etc.. required for setting out establishing. Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B. Ms. profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor

3. When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The material obtained from the cutting of benches can be utilised in the widening of the embankment. The dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.

4. The soil to be used for embankment shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations carried out by the Department The embankment shall consist of earth available from road-side borrow pits on either side with all lead and all lifts and within land width in the manner specified in para 11 bellow. The road, if any required for the purpose of haulage of earth by men, animals or vehicles will be constructed.(if not existing and maintained by the contractor at his own cost.

5. Department will extend all necessary co-operation in helping contractor to get borrow area from nearby Government or Panchayat land. if available. However, department is not responsible if not such area is made available to the contractor and in the case. contractor will have to make his own arrangement to get borrow area for borrowing earth of the quantity even by making, temporary arrangement with the private land owners.

6. The embankment shall be constructed in uniform layers not exceeding 250 mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment. unless otherwise directed by the Engineer-in-charge. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm. when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted.

7. Where embankment is to be placed on sloping ground. the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new subgrade level, the pavement shall be broken up in pieces not to exceed 0.1 m and may be left under the new embankment. If the existing road surface is of granular or bituminous type and lies within 1 mnt. of the new subgrade level, the same shall be scarified to a depth of minimum 50mm.so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge. suspend work on embankments forming approaches to such structures. until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridge and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days,the embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers with the laying of fill material. The material used for the filter shall conform to the requirements for filler medium and will be paid extra in the relevant item.

9. The embankment shall be finished in conformity with the alignment, levels, cross sections and dimension shown on the plans or as directed by Engineer in charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method. The contractor shall sign day to day leveling work and also original cross sections, longitudinal section etc. in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work has started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily. in token of his acceptance. If there is any disagreement, the contractor shall inform of it in writing to the officer concerned with specific reference to the sections-before starting further work. Once the work is started, no cognizance of any complaint will be taken. Merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. Deduction of 15% for shrinkage shall be made from gross measured quantity if measured before first monsoon and 10% if measured after one or more monsoon have been passed over the earth embankment. However the contractor shall have to bear loss of deformations etc. if any due to all settlements as well as other type of deformations etc. if any. that might have taken place at the time of taking final measurement of the item.

11. If usable approved material is available within the land width of road, the same shall be permitted for use in the road embankment subject to the following conditions :-

- (i) The borrow pits will be so excavated as to form a road side longitudinal gutter to drain the water. interrupted by such gutter,
 - (ii) The width of the drain shall be restricted to 1,5mts, only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only,
 - (iii) If there is top layer of black cotton or other objectionable soils, the same shall be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor choose to utilize this material,
 - (iv) The drain should be aligned along the boundary of the land width of the road. Not pit, other than this drain, shall be dug within 5 meters of the toe to the final section of the road embankment,
 - (v) No borrow pits shall be allowed in the length in which earth obtained from cutting from cutting is specified to be used in embankment.
12. The rate of earthwork includes, clearing jungles, dogbelling, fixing profiles, erecting necessary pillars for stones for bench marks for leveling purpose, excavating earth from borrow areas, breaking clods conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in the particular item. No payment shall be made under this item for the cutting stuff used in embankment but labour for cutting will be paid as per specifications in the particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item

ITEM 1-D Earthwork for embankment including breaking clods, dressing with all lead and lift (including watering and consolidation) (b) From borrowpits within kms. lead.

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30 cm and less, loose, stones, vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stacks along the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section. Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the works property or people in the neighborhood. In all cases, the materials shall be disposed off in a neat manner

2. After clearing the site, the alignment of the road shall be properly set out true to line, curves, slopes grades and sections as shown on the plan or directed by the Engineer-in-charge. The contractor shall provide all labours and materials such as lime, strings, pegs, nails, bamboos, stone, mortar, concrete etc. required for setting out, establishing. Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B.Ms, profiles alignments and other marks as long as they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the

department at the cost of the contractor.

3. When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The material obtained from the cutting of benches can be utilised in the widening of the* embankment. Where the width of the widened portions if insufficient to permit the use of usual rollers, compaction shall be carried out with the help of tandem/sheeps foot rollers, hand rollers, mechanical tempers or other approved plant. The dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.

4. The soil to be used for embankment shall be free from trees, stumps, roots, rubbish or any other objectionable materials. Only material considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable other disposed off as directed by him. The selection of the materials to be used in the construction of embankment shall be made after soil surveys and investigations are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with lead and all lifts, and within land-width in the manner specified in para 12 below.7 The road, if any, required for the purpose of haulage of earth by men, animals or vehicles will be constructed (if not existing) and maintained by the contractor at his own cost, he material satisfying the density requirements given in the table below shall be employed for embankment construction.

Type of Work	Laboratory Dry Density when tested as per IS : 2720 (Pt. VII)
- Embankment exceeding 3 metre height	Not less than 1.44 gm/cc
- Embankment exceeding 3 metre height or embankment or any height subject to long period of inundation.	Not less than 1.52 gm/cc
- Top 0.5 metre of embankment below the subgrade level and shoulder Where earth shoulder are specified]	Not less than 1.65 gm/cc

Field density shall be percentage of laboratory density as recommended by Gujarat Engineering Research Institute.

5. Department will extend all necessary co-operation in helping contractor to get borrow area from nearby Government or Panchayat land, if available. However, department is not responsible if no such area is made available to the contractor and in that case, contractor will have to make his own arrangement to get borrow area for borrowing earth of the approved quantity even by making temporary arrangement with the private land owners.

6. The embankment shall be constructed in uniform layers not exceeding 250mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment, unless otherwise directed by the Engineer-in-charge. The consolidation including watering and rolling of earthwork shall be carried out by the Department. The operation of laying the successive layer of earth shall have to be suitably synchronized with the consolidation work. If the soil as delivered to the road bed is too wet, it shall be dried by exposure to the sun till the moisture content is acceptable for compaction. All clods of hard lumps of earth shall be broken to have maximum size of 15cm when being placed in the embankment and a maximum of size 5 cm when being placed in the top 45 cm of the embankment. The work of next layer shall be allowed only after the first layer below it has been thoroughly compacted to the density specified.

7. Where an embankment is to be placed on sloping ground, the surface of the ground shall be benched in the steps of trenches or broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm so as to provide ample bond between the old and new material. However when the embankment is to be placed over an old concrete pavement and lies within 1 metre of new subgrade level the pavement shall be broken up in pieces not to exceed 0,1 m and may be left under the new embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt. of the new subgrade level, the same shall be scarified to a depth of minimum 50 mm. so as to provide ample bond between the old and the new material.

8. To avoid interference with the construction of abutment, wing walls or return walls of culverts/bridge structures, the contractor shall, at point to be determined by the Engineer-in-charge, suspend work on embankments forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference or damage to the bridge work. Unless directed otherwise, the filling ground culverts, bridges and other structures up to a distance of twice the height of the embankment from the back of the embankment shall be earned out independent of the

work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days, (the embankment shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for the filter shall conform to the requirements for filler medium and will be paid extra in the relevant item. Where it may be impracticable to use power rollers or other heavy equipment, the compaction shall be carried out by mechanical tampers or other methods approved by the Engineer-in-charge. Care shall be taken to see that the compaction plant does not hit or come too close to any structural member so as to cause any damage to them.

9. The embankment shall be finished in conformity with the alignment, levels, cross sections and dimension shown on the plans or as directed by Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawings or as the Engineer-in-charge may direct. Finishing operations shall include the work of shaping and dressing the shoulders, road bed and the side slopes to conform the cross section.

10. The consolidation of earth work including rolling and watering at O.M.C as per laboratory requirements shall be carried out by the department. The field and laboratory investigations and testing of sample shall be carried out by the Department, However, the contractor shall give full co-operation and shall be the charges for labours and collection of samples for testing at authorised Government laboratory. The work of laying of earthwork in layers shall be synchronized with the field and laboratory testing. When density measurements reveal any soft area as in the embankment the Engineer-in-charge shall direct that these areas shall be compacted further. If in spite of that, specified compaction is not achieved the materials in the soft areas shall be removed as directed and replaced by the approved materials.

11. The earthwork measurements shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method. The contractor shall sign day to day leveling work and also original cross section, longitudinal section etc. in token of his acceptance. The working sections both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work is started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily, in token of his acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with specific reference to the sectioned before starting further work. Once the work is started, no cognizance of any complaint will be taken. Merely not signing of level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earth work and on finalisation. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be taken on compacted earth work. No deduction for shrinkage shall be made from gross measured quantity of compacted earth work. However the contractor shall have to bear loss of quantity due to all settlements as well as other types of deformations etc. if any. that might have taken place at the time of taking the final measurements of this item.

12. If usable approved materials is available within the land width of road, the same shall be permitted for use in the road embankment subject to the following conditions :-

- (i) The borrow pits will be so excavated as to form a road side longitudinal gutter to drain the water, interrupted by such gutter
- (ii) The width of the drain shall be restricted to 1.5 mts. only. The depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only,
- (iii) If there is top layer of black cotton or other objectionable soils, the same be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor chooses to utilize this material.
- (iv) The drain should be aligned along the boundary of the land width of the road. No pit, other than this drain.

shall be dug within 5 metres of the toe to the final section of the road embankment. (v) No borrow pits shall be allowed in the length in which earth obtained from cutting is specified to be used in embankments.

13. The rate of earthwork includes clearing jungles, dogbelling, fixing profiles, erecting necessary pillars for stones for bench marks for leveling purpose, excavating earth from borrow areas, breaking clods, conveying and spreading earth in layers with all lead and Lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall be utilised in embankment construction under this item within the lead specified in that particular item. No payment shall be made under this item for the cutting stuff used in the embankment but labour

for cutting will be paid as per specifications in that particular item, and only balance quantity of earthwork brought from borrow areas will be paid in this item.

ITEM 1 (E) Rolling and Watering of earth work in layer with power roller including filling in depression which occurs during the process.

1. For spreading materials in layers and bringing the appropriate moisture content, the embankment materials shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder :-

Moisture content of the materials shall be checked at the source of supply and if found less than that specified for compaction, the same, shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from a hose line or from a truck mounted water tank, and flooding shall not be permitted under any circumstances.

If the materials delivered to the road bed is too wet it shall be dried, by evaporation and exposure to the sun. till the moisture content is brought down to acceptable standard for compaction. Should circumstances arise. where owing to wet weather, the moisture content cannot be reduced to the required level by the above procedure, work of compaction shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS 2720 (Part-11) and unless otherwise mentioned shall be so adjusted, making due allowance for evaporation losses, that at the time of the compaction it is in the range of 1 percent to 2 percent below the optimum moisture content determined in accordance with IS (Part-VII). Highly expansive clays shall however be compacted at 2 to 4 percent above the optimum moisture content.

After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 75mm when being placed in the top 0.5 meter portion of the embankment below the subgrade.

Hauling equipment shall be dispersed uniformly over entire surface of the previously constructed layer to minimize cutting of uneven compaction.

Where the embankment is to be constructed on low area ground that will not support the weight of trucks of other hauling equipment, the lower part of the fill should be constructed by dumping successive loads in a uniformly distributed layers of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

2. COMPACTION : Only compacting equipment approved by the Engineer-in-charge shall be employed to compact the materials. The contractor shall demonstrate the efficiency of the plants he intends to use for carrying out compaction trials.

Each layer of the materials shall be thoroughly compacted to the densities specified in Table 1.2

Table 1.2 Compaction requirements for embankment.

Sr. No.	Type of Work/materials	Field dry density as per centage of maximum laboratory dry density as per IS:2720 (Part-VII)
1.	Top 0.5 meter portion of embankment below subgrade level and shoulders.	Not less than 100.
2.	Other portion of embankment.	Not less than 95
3.	Highly expansive class	85 to 90

Subsequent layers shall be placed only after finished layer has been tested according to M.O.S.T. specification clause 902 and accepted by the Engineer-in-charge.

When density measurements reveal any soft areas in the embankment further compaction shall be carried out as directed by the Engineer-in-charge. If inspite of that the specified compaction is not achieved, the materials in the soft areas shall be removed and replaced by approved materials and compacted to the density requirement. to the satisfaction of the Engineer-in-charge.

3. Measurements for Payment : Consolidation of earth embankment construction shall be measured by taking cross section at intervals in the original position before the work starts and after its completion and computing of the volume of earthwork in cubic meters by the method of average and areas. The measurement of fill material from borrow areas shall be the difference between the net quantities of suitable materials brought from roadway and drainage excavation. For this purpose it shall be assumed that one cubic meter of suitable materials brought to site

from roadway and drainage excavation froms one cubic meter of compacted fill and alt bulking or shrinkage shall Tie ignored. Stripping including storing and reapplication of top soil shall be measured as volume in cubic meter.

4. The contract unit rate includes cost of mechanical roller required for consolidation including ail labour, equipments fuel, hire charges, tolls, and incidentals necessary.

ITEM-2 Earth Work In cutting In all sorts of Soil anJ Soft Murrum including conveying and putting the stuff spoil bank maintaining minimum distance of five meter between top edge of cutting and top of bank, (a) within 200 metres from the ends of the cutting with all required Lead and Lift.

1. The land width required for the roadway, gutter side slopes and catch water gutters shall be cleared of all trees having a girth of 30 cms. and less, loose, stones, vegetation, bushes, stumps and all other objectionable materials. The roots of trees and stumps shall be removed to a depth of 30 cms below the grade formation and slopes and excavatorfilled up with excavated materials and compacted. Alt the materials cleared will be the property of Government. Useful materials ?hall be arranged in convenient stacks along the road boundary or as directed at places within 50 mts. lead, and handed over to the department in convenient sections. Unsuitable material shall be burnt or otherwise disposed off by the contractor at his own cost without causing any nuisance, inconvenience or damage to the work, property or people in the neighborhood. If the materials are to be disposed off outside the road land, necessary permission from the private land owners shall be taken by the contractor and royalty etc. tf any paid by him without claiming compensations. In all cases, the materials shall be disposed off in a neat manner.

2. After clearing the site, the alignment of the road shall be properly set out true to lines, curves slopes, grades and sections as shown on the plans or directed by the Engineer-in-charge. The contractor shall provide all labour and materials such as lime, strings, pegs, nails, bamboos, stones mortar, concrete etc. required for setting out alignment establishing bench marks and giving profiles. The contractor shall be responsible for maintaining the B. Ms, profiles alignments and other stakes and marks as long as they are required for the work in the opinion of the Engineer. If the contractor defaults in this respect even after the direction by the Engineer within the specified time, they may be restored by the Engineer at the levels etc. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with th9 specific reference to the sections before starting further work. Once the work has started, no cognizance of any complaint shall be taken. Merely not signing of the book shall not be deemed as disagreement.

3. Profiles of the section including the road side gutters to be excavated shall be laid at suitable intervals of 10m. to 50 m. or other intervals as directed by Engineer to conform to the curved or straight alignment, sections. grades and side slopes. The line out shall be clearly marked and profiles of embankments where excavated materials are to be used shall be set up with the toe line marked on each side. The road way section shall first be excavated with vertical side for each lift and the sides slopes for that lift shall be excavated in steps. These steps shall be smoothed to the required slope when the excavation reaches the road formation. The contractor shall on no account excavate beyond the slopes or below the specified grade unless so directed by the Engineer in writing. If excavation is done below the specified level or outside the section, it shall not be paid for and the contractor shall be required to fill up at his own cost such extra excavation in the road portion, with approved materials of the embankment grade in layers, watered and fully compacted to attain maximum density laid down for the embankment in its relevant item. The Engineer may require measurement ridges and dead man to be left at specified intervals or places and kept intact till ordered to be removed for the purpose of check measurements. The excavation shall be finished neatly, smoothly, and evenly to the correct lines, curves, grades, if loose shall be scarified, watered and compacted to the same density as the embankment. The section, side slopes and catch water gutter shall be maintained by the contractor at his own cost in such a way that the formation and gutters wilt be drained by providing for necessary diversions etc, and not damaged due to obstruction of any drainage. Necessary passages shall be provided for leading away seepage, springs, surface flow or rainwater safely without damaging the work. If any damage occurs due to default of the contractor in this respect, he shall make good the damage at his own cost. If it is necessary in the execution of the work to interrupt existing surface drainage, irrigation channels, sewers or under drainage, temporary arrangements shall be provided till such time as is necessary. The contractor at his own cost shall make the existing works or work in hand caused as a result of his operations or negligence shall be made good by the contractor at his own cost. Road side gutters shall be excavated to the specified sections and shall be measured along with the main cutting in cubic meters. 4. If slides occur in the cutting they shall be removed as ordered by the Engineer. If finished slopes slide into the roadways before the final acceptance of the work, such slides shall be removed by the contractor and shall toe paid for at the contract rate for the class of excavation involved provided the slides are not due to any negligence of the contractor. The classification of the material in slides shall conform to its conditions at the time of removal

and payment made accordingly regardless of its prior condition. Care shall be taken to see that excavation is arranged in a safe way so that there will be no risk to the workmen by slides, falling materials, boulders and collapsing sides etc.

5. If there is traffic nearby or if there are towns and villages in the neighborhood, barricades and or traffic signals shall be provided day and night for the duration of the work in such a way as to prevent accidents. Warning signals shall be displayed at 7mt. from the danger point on both sides giving sufficient warning. If necessary, signalers shall be stationed at each end to regulate traffic where it is heavy. Measures shall be taken to see that the excavation does not affect or damage adjoining structures or property. If there is damage to property, injury to workers, the members of the public, animals etc., due to the negligence of the contractor, he will be responsible and liable to all the consequences including compensation.

6. All the excavated materials shall be property of Government. When the useful excavated material is to be used in embankment within a lead of 200 metre and all lift, it shall be directly deposited at the required location in specified layers. No handing or conveyance charges shall be paid if the material is temporarily deposited elsewhere and subsequently conveyed to site of deposition. The sequence of operations at convenient places, without interfering with the drainage in any way. If no Government land is available but the excavated useful stuff is to be stacked temporarily before use under the same agreement, the contractor shall make his own arrangements for the stacking of this material not required for use on embankment or unsuitable materials may be used on his own to uniformly widen embankment to flatten slopes and to fill low places in the road land, if so permitted by the Engineer. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in a manner approved by the Engineer. The excavated material shall not be deposited within 3 m. from the top edge of slope or toe of the bank. The lead shall be measured from the junction point of cutting and embankment up to 200 mt. on either side.

7. If the contractor does not wish to utilise the quantity of cutting within the specified lead for any reason, then he may do the embankment work with the earth from other sources (except borrow pits in the length of the road where cutting stuff is to be utilised) but in that case the full or part quantity on acceptable quality stuff for which payment is made or to be made will be deducted from the net quantity of the earth work in the embankment arrived at, within the chainage measured as above.

8. The Contract rate shall be a unit of one cubic metre for the start mentioned in the wording of the item of excavation acceptably completed, limited to the dimensions shown on the plans or as directed by the Engineer. Excavation shall be measured in its original positions by taking cross sections before the work starts and after it is entirely completed. The quality shall be worked by the average end area method. When the classification of the strata changes, the contractor shall bring this to notice of the Engineer, who will then verify and if necessary take levels for the changed strata for purpose of measurement.

(b) In Spoil Bank :Specification shall be as per Item 2(a) except that the excavated stuff shall be deposited in spoil Bank instead of using same in road embankment.

ITEM 3 Supplying and Stacking murrum binding materials including materials on road side including filling boxes with all lead & lift etc. complete.

1. Material for the purpose shall be of approved quality. Any material which is found inferior shall be rejected and the contractor shall remove such rejected material from the site at his own cost. The material shall be collected from quarries approved by the Executive Engineer. The material shall be granular and gritty.

2. The material shall be got approved by the Executive Engineer prior to collection on site. It shall be free from all rubbish, dust and any organic materials as well as clods of black cotton soils. Materials shall not be allowed to be collected from within the road boundary. Material to be used as crust and for side shoulders shall be as per C.B.R. report and that to be use bindage in W.B.M. road construction shall have P.I. value of less than 6 as determined in accordance with IS 2720 (Part-V). The material to be used should be got tested prior to its use in road construction. Testing charges shall be borne by the contractor.

3. River or nala or sea sand required for the work shall be clear, sound, properly, graded, free from organic materials silt clay etc. and shall be got approved by the Engineer-in-charge. The sand shall be obtained and brought from the source approved by the Engineer-in-charge. The sand shall be well graded. The payment shall be made on Cubic Metre basis.

4. Stacking shall be done by filling in the standard steel boxes of 2 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall make his own arrangement. No deduction for voids shall be made from the grade measurements. Where any doubt exists as to whether the quantity of stacks of murrum in an hectometer is not confirming with the cubic content of the standard pharas (2 x 1.5 x 0.5 M) the same shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of murrum in any stack in a particular hectometer is found to be less than the standard measurements viz., 1.5 cmt. the entire collection in the

hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the Contractor on a fairly level ground. Stacking of the murrum shall be done in a manner as directed by the Engineer-in-charge.

5. For road work completed stacking of murrum as per requirement shall be carried out in 2 K.M. length before spreading. The collection shall always, be commenced at one end of the K.M. and be carried continuously toward the other end unless the Engineer-in-charge shall direct otherwise.

6. The payment shall be made on cubic men basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.

7. The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.

8. The rate quoted are inclusive of all shall such tools, duties, fees, royalties, taxes etc.

Item-3(A) Supplying and Stacking hard murrum/ sand/yellow earth/ binding materials on road site including filling boxes with all leads and lifts etc. complete on site of work as per specification.

1. The materials for the purpose shall be of approved quality. Any materials which is found inferior shall be rejected and the contractor shall remove such rejected materials from the site at his own cost. The material shall be approved by the Executive Engineer or his authorised agent.

Para 3 to 8 of Item No. 3 shall apply.

The sand used as crust shall be as per C.B.R. Report.

9. The measurements shall be taken on cubic metre basis.

ITEM NO 4 : Supplying standard size stone aggregate.

ITEM NO.4(A) Supplying and stacking of hand broken stone coarse aggregates chippings etc of hard stone of size 25mm.to 90 mm size nominal size free of disintegrated pieces, deleterious and organic matter including Filling boxes with all lead and lift etc complete for W.B.M. road.

1. The stone metal shall be obtained iron quarries approved by the Executive Engineer prior to collections. The metal shall be of approved quality with all leads and lift. The metal shall be obtained from hard tough, sound durable. stone of close texture as is locally available and reasonably free from decay and weathering. Pieces of the stone shall be angular and roughly cubical in shape and round. elongated or flaky materials shall be allowed. The size of metal shall be 25 mm to 90 mm and shall be hand broken. All unsound weathered or disintegrated stone obtained from the upper surface layer of the quarry or other layers of boulders shall be rejected.

2. The samples of metal collected from approved quarries shall be got tested at Government recognized laboratory as may be directed to the contractor at his own cost. The test results shall conform to the standard requirements laid down for metal to be used for W.B.M. work.

3. The physical requirement for standard size metal shall conform to the test results indicated in the Table below:

Type of Const.	Test	Test Method	Requirement
Base	(a) Los Angeles Abrasion Value Aggregate	IS 2386 Part IV	50% (Maximum)
			40% (Maximum)
	(b) Flakiness Index	IS 2386 Part-IV	15% (Maximum)
		IS 5640 IS 2386 Part - I	

Frequency of test shall be as per Ministry of Surface Transport Specifications. The grading requirements of the metal to be used for W.B.M. shall be as under :

4. The grading requirements of the metal to be used for W.B.M. shall be as under:

Sr. No.	Size RAnge	Sieve designation	Percentage by weight Passing through the sieve
1.	25mm to 90mm	100mm	100
		90mm	90-100
		50mm	40-60
		25mm	0-10
		20mm	0-5

The size of metal for W.B.M. shall be 25mm to 90mm. wherein tolerance limit for oversize shall be up to 10% and that for lower size should be up to 10%.

5. Wherever any doubt exists as to whether the above requirements are satisfied, in whole or any part of the collection, metal shall be got screened by the contractor at his own cost, if so ordered by Engineer-in-charge.
6. Stacking shall be done by filling in the standard steel boxes of 2 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent. Otherwise contractor shall make his own arrangements. No deduction for voids shall be made from the gross measurements. Where any doubt exists as to whether the quantity of stacks of metal in any hectometer is not confirming with the cubical content of the standard pharas { 2 m x 1.5 m x 0.5 m) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of metal in any stack in a particular Hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge. Collection of metal shall be completed in two hectometer wise as per the final requirement and measurement shall be recorded two hectometer-wise. Until the quantity of metal as per the final requirement is not collected in any two consecutive HM. and std. boxes are not filled in completely in two hectometers, measurements shall not be recorded and payments shall not be done.
7. For road work complete staking of metal as per requirement shall be carried out in 2 Km. Length before spreading. The metal stacks shall be measured and recorded and got cross checked by other Deputy Executive Engineer as per rules before spreading. The collection shall always, commence at one end of the Km. and be carried continuously towards the other end unless the Engineer-in-charge shall direct otherwise.
8. The payment shall be on cubic metre basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials shall not measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.
9. The rate includes cost of collection, conveyance to the site with all lead and lift and filling the boxes including all labour, tools, equipment and other incidental expenses. The rates quoted are inclusive of all such tools, duties, fees, royalties, taxes, etc.

ITEM 4 (B) Supplying & stacking of hand broken crushed stone aggregate Chippings etc of hard stone of 40mm to 63mm size nominal size free of disintegrated pieces, deleterious and organic matter including filling boxes with all lead and lift etc. complete for road work.

Para to 1 to 9 of item of hand broken metal size 25 mm to 90 mm size will apply except the size of metal mentioned in para 1 and the table of grading requirements. These will be as under

- (i) Para 1 to size will be 40 mm. to 63 mm. instead of 25 mm to 90 mm in para 1.

(4) The grading requirements of the metal to be used for W.B.M shall be as under :-

Sr. No.	Size Range	Sieve designation	Percentage by weight Passing through the sieve
1	2	3	4
1.	40mm to 63mm	75mm	100-100
		63mm	90-100
		50mm	60-80
		40mm	0-15
		25mm	0-5

The size of metal for W.B.M shall be 40 mm. to 63 mm. wherein tolerance limit for oversize shall be 10 percent and that for lower size should be upto 15 percent and below 25 mm it shall be upto 5 percent,

10. Standard for acceptance at reduced rate and rejection shall be as under :-
- (a) Retained on 63 mm. square mesh sieve :
Not more than 30%
- (b) Retained on 75 mm. square mesh sieve :
Nothing will be retained & 100% metal shall be pass through the sieve. For the over size metal. payment at reduced Rate should be made as under :
- (A) 90% of accepted tender rates for the metal retained between 10% and 20% square mesh sieve of 63 mm. gauge.
- (B) 75% of accepted tender rates for the metal retained more than 20% and upto 30% on square mesh sieve of 63 gauge. If more than 30% of metal is retained on specified sieve, (i.e. 63 mm. square sieve) the stack shall be

rejected. Also if any stone aggregate retained on 75 mm. sieve the stack shall be rejected.

The quality for which reduced rate will be applicable is the quantity retained on the above mentioned square mesh sieve and not the whole quantity.

For example in a stack of 1.5 cum. metal if 18% is retained on square mesh sieve of the prescribed size (i.e. 63 mm) the reduced rate of 90% will be applicable to 0.27 cu.m. only and the balance quantity size shall be paid for the accepted rates for standard size metal.

Before any secured advance for metal is paid to the contractor, the metal shall have to be tested for its quality in the laboratory. Contractors' request for such secured advance will be considered only after test results of metals are received and results are satisfactory.

[As per Government circular No. SSR 1070-1B-191-22-S of 5-3-92]

ITEM 4 (C) Supplying and Stacking of machine Crushed Stone aggregate Chipping etc of hard Stone of 20 to 50 mm nominal size free of disintegrated pieces, deleterious and organic matter (for bitumen surface dressing etc.) as per I.R.C. Code including filling the boxes with all lead and lift etc. complete.

1. The field of M.C. metal shall be of approved quarry as shown on the quarry chart as well as approved by the Executive Engineer prior to collection.

2. The M.C. metal shall be hard, tough, sound, durable, black trap field metal of close texture, free from decay and weathering. Each piece of the stone shall be angular and roughly cubical in shape and round elongated or flaky material shall be rejected. No round or oblong pebbles or angular chips larger or smaller than specified size shall be allowed

3. All unsound, weathered or disintegrated stone obtained from the upper surface layer of the quarry or other layer of boulders shall be rejected. The physical requirement for standard size metal shall conform to the test results indicated in para 3 of item 4.

4. The M.C. metal shall be as nearly uniform in size as possible and shall conform to following minimum requirements of passing through the rings :

Sieve Size	Percentage passing through
63 mm	100
50 mm	95-100
40 mm	35-70
20 mm	0-10

5. Wherever and doubt exists as to whether the above requirement are satisfied in whole or part, the collection of M.C metal shall be got screened by the contractor if so ordered by the Executive Engineer and for which no extra payments shall be claimed by the contractor

6. Any collection which does not fully satisfy the above requirements is liable to be rejected altogether

7. Stacking shall be done by filling in the standard steel pharas of 2.00 x 1.50 x 0.50 metre and no deduction of voids shall be made from the gross measurements.

8. Regular stacks shall be done by the contractors on a fairly level ground. All the stacks shall be marked by white wash immediate on being measured and recorded by the Engineer-in-charge.

9. The rate includes blasting the rock, it any, breaking the metal, stacking, measuring in pharas etc. complete.

ITEM - 4 (d) Supplying & stacking machine crushed stone aggregate chipping etc. of hard stone of 25 mm to 40 mm nominal size free of disintegrated pieces, deleterious and organic matter including filling the boxes with all lead and lift etc. complete on site of the work for bituminous surface dressing etc. as per I.R.C. Code.

as per item No. 4 (c) except that gradation of Aggregate shall be as under.

Sieve Size	% by weight passing through
50 mm	95-100
40 mm	65-90
20 mm	0-10
10 mm	0-5

ITEM-4(e) Supplying and stacking of quarry spauls materials at site including filling boxes with all lead and lift.

1. The quarry spauls shall be approved quarry as approved by the Ex. Engineer prior to collection, Filling of boxes, shall not be allowed till the metal is broken to the specified site.
2. The quarry spaul shall be as uniform in size as possible. The quarry spaul shall be hard, tough, solid, durable of black trap quarry of close texture, free from decay and weathering. The stone shall be angular and roughly cubical in shape and round elongated or flaky materials shall be rejected. No sound or long rubble or angular chips smaller than specified size shall be allowed.
3. All unsound, weathered or disintegrated stone obtained from the under surface layer of the quarry or other layers of boulders shall be rejected.
4. Wherever any doubt as to whether above requirement are satisfied in whole or part of the collection it shall be got screened by the Contractor if so ordered by the Executive Engineer, and for which no extra payment shall be claimed by the contractor.
5. Any collection which does not fully satisfy the above requirements is liable to be rejected all together.
6. Stacking shall be made by the Contractor by steel pharas of 2 M x 1.5 M x 0.5 M and no deduction of voids shall be made from the gross measurements.
7. Regular stacks shall be made by the contractor on a fairly level ground. All the stack shall be marked by white wash immediately on being measured and recorded by the Engineer-in-charge.
8. The rate includes blasting the rock, if any, breaking the quarry spauls, stacking measuring in pharas etc. complete.
9. Stacks shall as per actual requirements and any materials in excess shall have to be transported-by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.
10. While stacking materials the depositing should commence at one end of the K.M. and carried continuously towards the other end unless the Executive Engineer shall direct otherwise and as a rule measurements shall be taken after metal for half kilometer or Km. has been fully collected. Any fraction of these distance shall not be measured up.
11. The measurements shall be recorded in on Cum. basis & shall be paid accordingly.

ITEM-4(f) Supplying and stacking rubble of hard stone on road side with all leads and lift as directed.

1. The rubble stones shall be black in colour, shall be hard, tough, sound durable and of close texture, free from cracks and it shall be obtained from the approved quarries.
2. The rubble obtained from the top surface of the quarry is soft one and hence such soft variety shall not be accepted. All unsound weathered or disintegrated stones obtained from the upper portion of the quarry shall be rejected.
3. The quarry shall be well protected shall be dug by a moving all the katcha and weathered stuff approved quality of materials is available.
4. The length and breadth shall not exceed 1/f (1,2) times the thickness of the stones.
5. The rubble stacks shall be made on a fairly level ground and stacks shall be so made that rubble stones are stacked as close as possible so as to leave no excessive voids and no hollows are left out.
6. The tendency to prepare the stacks by keeping excessive voids or keeping hollow places shall not be tolerated.
7. The stacks shall be uniform in length and breadth and top portion shall be in level so that height at any point is uniform.
8. All the stacks shall be of standard dimensions which shall be prescribed by the Executive Engineer deduction for voids shall not be made.
9. The rubble shall be got approved by the Executive Engineer, prior to collector on site or otherwise it is liable to rejection for which no claim shall be entertained.
10. The contractor shall maintain all stacks in regular and proper sizes till the whole material is collected. Measured and finally accepted by the department, 15 percent spauls will be allowed for filling in interstices.
11. The rubble shall be stacked in quantities as per hectometer wise requirement as directed by the Executive Engineer or his agent.
12. Measurement shall be given only when the full quantity of a half kilometer is stacked measurements shall be recorded and paid only once in a hectometer and no piecemeal measurements shall be recorded and paid.

13. Stacks shall be made as per actual requirements and any material in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor

ITEM-4A (As approved by R & B. D Circular No. SSR / 080 / IB / 547 (28) C dt. 15.3.88)

1.0 Specifications for W.B.M. : (Sub base/Base Course)

1.0 **Item** : Providing and laying water bound macadam of crushed/broken stone aggregates of mm compacted thickness mechanically interlocked by rolling and bonded together with screenings/approved quality of murrum or gritty material and water in accordance with the requirements of specifications, etc. complete.

2.0 Materials :

2.1 Coarse aggregates : General requirements : The coarse aggregates shall be stone metal obtained from quarries approved by the Executive Engineer prior to collection. The metals shall be of approved quality with all leads and lifts. The metal shall be obtained from hard, tough; sound, durable, stone of close texture as is locally available and reasonably free from decay and weathering. Pieces of the stone shall be angular and roughly cubical in shape and round, elongated or flaky materials shall be rejected. No round or oblong pebbles or angular chips larger or smaller than specified size shall be allowed. The size of metal shall be 40 mm to 63 mm and shall be crushed/hand broken. All unsound weathered or disintegrated tone obtained from the upper surface layer of the quarry or other layers & boulders shall be rejected.

2.1.1 Physical requirements : The aggregates shall conform to the physical requirements as indicated in the Table No. 1 hereafter.

**Table No. 1 :
Physical requirements of Coarse Aggregates for Water Bound Macadam**

Sr. No	Type of Construction	Test	Test Method	Requirement
1.	Sub Base	(a) Los Angeles Abrasion value *	IS : 2386 (Part IV)	50% (Max.)
		Or Aggregate Impact Value	IS : 2386 (Part IV) or IS : 5640**	40% (Max.)
2.	Base	(a) Los Angeles Abrasion value *	IS : 2386 (Part IV)	50% (Max.)
		Or Aggregate Impact Value	IS : 2386 (Part IV)	40% (Max.)
			or IS : 5640"	15% (Max.)
		(b) Flakiness Index	IS : 2386 (Part i)	

* Aggregates may satisfy requirements of either of The two test.

** Aggregates like bricks, metal kankar laterite etc. which get softened in presence of water, shall be tested for impact value under wet condition in accordance with IS : 5640

2.1.2 Grading requirement : The coarse aggregates shall conform to the grading requirement as indicated in Table No. 2 below :

**Table No. 2 :
Grading Requirements of Coarse Aggregates**

Grading NO.	Size range	Sieve Designation	per cent by Weight
2	63 mm	80	100
	to	63	85-100
	40 mm	40	0-15

2.2 Screenings/approved quality of murrum/gritty materials : Screenings/murrum/gritty materials to fill voids in the coarse aggregate and to act as binding materials shall generally consist of predominantly non-plastic material such as murrum or gravel (other than rounded river borne material) provided the liquid limit and plasticity index of the material is below 20 & 6 respectively & fraction passing 75 micron sieve does not exceed 10 percent.

2.2.1 As far as possible, screening/murrum/gritty materials shall conform to the grading set forth in Table No. 3 below :

**Table No. 3 :
Grading for Screenings/approved quality of murrum/gritty materials.**

Grading Classification	Size of Screenings	Sieve Designation	Percent by weight passing the Sieve
A	12.5 mm	12.5 mm	100
		10.0 mm	90-100
		4.75 mm	10-30
		150 micron	0-8
B	10 mm	10mm	100
		4.75 mm	85-100
		150 mm	10-30

3.0 Construction Operations :

3.1 Preparation of base : The subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified grade and camber and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50 mm x 50 mm furrows shall be cut at an angle of 45 degrees to the road at 1 metre intervals in the latter before laying the coarse aggregate.

3.2 Spreading course aggregate : The coarse aggregates shall be spread uniformly upon the prepared base in such quantities that the thickness of the compacted layer is 100 mm for grading 1 and 75-100 mm for gradings 2 and 3 as specified.

The spreading shall be done from stock piles along the side of the roadway or directly from vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregate nor shall hauling over uncompacted or partially compacted base be permitted.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregate as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The coarse aggregate shall not normally be spread more than 3 days in advance of the subsequent construction operations.

3.3 Rolling : Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 6 to 10 tonne capacity or tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and as may be indicated by the Engineer-in-charge. Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre, First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall continue until the aggregate are thoroughly keyed and the creeping of aggregates ahead or roller is longer visible. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the subgrade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding and removing necessary amounts of aggregates and re-rolling until the entire surface conforms to desired number and grade. In no case shall the use of screenings be permitted to make up depressions.

3.4 Application of screenings/ murrum/ gritty material : After the coarse aggregate has been rolled to Clause 3.3 screenings/murrum/gritty material to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings/murrum/gritty material are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings/murrum/gritty material shall not be dumped in piles but spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreaders, or directly from trucks. Trucks operation for spreading the screenings/murrum/gritty material shall be driven as not to disturb the coarse aggregate.

The screenings/approved quality murrum/gritty material shall be applied at a slow and uniform the (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand-brooms or both. In no case shall the screening side applied so fast and

thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling and brooming of screening/murum/gritty material shall be carried out in only such lengths of the road which could be completed within one day's operation.

3.5 Sprinkling and grouting : After the screenings /murum/gritty material have been applied. the surface shall be copiously sprinkled with water, swept and rolled Hand brooms shall be used to sweep the wet screenings/murum/gritty material into void and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary. until the coarse aggregate has been thoroughly well-bonded and firmly set in full depth and a grout has been formed of screenings/murum/ gritty material. Care shall be taken to seen that the base or sub grade does not get damaged due to the addition of excessive quantities of water during construction.

3.6 Setting and drying : After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings/murum/gritty material as directed, slightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer-in-charge shall have the discretion to stop having traffic from using the completed water bound macadam course if in his opinion it would cause excessive from to the surface. 4.0 Surface Finish :

The surface finish of construction shall confirm to the following requirements :

4.1 General : All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer-in-charge subject to the permitted tolerances described hereinafter.

4.2 Horizontal Alignments : Horizontal alignments shall be reckoned with respect to the centre line of the carriage way as shown on the drawings. The edges of the carnage way as constructed shall be correct within a tolerance of ± 25 mm there from. The corresponding tolerance for edges the roadway and lower layers of payments shall ± 40 mm.

4.3 Longitudinal profile : The levels 'of the subgrade and different pavement course as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer-in-charge, beyond the tolerances mentioned below:

Subgrade	± 25 mm
Sub-base	± 20 mm
Base course	± 15 mm
Wearing course	± 10 mm

provided, however, that the negative tolerance for wearing coarse shall not be permitted in conjunction with the positive tolerance for base course if the thickness of the former is thereby reduced by more than 6 mm.

4.4 Surface Regularity : The surface regularity of completed sub-base, base course and wearing surface in the longitudinal and transverse directions shall be within the tolerance indicated in Table No.4 below:

Table No. 4:

Permitted tolerance of surface Regularity for payment course

Sr. No.	Type of Construction	Longitudinal Profile with 3 metre straight edge	Cross profile
	Template Maximum permissible undulation mm	Maximum number of undulations permitted in any 300 m. length exceeding : mm	Maximum Permissible variation from specified Profile under camber
1	2	3	4
1.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size)	12	30
			8

The longitudinal profile shall be checked with a 3 metre long straight edge at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set of three camber at intervals of 10 metres.

4.5 Rectification : Where the surface irregularly of subgrade and the various pavement course fall outside the specified tolerances,the shall be liable to rectify these in the manner described below and to the

satisfaction of the Engineer-in-charge.

When the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompactd as per the specification of W.B.M. The area treated at a place shall not be less than 5 metres long and 2 metres wide.

5.0 Quality Control tests during Construction :

5.1 General : The materials supplied and the works carried out by the contractor shall conform to the specification prescribed in the preceding Clauses.

For ensuring the requisite quality of Construction, the materials and works shall be subjected to quality control test, as describe hereinafter, by the Engineer-in-charge. The testing frequencies set forth are desirable minimum and the Engineer: in-charge shall have the full authority to carry out tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications.

Test procedures for the various quality control tests are indicated in the sections of the specifications or for certain test within this section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent engineering practice to the directions of the Engineer-in-charge.

5.2 Test on Sub-bases & Bases :

5.2.1 The tests and their frequencies for W.B.M. types of bases & sub-base shall be as given in Table NO.5 below :

Table No. 5 .

Control tests & their frequency for sub-base & bases of water bound macadam

Sr. No.	Type of Construction	Test	Frequency
1.	Water Bound Macadam	(i) Aggregate impact value (ii) Grading (iii) Flakiness index (iv) Atterberg limit	One test per 1200 cu.m. One test per 100 cu.m. One test per 200 cu.m. One test per 25 cu.m. of materials for screenings.

5.2.2 Compaction Control :Control shall be exercised by tacking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS 2720 (Part XX VIII). Test locations shall not be based on the results of any one test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 5 as long as it is felt that sufficient control over materials and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance of work shall be subject to the condition that the mean dry density equals or exceeds the specified density and the standard deviation for any set of results is below 0.08 gm/cc.

6.0 Arrangement of Traffic during Construction :

6.1 General : The contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway. the contractor shall, in accordance with the directives of the Engineer-in-charge, provided and maintain, during the execution of the work, a passage for traffic along a part of the existing way uncier improvement, or along a temporary diversion constructed close to the highway.

6.2 Passage of Traffic along a part of the Existing Carriage way Improvement : This method shall be adopted where, in the opinion of the Engineer-in-charge. the improvement works, namely widening of the existing pavement or reconstruction/repairs to cross-drainage works, could be carried out on part widths at a time and the traffic could simultaneously be passed without undue delay and difficulty on the other part. The road shoulder shall be dressed and brought in line with the pavement and maintained throughout the duration of the work to the satisfaction of the Engineer-in-charge. Where works is in progress in continuous long stretches, passing places, at least 20 metre long 6 metre wide, inclusive of the width of the existing carriage way shall be provided at half to one kilometer intervals as directed by the Engineer-in-charge. Extra treatment to shoulders where necessary, shall be given as ordered by the Engineer-in-charge.

6.3 Passage of traffic along a Temporary Diversion : If in the opinion of the Engineer-in-charge it is not possible to pass the traffic on part width of the carriage way for any reason, a temporary diversion close to the highway shall be constructed as directed. It shall be paved with locally available materials such as hard murrum, gravel, brick or stone metal to the specified thickness and provided with bituminous surfacing, where directed. In all case, the alignment, gradients and surface type of the diversion, including its junctions, shall be

approved by the Engineer-in-charge before the highway is detoured and closed to traffic. At cross drainage points, the contractor shall provide temporary crossings for the diversion according to the designs approved by the Engineer-in-charge.

6.4 Traffic Safety and control : The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer-in-charge for the information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

The barricades erected on either side of the carriage/portion of the carriage way closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept throughout from sunset to sunrise.

At the point where traffic is to deviate from its normal path whether on temporary diversion or part width of the carriage way the channel for traffic shall be clearly marked with the aid of pavement markings painted drums or a similar device to the directions of the Engineer-in-charge. At night the passage shall be delineated with lanterns or other suitable light source.

One way traffic operation shall be established wherever the traffic is to be passed over part of the carriage way inadequate for two-lane traffic. This shall be done with the help of flagmen kept positioned on opposite sides during all hours for regulation of traffic. The flagmen shall be equipped with red and green flags and lanterns/lights.

On both sides, suitable regulatory/warning signs shall be installed for the guidance of road users. On each approach at least two signs shall be up put one close to the point where transition of carriage way begins and the other 120 metres away. The signs shall be of approved design and of refractory type if so directed.

6.5 Maintenance of Diversion and traffic control Devices : Signs, lights, barrier and other traffic control devices, as well as the riding surface of diversions shall be maintained in satisfactory conditions till such time they are required as directed by the Engineer-in-charge. The temporary travel way shall be kept free of dust by frequent application of water if necessary.

6.6 Measurements for payment traffic Arrangement : All arrangements for traffic during construction including maintenance these off but excluding initial dressing and/or extra treatment of the shoulders and construction of temporary diversions shall be considered as incidental to the works and Contractor responsibility.

Construction of temporary diversions, initial dressing of the shoulders and extra paving at paving places shall, however be paid for as provision sum, if written order is issued to do so by the Engineer-in-charge).

7.0 Measurements for payments for W.B.M.

7.1 Water bound macadam shall be measured as finished work in position is cubic metres. The finished thickness of sub-base and base courses to be paid on volume basis shall be computed in the following manner :

Levels shall be taken before and after construction, at a grid of points 10 metres centre to centre longitudinally in straight teaches but 5 metres at curves. Normally, on two-lane roads the levels shall be taken at four positions transversely, at 0.75 and 2.75 metres from either edge of the carriage way and on single layer roads these shall be taken at two positions transversely being at 1.25 metre from either edge of the carriage way. Suitable reference for the transverse grid line should be left in the form of embedded bricks on either ends or by the other means so that it is possible to locate the grid points for level measurements after each successive course is laid.

For pavements courses laid only over widening portion, at least one line of levels shall be taken on each strip of widening or more depending on the width of widening as decided by the Engineer-in-charge, notwithstanding the above, if the need may arise particularly in the case of estimation of the volume of the material for leveling course. The average thickness of the pavement source in any area shall be the arithmetical mean of the difference of levels before and after construction at all the grid points falling in that area, provided that thickness of finished work shall be limited to those shown on the drawings or approved by the Engineer-in-charge.

As supplement to level measurement, the Engineer-in-charge shall have the portion to cut cores/holes to check on the depth of construction.

The contractor shall sign day to day leveling work and also original cross section, longitudinal section in token of his acceptance etc. The working sections both longitudinal and cross of the sub-grade shall be taken by the Engineer-in-charge before the actual W.B.M. work is started. The contractor or his authorised representative shall attend day to day leveling work and sign with date the field book daily in token of his

acceptance. If there is any disagreement the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started no cognizance of any complaint taken. Merely not signing of the level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5 percent before commencement of WBM. WBM shall be maintained by the contractor to proper formation and grade till this item is finally measured and accepted by the Department. The measurement shall be taken on compacted WBM.

Any crack formation of screenings observed in between any layer of WBM work shall be deducted from the measurements so taken and net quantity of WBM work shall be considered for payment.

8.0 Rate

8.1 The contract unit rate for water bound macadam sub-base/base course shall be payment in full for carrying out the required operations including full compensation for all components listed below :

- (i) Making arrangements for traffic to Clause-6 except for initial treatment to shoulders and construction of diversions.
- (ii) Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts.
- (iii) All labour, tool, equipment and incidentals to complete the work to the specifications and (iv) Carrying out the work in part widths of roadway where directed.
- (iv)

ITEM - 5 Spreading Soft murrum/murrum/sand/yellow/earth/bindage or road crust filling the gaps in metal and leveling to camber and gradient as directed.

Spreading of material shall be started after the full supply in a particular K.M. is collected, measured and recorded in the measurement books. Permission of the Engineer-in-charge shall be obtained before spreading. It shall be seen that the formation is dressed to the required camber and grade. If the murrum is to be spread over the metaled surface then the spreading shall be uniform and as its has to act as binding surface it shall be used for filling the interstices of metal and forming a smooth running surface as far as possible. Murrum blindage shall be specified as blindage shall be spread evenly with a twisting motion of the baskets. No more Murrum shall be used then specified as blindage. The rate is for gross measurements and no deduction of voids shall be made. I, the murrum is to be spread over earthen embankment as a sub-base or for side shoulders or as blindange.it shall be spread in a manner as directed by the Engineer-in-charge and as per required width and thickness. The contractor shall make good all unevenness, depression, projections etc..during consolidation work. Rate of this item includes all these operation except consolidation. The payment shall be made on cmt. basis.

ITEM - 6 Spreading the stone aggregates for soiling and W.B.M. including filling the interstices to required camber and gradient (excluding spreading of blindage) (i) 40 mm to 63 mm size H.B. Stone aggregates (H.B.) (ii) 25 mm to 90 mm size H.B. stone aggregate, (iii) Chipping varying from 6 mm to 25 mm size (iv) 20 mm to 50mm size crushed.

1. Metal shall not be spread without permission of the Engineer-in charge. Metal should be spread under careful supervision by trained coolies. Contractor shall see that uniform spreading as per collection of metal is done. The contractor shall spread the metal fully from the stacks without keeping any balance unless directed by the Engineer-in-charge to keep some stack in balance for making good unevenness or depressions during rolling works. To ensure that the material is spread to the required thickness, the road surface shall be marked out in to length over which the contents of heaps are to be spread. The bounds of earth or murrum (one on either side) shall be laid with a distance between them equal to the width of road to be metaled and shall be enough to prevent the loose metal from spreading during consolidation as well as to retain water used for consolidation. Payment for bunds will be made in the respective item

2. The metal (including old metal) shall be screened and rubbish, dust, grass shall be removed and spread evenly on the prepared sun, one in grade and camber by using camber board etc. so as to ensure that the surface is true to camber and grade. At least two camber by using camber boards shall be in use at site The surface shall be checked at every 50 ft. by means of template while the correctness of the camber in between shall be tested by string and corrected as required. Between the straight lengths and the curves in camber of road to : uperelevation shall be made very gradually as may be directed by the Engineer-in-charge.

3. The spreading of metal shall proceed only 200 ml. (max.) advance of the rolling operations. The collection and spreading of the metal shall not be carried out in one and the same kilometer.

4. At the time of rolling all surface irregularities, hollows, depressions, humps etc. shall be straight. The spreading of metal in required layer shall be done by the contractor. The rate for this item shall be paid on cmt. basis and includes all the above operations with all lead anu lift except consolidation.

Item-6(A) Spreading the stone aggregates for soiling and W.B.M. including filling the interstices forming the surface to required camber and gradient by paver finisher (Labour charger, only but including hire and operating charges of paver)

Specification same as item No.6 except that metal or stone aggregate shall be spread by paver finisher and not manually. Besides all the labour charges, the rate also includes the hire and operating charges of paver. The contractor shall have to make his own arrangement for procuring appropriate paver.

Item-6(B) Spreading quarry spalls in grade & camber complete.

1. The quarry spalls shall only be allowed to be spread after the written permission of the Executive Engineer is obtained.

2. The permission for spreading the metal shall be given by the Executive Engineer if

(i) The full quantity of a particular mile (kilometer) is completely collected.

(ii) The collection of metal is also completed in the adjoining two miles (Kilometers)

(iii) The measurements are recorded in the Measurement book.

3. Q.S. shall, if required, be screened to contain no rubbish, dust, grass, etc. It shall then be filled in a basket & conveyed where required and spread evenly on the prepared surface by giving a twisting motion to the basket at the time of spreading. The surface shall then (15 m) be checked by means of templates and strings as well as with camber boards and spirit level.

4. Between the straight length and curves and at the meeting points of the convex and concave portions of the reverse curves, the change in camber of the road, due to super elevations shall be made as well as with camber boards and spirit level.

5. At the time of spreading Q.S. a small quantity (about 4 to 5 percent) of metal as directed shall be retained at the first instance. It shall be spread later & after partial consolidation as required to rectify the camber and to fill up the hollows if any. No extra amount shall be paid for this.

6. Measurements shall be paid as per the measurements of collection less the quantity retained to be spread and on a cubic metre basis.

7. The rate includes the cost of screening the Q.S. if any spreading, sectioning, with template and adding reserved quota of metal, while rolling is in progress for making good hollows and camber.

8. The surface shall be brought to the required camber which shall be checked at every 50 ft. (15 M.) by means of templates and while the necessary of the in between shall be tested by strings and corrected as required.

9. The centre line shall first be marked in the subgrade which is properly consolidated and has uniform camber and grade as required.

10. The Q.S. shall be laid for a small length on 25 ft. (8 M.) and then the edge stones shall be laid.

11. Pegs shall be driven on either side of the road and joined with strings true and parallel with a distance between them equal to the width to be laid with oversize metal. Similarly.

12. The Q.S. shall be laid as close as possible so as to leave minimum possible interstices and voids.

13. Before rolling is allowed on soiling the side berms shall be filled up to the top of the soiling and at least 3'-0" (1 m.) on either side so as to prevent metal layer getting disturbed at times during rolling. The rate is inclusive of all the operations as stated above.

ITEM-7 Rolling & Consolidating water bound macadam (except laterite & kankar) incl. watering not exceeding 150 mm thickness (main layer including binding materials) including filling in depression which occur during the process with power roller exceeding 8.0 M.T. but not exceeding 12.0 M.T.

1. Immediately following the spreading of the coarse aggregates rolling shall be with three wheeled power rollers of 8 to 10 tonne capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the type of the aggregate and be indicated by Engineer-in-charge.

2. Except on super elevated portions where the rolling shall proceed from inner edge to outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to center line of the road. In successive passes uniformly lapping preceding tracks by at least one half the width.

3. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wave like motion in the sub-grade or sub-base course.

4. The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screening be

permitted to make up depression.

5. The blindage material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms or mechanical brooms to fill the voids properly and rolled, during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the moving roller

6. After the final compaction of water bound macadam course the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings of binding materials as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer-in-charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause excessive damage to the surface.

7. Payment will be made on Smt. basis of the finished work and shall include cost of watering, rent of machinery cost fuel, wages of drivers and cleaners and murrum bund etc.

ITEM-8 Providing and fixing indicator stone of approved stone as per I.R.C. type design in C.C. 1:4:8 including whitewashing etc. complete.

(1) Fixing in earth.

1. Indicator stones shall be of approved quality and of the size 20 cm x 20 cm. Its length shall not be less than 80 cms. The top, 38 cm shall be chisel dressed on all sides. The size, shape and dimension of the indicator stone shall be exact and stones shall be neatly dressed, and finished before fixing. The indicator stones shall be fixed firmly in position in embankment or cutting as the case may be. The exposed part of the indicator stone shall be done by the contractor at his own cost. The measurement for payment shall be per number of indicator stone fixed in position.

2. Unit rate indicator stone includes the cost of all materials, labour, tools, fixing, and white washing as directed by the Engineer-in-charge.

(2) Fixing in C.C. 1:5:10

Specification same as 8(1) above except that the indicator stone shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. Rate includes all labour and curing etc. necessary for concrete.

ITEM-9 Providing and fixing ordinary kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C.C. 1:4:8 including and paints and letter etc. complete, (for N.H., S.H. and M.D.R.)

1. Kilometer stone shall be of approved quality and shall be either black Rajula stone or of precast 1:2:4 R.C.C. as specified in the item.

2. The size, manner of fixing, painting and lettering of K.M. stone shall conform specification as per I.R.C.-8 (Type design for Highway kilometer stones). The fixing of K.M. stone shall be carried out in ordinary concrete of grade specified in the item using hand broken metal field metal or gravel. The measurement for payment shall be made per No. of K.M. stone fixed in position.

3. Unit rate for kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

ITEM-10 Providing and fixing fifth kilometer stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C. C. 1:4:8 including painting and lettering etc. complete, (for N.H., S.H. and M.D.R.)

1. The work shall be carried out as per the item of ordinary kilometer stone except that the size of the fifth kilometer stone shall be bigger than that of ordinary kilometer stone as per I.R.C.-8 (Type design for highway kilometer stones). The fixing of K. M. stone shall be in ordinary concrete of grade specified in the item. The measurement for payment as well as the operation included in the unit rate shall be as per ordinary kilometer stone.

2.

ITEM-11 Providing and fixing hectometer stone as per I.R.C. type design including painting, lettering etc. complete.

(1) Fixing in Earth :

The work shall be carried out as per the item of ordinary kilometer stone except that the size of Hectometer stone shall be smaller than that of ordinary kilometer stone as per I.R.C. 26 (Type design for 200 metre stones) and fixing shall be in earth. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary kilometers stone.

(2) Fixing in C. C. 1:5:10

Specification same as 11 (1) above except that the indicator stone shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. Rate includes all labour and curing etc. necessary for concrete.

ITEM-12 Providing and fixing guard stone as per I.R.C. type design including white washing etc. complete.

(1) Fixing in Earth /Wearing Coat :

1. The guard stone shall be of approved quality and of 20 cm x 15 cm. size and its length shall not be less than 75 cms. The top portion shall be rounded. The top 38 cm. shall be chisel dressed on all sides. The size, shape and dimensions of the guard stones shall be exact and shall be neatly dressed and finished.

2. The guard stone shall be fixed in position as directed by the Engineer-in-charge in earth/wearing coat. If the guard stone shall be fixed in wearing coat, the equivalent volume covered by the guard stones shall be deducted from the gross measured quantity of wearing coat. The exposed part of the guard stones shall be given three coats of white wash. Any excavation necessary for fixing of the guard stones shall be done by the contractor at his own cost. The measurement for payment shall be per number of guard stone fixed in position.

3. Unit rate of guard stone includes the cost of all materials, labours, tools, fixing & white washing as directed by the Engineer-in-charge.

4. In case of Deep/Causeway the guard stone shall be fixed in masonry of head wall as directed by Engineer-in-charge.

(2) Fixing m C.C. 1:5:10

Specification same as 12 (1) above except that the indicator stone shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. Rate includes all labour and curing etc. necessary for concrete.

ITEM-13 Supplying and fixing road sign board of M.S. Plates and angle iron including painting, lettering etc. complete including fixing in C.C. 1:4:8 with necessary excavation etc. complete as per I.R.C. design.

(1) Non reflective type :

1. The board shall consist of a 90 cm x 90 cm triangular plate of 6 mm thickness at the top and a 90 cm x 61 cm rectangular plate of 6 mm thickness below if fixed at suitable distance. This shall be fixed to the angles iron post of 75 mm x 75 mm x 6 mm size by means of welding or riveting as directed by the Engineer-in-charge. The angle iron post shall be split at the bottom end to 10 cm (minimum) in length and shall be fixed at right angle to the central line of the road in ordinary concrete of grade as specified in the item, using hand broken metal, field metal or gravel. Two steel bars of 12 mm dia, shall also be embedded in concrete for fixing as directed by the Engineer-in-charge. The top of the post shall be at a height of 25 cm. as above the ground level. Concrete platform shall be of the size 45 cm x 45 cm and shall project 2.5 cm above ground level and shall be at least 60 cm below ground level. Total height of post shall be 3 mt. (minimum). The exposed platform shall be neatly finished and its shape shall be as directed by the Engineer-in-charge.

2. The post will be painted with two coats alternatively in black and white strips 23 cm in height after applying one coat of anticorrosive paint. The paint shall be of approved quality. The board shall be painted with approved colour and lettering shall be in accordance with I.R.C. 30 (Standard Letters and Numerals of Different Heights for use on Highway designs) and as per notified signs of Motor Vehicle Act. respectively.

3. The measurement for payment shall be per number of sign board fixed in position.

4. The unit rate includes the cost of materials, labour tools, drilling of holes, riveting or welding, fixing, curing, lettering, painting as directed by the Engineer-in-charge.

(2) Reflective Type

Specifications will be same as 13 (1) above except that signs shall be reflective type.

ITEM-14 Providing and fixing village name boards as per standard I.R.C. type design of steel plate including painting, lettering etc. complete with fixing in C.C. 1:4:8 block with necessary excavation.

1. The work shall be carried out as per the item of sign boards except that there shall not be top plate of 90 cm x 90 cm triangular shape and lower plate of 90 cm x 61 cm rectangular plate of 6 mm thickness shall be fixed at top facing towards the direction of the village.

2. The board plate shall be painted in black colour Letters '& figures shall be painted in white colour with an arrow directing towards the village painting & lettering shall be done both sides. The size of the letters & figures as well as thickness of arrow will be as directed by the Engineer-in-charge. ***

3. The measurement for payment as well as operations included in the unit rate shall be as per item of sign boards.

ITEM-15 Supplying of machine crushed stone aggregate chipping etc. of hard stone following nominal size free of disintegrated pieces deleterious and organic matter including filling the boxes with all lead and lift etc. complete on site of road. (a) Kapchi and (b) Grit

1. Stone chips shall consist of regular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, and shall be free of elongated and flaky pieces, soft and disintegrated materials, and vegetable or deleterious matter. They shall satisfy the quality requirements set forth as shown hereafter.

Sr. No.	Test	Test Method	Requirement
1.	Los Angeles Abrasion Value	IS : 2386 (part IV)*	35% Maximum
2.	Aggregate Impact Value	-do-*	30% Maximum
3.	Flakiness Index	IS : 2385 (Part I)	30% Maximum
4.	Stripping Value	IS:62+4	25% Maximum
5.	Water Absorption	IS:: 2386 (Part 111)	2% Maximum

* Aggregate may satisfy requirement of either of the two tests.

Size of stone chips shall be as under :-

(a) Kapchi : 12 mm size : Passing 20 mm sieve and retained on 10 mm sieve.

(b) Grit : 5 mm size : Passing 10 mm sieve and retained on 2.36 mm sieve.

3. The samples of stones chips collected from approved quarries shall be got tested at Government recognized laboratory as may be directed to the contractor at his own cost. The result shall conform to the standard requirements laid down in para (i) above. Collection of stone chips as per approved samples shall be allowed by the Engineer-in-charge. Testing charges shall be borne by the contractor. Payment at full rates for the stones chips shall not be made till the test results from the laboratory are received and found acceptable.

4. Stacking shall be done by filling in standard steel boxes of 2.0 m x 1.5 m x 0.5 m size which shall be supplied by the Department if available on rent, otherwise contractor shall make his own arrangements. No deduction for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks in any hectometer is not confirming with the cubic content of the standard pharas (2.5 m x 1.5 m x 0.5 m) it shall be got corrected by the Contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the Contractor. If the quantity in any stack in a particular hectometer is found to be less than the standard measurements viz., 1.5 cmt, the entire collection in the hectometer shall be paid on the quantity of the smallest stack so found. Regular stacks shall be done by the Contractor on a fairly level ground. Stacking shall be done in a manner as directed by the Engineer-in-charge.

5. The collection shall always commence at one end of the Kilometer and be carried out continuously towards the other end, unless the Engineer-in-charge directs otherwise.

6. Control on quality of material shall be exercised by the Engineer-in-charge by carrying out the following tests at the frequencies shown against each.

Sr. No.	Type of Construction Material	Test	Frequency
1.	Grit/Kapchi for open graded Carpet and seal coat.	(i) Aggregate impact value (ii) Flakiness Index of aggregate (iii) Stripping value & water absorption of aggregates (iv) Grading of aggregates	One test per 100 cu.m One test per 100 cu.m initially one set of 3 representative specimens for each source of supply subsequently when warranted by changes in the quality of aggregates. One test per 100 cu.m. of aggregate.

7. The payment shall be made on cubic metre basis without deduction for voids. The contractor shall be responsible for preserving the materials throughout the period the contract remains in force. The use of materials shall not be allowed till the materials conveyance to the site with all lead and lift and filling boxes including all labour, tools, equipment and other incidental expenses.

ITEM - 16(A) Supplying and Stacking 80/100 asphalt as per requirement including carting, stacking, and protecting on road side etc. complete. (If asphalt is supplied by Department)

1. Bitumen shall be issued by the Department at the rate and place mentioned in Schedule 'A' of the tender It shall have to be carted by the contractor to the site of work at his own cost. Empty asphalt drums shall have to be returned free of cost to P.W.D. store from where they are issued or as directed, if so provided in

Schedule 'A' Any damage caused to the asphalt drum or loss of asphalt after issue from the store shall be the responsibility of the contractor. Drums of asphalt shall be so stored as to allow easy inspection and in such place a will not damage the drums and cause leakage or allow water and other foreign matter to enter, (dilute may be included in labour)

2. Bitumen shall be issued by department in bulk at the rate and places as shown in Schedule-A For bulk asphalt contractor shall have to make adequate arrangement taking bulk asphalt at plant site according to requirement.

Bulk asphalt shall be used as per instructions of the Engineer in charge of work. The tanker of bulk asphalt should be unloaded in asphalt tank or in empty drums on site of work as directed Proper rate for carting shall be deducted as per carting rate, if the bulk asphalt is given on site of work instead of place shown in Schedule-A. The carting of bulk asphalt shall be made by the contractor from Koyali Refinery as per Schedule-A

Keeping Records :

The department shall keep a day to day account of the supply and use of the asphalt in separate bound registers having numbered pages and in the Form prescribed by the department. The contractor's responsible representatives shall also sign day to day in the register.

3. The payment shall be made on tonnage basis.
4. The contract unit rate of supplying bitumen shall include
 - (1) Obtaining the bitumen from the Department.
 - (2) Transporting to site.
 - (3) Storing, stacking and protecting
 - (4) Keeping record of supply and use and
 - (5) Returning of handing over the empty drums in good condition to the Department if so provided in Schedule 'A'

ITEM - 16(B) Supplying and Stacking 80/100 asphalt as per requirement including carting, stacking, testing and protecting on road side etc. complete. (If asphalt is supplied by Contractor)

1. Bitumen shall be procured directly from refinery by the Contractor. The contractor shall make adequate arrangements for storing bulk asphalt at plant site. The Contractor will produce in original the bill of Refinery, all the gate passes issued by the refinery and the number of transport tanker. The Contractor will also produce the Test Certificate regarding the grade of asphalt issued by Refinery. The Department does not undertake to furnish "P" form (regarding Sales Tax Concessions) for purchase of asphalt.

2. On receipt and storage of bitumen. The bitumen shall be got tested in GERI Laboratory or other I laboratories approved by R. & H. Department. The frequency of test is specified in Para 5.

3. TK' Contractor will establish on site of work site laboratory in area not less than 25 sq.m. with pucca construction and equipped with instruments to enable to carry out the following tests.

1. Penetration test as per I 3. 1203
2. Softening point test as per I.S. 1204
3. Ductility test as per I.S. 1208
4. Viscosity test as per I S. 1206
5. Specification Gravity test as for I.S. 1202

The above instruments should be certified as per I.S. standard, the same should be regularly calibrated and should be maintained in efficient condition.

4. The Registers for use, temperature and other quality requirements of bitumen will be maintained at Plant site. The registers will be printed, as per formats approved by R.&B. Department and authorised for use by the Engineer-in-charge. The entries in the registers will be made by the departmental representative and signed by the contractor or his authorised representative.

5. Frequency of Tests :

As regards quality of binder, three tests of one sample per two tankers will be done on plant site. The tests will be carried out as per Table 900.4 of Section 900 of M.O.ST. standard specifications. The frequency of use of specifications will be as under :

No. of Tanker	No. of Tests	No. of Tanker	No. of Tests
Upto 10	One	50 to 100	Four
11 to 20	Two	For further every 50 tanker	One
20 to 50	Three		

ITEM-17 2 cm thick open graded pre-mix carpet surfacing with 0.27 cum. of stone chipping (12 mm size 0.18 cum and 10 m size 0.09 cum) mixed with 14.4 kg. of bitumen per 10 sq.m. of road

surface excluding rolling and consolidation etc. complete. (Stone chipping and bitumen shall be paid separately)

1. With tack coat at rate of 5.0 kg/10 sq. m.

2. With tack coat at rate o.f 10.0 kg/10 sq.m

1. This work shall consist of laying an open graded carpet of 2 cm. thickness in a single course and seal coat [excluding coat of asphalt, stone chips and rolling] composed of suitable small size aggregate premixed with a bituminous binder on a previously prepared base.

2. The materials shall be proportioned as per quantities given in the following table.

Quantities of materials required for 10 smt. of road surface for 2 cm. thick open-graded premix carpet with seal coat.

Aggregate for Carpet

(A)	Stone Chipping	12 mm size	0.18 cubic metre
(B)	Stone Chipping	6 mm size	0.09 cubic metre
		Total	0.27 cubic metre

Aggregate for seal coat :

	Stone chipping	6 mm size	0.12 cubic metre
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Binder for premixing (Quantities in terms of straight run bitumen)

(i) For Carpet

(A) For 0.18 cmt. of 12 mm size stone chipping at 52 Kg/gmt 9.36 kg.

(B) For 0.18 cmt of 6 mm size stone chipping at 64 kg/cmt 5.04 kg.

Total 14.40 kgs.

(ii) For Seal Coat

For 0.12 cmt of 10 mm size stone chipping at 64 kg/cmt 7.68 kgs.

3. Carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 degree centigrade or below.

4. The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross-section as directed by the Engineer-in-charge. The surface shall be well cleaned with wire brushed, sweeping with brooms and finally dusting with sacks as necessary.

5. Tack coat : This work shall consist of application of a single coat of bituminous material to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160.0 deg. Centigrade to 175.0deg. centigrade.

6. Binder shall be heated to temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg. per 10 square metre area for untreated water bound macadam surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the oncoming bituminous construction. For the purpose of calculating consumption, wastage of bitumen will not be permitted beyond 2.5% Excess consumption over 2.5% will be charged at panel rate.

7. Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder, The binder shall be heated to the temperature approved by the Engineer-in-charge, avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry before they are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. Kerosene to an extent of 4% to 6% of asphalt shall be provided by the contractor according to the requirement at the contractors cost. The mixing of binder with chipping shall be continued until the chipping are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit. if so directed.

8. The premixed material shall be spread on the road surface with rakes to the required thickness and camber, or distributed evenly with the help of a drag spreader, without any undue loss of time. The chamber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material has been laid rolling shall commence [Rolling shall be done departmentally. When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. The contractor shall provide necessary labour for keeping the roller wheels damp during rolling «o as to prevent the premix from adhering to the wheels and

being picked up. The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against.

9. Seal coat for preparation of premix and spreading, etc Para 7 & 8 above shall -apply. The coat shall be applied immediately after the laying of bituminous course of carpet. Before application of seal coat, materials surface shall be cleaned free of any dust or other extraneous matter.

10. Coarse sand or stone dust flushing at the rate of 0.03 cmt/10 smt shall be done on asphalt surface at the contractors own cost.

11. Traffic may be allowed soon after final rolling when the premixed materials has cooled down to surrounding temperature.

12. Control on quality works shall be exercised by the Engineer-in-charge by carrying out the following tests at the frequencies shown against each :

Sr. No.	Type of Const. Material	Test	Frequency
1.	Tack Coat	(i) Binder temperature for application (ii) Rate of spread of binder of aggregate	At regular close intervals. Two test per day
2.	Open graded premix carpet with seal coat	(i) Temperature of binder at application (ii) Binder Content (vide As/TM : D2172) (iii) Rate of spread of mixed material	At regular close intervals. Two tests per day for work of every 3 Km length in one lane. Regular control throughout checks on material and layer thickness.

13. Para 13 to 17 : As regards arrangements for traffic para 29 of 33 of semidense carpet shall apply.

18. Open graded carpet and seal coat shall be measured in cubic metres on the basis of stone- chips actually used.

19. The contract unit rate for open grade carpet and seal coat (excluding cost of asphalt, stone chips and rolling) shall be payment in full for carrying out the required operations including full compensation for

- (1) Preparation of base.
- (2) Providing all materials like fuel, lubricants, kerosene and coarse sand or stone dust for flushing with all leads and lifts.
- (3) All labours, tools, equipment and incidentals.
- (4) Making arrangements for control and safety of traffic.

ITEM-18 Providing and laying 20725mm thick bituminous open graded carpet with B.T. aggregates 0.66 cm/M.T. using bitumenious for tack coat at the rate of @ rate of 10 Kg./10 Smt. on W.B.M. surface and 5 Kg./10 Smt. for B.T. surface and for mixing at the rate of 32.8 kg/M.T. of total mix i.e.3.28 per M.T. of total mix and heating asphalt & aggregate by continuous batching hot mix plant and spreading the same by paver finisher including consolidation with power road roller including providing equipment T & P oil, fire wood,kerosene labour charges etc. compt. using contractor's own machineries hot mix plant and paver finisher including flushing of sand 0.30 cmt/100 sq.mt.

1. The work shall consist of construction in a single course of 20/25 mm. thick premixed carpet as course, on a previously prepared base Single course shall also include additional thickness if any to remove unevenness of the existing surface.

2. The coarse aggregates shall consist of crushed stone only. These shall be clean, strong durable of fairly cubical shape, free of disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth as under.

Physical Requirements of Aggregates for Bituminous Macadam.

Sr. No.	Test	Test Method	Requirement
1 .	Los Angles Abrasion Value	IS : 2386 (part IV)*	35% Maximum
2.	Aggregate Impact Value	-do-*	30% Maximum
3.	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4.	Stripping Value	IS : 6241	25% Maximum
5.	Water Absorption	IS : 2386 {Part III}	2% Maximum

* Aggregates may satisfy requirements of either of the two tests.

3. The fine aggregates shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substance.

4. The filler, where required, shall be an inert material, the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime or fly ash approved by the Engineer-in-charge.

5. The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to the grading as under-

Table Aggregate gradation for Asphalt carpet.

Sieve Size	% by weight passing the Sieve for 20/25 mm thickness
20 mm	100
12.5 mm	70-100
10.0 mm	20-40
4.75 mm	0-5
2.36 mm	

6. The samples of aggregate of requires gradings for the work shall be got approved from the Engineer-in-charge prior to transportation and collection on plant site. Unapproved materials shall have to be removed from the plant site by the contractor at his own cost. If contractor fails to remove the inferior type of materials from the plant site, the same will be removed by the Department at the cost of the Contractor. Collection of aggregate shall be in different stacks according to various sizes of aggregates.

7. For the purpose of collection of materials, plant site shall be established at suitable place, where hot mix plant shall be installed. Department will extend all necessary co-operation in helping Contractor to get nearby Government land of establishing plant site. However, department is not responsible if no such land is made available to the Contractor and in that case, the Contractor will have to make his own arrangement for the same. Incoming material shall be recorded in a register for the purpose of record.

8. The binder shall be straight run bitumen of a suitable grade satisfying the requirements of IS:73. Bitumen shall be 60/80/100 grade and shall be supplied by the department at the rate and place as mentioned in Schedule "A" of the tender and it shall have to be carted, by the Contractor to the site of work at his own cost. Empty asphalt drums shall have to be returned free of cost to RW.D. Store from where they are issued or as directed, if so provided in Schedule 'A' Any damage caused to the asphalt drums or loss of asphalt after issue from store shall be the responsibility of the Contractor. Drums of asphalt shall be so stored so as to allow easy inspection and in such place as will not damage the drums and cause the leakage of allow water and other foreign matter to enter. For the purpose of calculating consumption, wastage will not be allowed beyond 2.5 percent. Excess consumption over 2.5 percent will be charged at a panel rate.

9. In case bitumen is to be issued by department in bulk, the same shall be issued to the Contractor at plant site by tankers at the same rate as shown in Schedule 'A'. Contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site according to the requirement. No deduction in rate will be made for supplying heated bulk asphalt.

10. The asphalt should not be used as a fuel. If however, Contractor is found to be using asphalt as fuel, the quantity of asphalt utilized shall be assessed, by the Executive Engineer whose decision will be final and binding to the Contractor who will be charged at double the rate provided in Schedule 'A' of the agreement even though the total consumption of asphalt may be within the theoretical consumption.

11. Department shall keep a day to day account of the supply and consumption of bitumen in a separate bound register having numbered pages and the proforma prescribed by the Department. Day to day signature of the Contractor's representative shall be obtained in this register. Issue rate of bitumen includes (i) Obtaining asphalt from Department's store, (ii) Transporting to site, (iii) Storing and stacking, (iv) Keeping records of supply and consumption and (v) returning the empty drums in good condition to the Department.

12. Semi dense carpet shall not be laid during rainy weather or when the base course is damp or wet.

13. The base on which semidense carpet is to be laid shall be thoroughly swept and scraped clean and free of dust and foreign matter.

14. The work shall consist of application of a single coat of bituminous to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160 degree centigrade to 175 degree centigrade.

15. Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread of straight run bitumen for tack coat shall be 5 kg per 10 square meter area for an existing bitumen treated surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the on coming bituminous construction. In case carpet is to be laid on W.B.M. surface, rate of spread of Bitumen for tack coat will be 10 kg./10smt.

16. The binder content for premixing shall be 3.28 percent by weight of the total mix unless otherwise specified. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

17. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work. In order to obtain the required type of mix, the department may change the proportion of bitumen and gradings of aggregate and contractor shall have to collect the materials accordingly. In case of increase in proportion of bitumen the increased or decreased quantity will be adjusted at the rate provided in Schedule 'A' The contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job-mix formula and producing a uniform mix.

18. Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant may be either a batch type or a continuous one, having coordinated set of essential unit such as dryer for heating the aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimate mixing of the binder and aggregate.

19. The temperature of binder at the time of mixing shall be the range of 150 - 177 degree centigrade and of aggregates in the range of 155 - 163 degree centigrade. Provided also that at no time shall the difference in temperature between the aggregates and the binder exceed 14 degree centigrade.

20. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all the particles to the mineral aggregates are coated uniformly.

21. The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over during transit if so directed by the Engineer-in-charge.

22. The mix, transported from the hot mix plant to the site, shall be spread by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix, to specified grade, lines and cross sections. The temperature of mix at the time of laying shall be in range 121-163 degree centigrade.

23. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by at least 150 mm. from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

24. Immediately after the spreading of mix, it shall be thoroughly compacted by 8-10 tonnes 3 Wheel roller moving at a speed not exceeding 5 km per hour.

25. The roller wheels shall be kept damp to prevent the mix from adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except on super elevated portions. When it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or mixed wheel leading or as to minimize the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

26. Sand or stone dust flushing at the rate of 0.03 cmt. / 10 smt. shall be done on asphalt surface for which no separate payment will be made.

27. Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

28. Surface finish and quality control of work ; Control on the quality of materials and works shall be exercised by the Engineer-in-charge by carrying out the following test at the frequencies shown against each :-

Sr. No.	Type of Construction	Test	Frequency
1.	Tack Coat	(i) Binder temperature for application (ii) Rate of spread of binder (i) Aggregate Impact Value (ii) Flakiness Index of Aggr. (iii) Stripping Value (iv) Mix Grading (v) Temperature of binder in the boiler, aggregate in the dryer and mix at the time of laying and rolling (vi) Control of binder content and gradation in the mix (Binder Content test vide (ASTM D-2172) (vii) rate of spread mix material	At regular close intervals. Two test per day One test per 100 cu m. of aggre. -Do- -Do- One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to a minimum of two test per day At regular close intervals. One test for each 100 tonnes of mix subject to max. of two test per day per plant Regular control through checks on layer thickness

29. The contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway, the contractor shall in accordance with the directives if the Engineer-in-charge provide and maintain, during the execution of the work, a passage for traffic either along a part of the existing carriage way under improvement or on diversion.

30. In case of the improvement works, namely widening strengthening of the existing payment or reconstruction repairs to cross-drainage works. Where such works could be carried out on part widths at a time and the traffic could simultaneously be passed without undue delay and difficulty on the other part; the road shoulder shall be dressed and brought in-line with the payment and maintained throughout out the duration of the work to the satisfaction of the Engineer-in-charge. Where work is continued on long stretches, passing places, at least 20 metre long and 6 metre wide inclusive of the width of the existing carriage way shall be provided at half or one kilometer intervals as directed by the Engineer-in-charge. Extra treatment to shoulders where necessary, shall be given as ordered by the Engineer-in-charge.

31. The contractor shall take the all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades including signs, marking lights and flagmen as may be required, by the Engineer-in-charge for the information and protection of traffic approaching or passing through the section, of the highway under improvement. Before taking up any construction an agreed phased programme for the control of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

32. The barricades erected on either side of the carriage way/portion of the carriage way closed to traffic shall be strong to resist violation, and painted with alternate black and white stripes. Rod lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise. At the points where traffic is to deviate from its normal path the channel for traffic shall be clearly marked with the aid of payment marking, painted drums or a similar device to the direction of the Engineer-in-charge. At night the passages shall be delineated with lanterns or other suitable light source.

33. One way traffic operation shall be established whenever the traffic is to be passed over part of the carriage way inadequate for two lane traffic. This shall be done with the help of flagmen kept positioned on opposite side during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns lights. On both sides, suitable regulatory/warning signs shall be installed for the guidance of carriage way begins and the other 120 metres away. The signs shall be of approved design and the refractory type if so directed.

34. The payment shall be made on the tonnage basis of the weight of mix of aggregate and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighment of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weigh bridges. Weigh bridge will be

periodically got calibrated and verified from weight and measure authorities.

35. Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department and the measurements shall be recorded by the Deputy Engineer, Junior Engineer of Supervisor, if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the department representatives and signed by the contractor. Proper gate pass system shall be established, for the vehicles coming to the plants, site and out going from the plant site. The location of hectometer in which individual dumpers are unloaded shall be recorded carefully.

36. The contract unit rate for semi-dense carpet shall be in full for carrying out the required operation including full compensation for :-

1. Making arrangements of control and safety of traffic.
2. Preparation of base.
3. Providing all materials to be incorporated in the works with all lead and lifts.
4. All labour, tools, equipment and incidentals to complete the work to the specification.

ITEM 19 Semi Dense Carpet

(As standardized by R & B Circular No. SSR-1087-205 (21) (C) dated : 29-10-1987.

1. Description

The work shall consist of construction in a single course of 20/25 mm. thick semi-dense carpet as wearing course, on a previously prepared base, to the requirements of these specifications.

2. Materials

2.1 Binder : The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS : 73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge.

2.2 Coarse aggregates : The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free from disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2.

2.3 Fine aggregates : The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 Filler : The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

2.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below :

Table : Aggregate gradation For Semi-Dense Carpet

Sieve Designation	% by weight passing the Sieve		Sieve Designation	% by weight passing the Sieve	
	For 25 mm thickness	For 20 mm thickness		For 25 mm thickness	For 20 mm thickness
20 mm	100	-	600 micron	10-22	10-22
12.5 mm	75-100	100	300 micron	6-16	6-16
10 mm	60-85	75-100	150 micron	4-12	4-12
4.75 mm	35-55	35-55	75 micron	2-8	2-8
2.36 mm	20-35	20-35			

2.6 Proportioning of materials : The binder content for premixing shall be 4.28 percent by weight of the total mix.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material : The Contractor shall have the responsibility of ensuring proper proportioning of material in accordance with the approved job mix formula and producing a uniform mix. variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : Semi dense carpet shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which semi-dense carpet is to be laid shall be prepared shaped and conditioned to the specified, lines grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 per square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in the range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14° C.

Mixing shall be through to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C-163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road, Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the payment. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 112 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded dumpers test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified, from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

8. RATE

The Contract unit rate for semi-dense carpet shall be payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8.

ANNEXURE-A TECHNICAL REQUIREMENTS OF HOT MIX PLANT

Composition of plant : The Hot Mix Plant shall conform generally to IS Specifications No. IS 3066/1965 as amended from time to time and shall be equipped with the following arrangements :

1. Cold Aggregate Feeder : The cold aggregate feeder shall have minimum three independent bins or compartment, each provided with accurate mechanical pre-determined rate to the cold elevator or to some intermediate conveyor or directly into the dryer. The feeder shall provide for the adjustment of total and proportional feed and shall be capable of being locked in any setting.

2. Dryer : The dryer shall be capable of continuously agitating the aggregates while heating to the desired temperature. At the discharge end of the dryer or any other suitable location, means shall be provided for ascertaining the temperature of the heated aggregate.

3. Screening Unit and Gradation Control : The dried aggregate shall be screened into not less than three size. The plant shall include means for accurately proportioning each bin size of aggregate either by weight or volumetric measurement. When the gradation control is by volume, the unit shall include a feeder mounted under the compartment bins. Each bin shall have an accurately controlled, individual gate to form an orifice for proportioning the material drawn from each respective bin compartment. The orifice shall have positive mechanical adjustment and provided with a lock. Indicators shall be provided on each gate to show the opening in centimeters.

4. Mixer Unit : The plant shall include a mixer of an approved twin shaft pugmill type capable of producing a uniform mix. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of fines.

5. Mineral Filler Supply Unit : There shall be an independent arrangement to feed mineral filler directly into the pugmill. The hopper to bin for mineral filler shall provide for the adjustment to proportion the feed with the aggregate and bitumen feeds and shall be capable of being locked in any setting.

6. Bitumen Heating : A heating system for bitumen always with effective and positive control of temperature shall be provided, to maintain proper temperature and for allowing continuous circulation between storage tank and proportioning units during the entire operating period. Suitable arrangements shall be provided for recording the temperature at the tanks and in the circulating system.

7. Synchronization : For Synchronization of Aggregate, Bitumen and filler feeds satisfactory means shall be provided to afford positive inter-locking control between the flow of aggregate from the bins or compartment, flow of bitumen from the tank and flow of mineral filler.

ITEM - 20 40 mm Thick Asphaltic Concrete

1. DESCRIPTION

The work shall consist of construction in a single course, of 40 mm thick asphaltic concrete as wearing surface, on a previously prepared base to the requirements of these specifications.

2. MATERIALS

2.1 Binder : The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge.

2.2 Coarse aggregates : The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free of disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2.

2.3 Fine aggregates : The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 Filler : The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

2.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in table below :

Table : Aggregate gradation For Asphaltic Concrete

Sieve Designation	% by the weight passing the Sieve	Sieve Designation	% by weight passing the Sieve
20 mm	100	600 micron	18-29
12.5 mm	80-100	300 micron	13-23
10 mm	70-90	150 micron	8-16
4.75 mm	50-70	75 micron	4-10
2.36 mm	35-50		

2.6 Proportioning of materials : The binder content for premixing shall be 5.5 percent by weight of the total mix.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material : The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : Asphaltic Concrete shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which asphaltic concrete is to be laid shall be prepared shaped and conditioned to the specified, lines grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in the range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14° C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix. transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C - 163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road, Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

8. RATE

The Contract unit rate for semi-dense carpet shall be payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8

ITEM-21 Providing and laying bituminous 37.5 mm thick lean bound macadam in one or two layers considering 0.66 cum. per M.T. mix materials with machine crushed stone aggregate and asphalt for tack coat @ the rate of 10 Kg /10 sq. mt. (on metaled surface) / 5 kg per 10 sq. mt. (on existing B.T. surface) using 30 kg. of bitumen per asphalt including mixing the aggregate, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and flushing sand at the rate of 0.30 cu.m /100 sq. mt.

1. DESCRIPTION

The work shall consist of construction in one layers each 37.5 mm thick IBM on previously prepared base, to the requirements of these specifications.

2. MATERIALS

2.1 Binder : The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73 The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by the contractor to the site of work at his own cost.

2.2 Coarse aggregates : The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2.

2.3 Fine aggregates : The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft of flaky pieces and organic or deleterious substances.

2.4 Filler : The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matttr approved by the Engineer-in-charge.

2.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below :

Table : Aggregate gradation For LBM

Sieve Size	%by weight passing the Sieve		Sieve Size	%by weight passing the Sieve	
	37.5	75 m.m.		37.5	75 m.m
40mm	-	100	-	-	-
25mm	100	75-100	4.75 mm	15-35	15-35
20.0mm	70-100	60-95	2.36 mm	5-20	5-20
10.0mm	35-60	30-55	0.75mm	0-5	0-5

The above gradation is tentative. To archive Correct quantity the contractor shall get the job mix farmula for the mix approved by Engineer-in-charge before starting the work.

2.6 Proportioning of materials : The binder content for premixing shall be 3.0 percent by weight of the total mix. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material : The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible in Individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : Lean Bound Macadam shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which-LBM is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. At specified temperature, so as to provide uniformly rate and unbroken spread bitumen. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and

uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit -for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150 C - 177 C and aggregates in the range of 150 C -163 C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14 C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121 C- 163°C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road, Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne random rollers, or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the payment. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

7.2 In case of LBM, DBM and asphaltic concrete of thickness 50 mm and above, initial levels before commencement of the work and final levels after completion of the work will be taken as indicated below for working out the average thickness of pavement laid, also the actual area of work done will be measured and the quantity of the work actually done shall be computed in Cu.M. basis. The actual tonnage of the mix shall then be worked out based on the designed density, for broad cross check on the actual tonnage of total mix used in the works.

Surface levels before and after laying the pavement course shall be taken as below : Cross profiles will be taken at least at every ten meters longitudinally as shown below :

- (a) For single lane : Levels at 15 Cms & 75 cms. from both the edges and centre point. (Levels at 5 points)
- (b) For double Lane : Levels at 15 Cms & 75 cms : 175 Cms. 275 Cms. from both the edges and the centre point. (Levels at 9 Points)
- (c) Widening single to double lane : Levels at 15 Cms. from both the edges and the centre Carriage way (Up to 2 meters widening) point (Levels at 3 Points)]

However, in special cases if necessary, the cross profiles may be taken at closer length upto 3 meters.

8. RATE

The contract unit rate for L. B. M. shall be for payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8. ITEM 22 DBM 50 MM THICK.

1. DESCRIPTION

The work shall consist of construction in a single course of 50 mm thick DBM on a previously prepared base to the requirements of these Specifications.

2. MATERIALS

2.1 Binder : The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge.

2.2 Coarse aggregates : The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free of disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2.

2.3 Fine aggregates : The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 Filler : The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter as approved by the Engineer-in-charge.

2.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in table below :

Table : Aggregate gradation For DBM

Sieve Designation	%by weight passing the Sieve	Sieve Size	%by weight passing the Sieve
25mm	100	10mm	35-60
20mm	70-100	4.75mm	15-35
12.5mm	55-80	2.60mm	5-20
		0.75mm	0-5

2.6 Proportioning of materials : The binder content for premixing shall be 5.5 percent by weight of the total mix.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material : The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : DBM shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which DBM to be laid shall be prepared shaped and conditioned to the specified, lines grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in the range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14° C.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C- 163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road, Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the payment. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimize the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this

purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant site.

Department will be free to get some loaded dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer of Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

7.2 In case of IBM, DBM and asphaltic concrete of thickness 50 mm and above, initial levels before commencement of the work and final levels after completion of the work will be taken as indicated below for working out the average thickness of pavement laid, also the actual area of work done will be measured and the quantity of the work actually done shall be computed in Cu. M. basis. The article tonnage of the mix shall then be worked out based on the designed density, for broad cross check on the actual tonnage of total mix used in the works.

Surface levels before and after laying the pavement course shall be taken as below :

Cross profiles will be taken at least at every ten meters longitudinally as shown below :

- (a) For single Lane : Levels at 15 Cms & 75 from both the edges and centre point. (Levels at 5 points)
- (b) For double Lane: Levels at 15 Cms & 75 cms : 175 Cms. 275 Cms. from both the edges and the centre point. (Levels at 9 Points)
- (c) Widening single to double lane : Levels at 15 Cms. from both the edges and the centre Carriage way (Up to 2 meters widening) point (levels at 3 Points)

However, in special cases if necessary, the cross profiles may be taken at closer length upto 3 meters.

8. RATE

The contract unit rate for DBM shall be for payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8.

ITEM-23 Providing and laying seal coat with 0.18 cum stone chips i.e. 0.2727 M. T. per 10 sq. mt. using 42.80 kgs of bitumen per M.T. (4.28% by weight) for mixing the aggregates, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and flushing sand at the rate of 0.30 cu.m / 100 sq. mt.

1. DESCRIPTION

The work shall consist of construction of premix seal coat as wearing course, on a previously prepared base, to the requirement of these specifications.

2. MATERIALS

2.1 Binder: The binder shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge and it shall have to be brought by contractor to the site at his own cost unless otherwise specified in schedule 'A'.

2.2 Coarse aggregates : The coarse aggregate shall consist of crushed stone or crushed gravel. These shall be clean, durable, of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table given in Item No. 18 Para 2. Except that the upper limit for water absorption value shall be one percent.

2.3 Fine aggregates : The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

2.4 Filter : The filler, where required, shall be an inert material the whole of which passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

2.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below:

Table : Aggregate gradation Pre-Mix Seal Coat

Sieve Designation	Percentage by For type 'A'	wt passing through Sieve For Type 'B'
12.5 mm	-	100
10 mm	100	70-100
4.75 mm	40-85	20-40
2.35	5-20	5-20
75 micron	0-4	0-4

2.6 Proportioning of materials : The binder content for premixing shall be 42.80 kg per M.T. (4.28% by weight) for mixing aggregate.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

2.7 Variation in Proportioning of material : The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : Premix seal coat shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which premix seal coat is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated set of essential units such as dryer for heating the aggregates, device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150° C - 177° C and aggregates in the range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14° C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix, transported from the hot mix plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross sections. The temperature of mix at the time of laying shall be in the range of 121° C - 163° C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road, Longitudinal joints shall be offset by at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers. Rolling temperature shall not be less than 100° C in any case the rolling shall be completed the temperature

of mix falls about 80 °C.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

6. ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow to traffic during construction.

7. MEASUREMENT FOR PAYMENT

The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this purpose the contractor shall have to install a weigh bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty dumper and weight of loaded dumper will be recorded in bound and numbered register on plant side.

Department will be free to get some loaded dumper test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer in which individual dumper are unloaded will be recorded carefully.

8. RATE

The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.7

ITEM - 24 Special Conditions for Bituminous surface work with use of Hot Mix Plant paver Finisher.

1. The Hot Mix Plant and accessories to be used for the work shall be in conformity with the specifications prescribed vide Govt. of India, Ministry of Transport Circular No. RQ/RMP/1613784 dt.1-1-87. The plant shall be equipped with all units and accessories as per latest I.S. 3066/1965, as amended from time to time. The Contractor will have to modify their plants suitably within a period of six months from the date of issue of latest I.S. Specification or Codes.

2. The work of laying aggregate mixed with bitumen shall start on site of work only after 8.00 hours in the morning and continue upto 17.00 hours in winter season and upto 18.30 hours in summer. No work shall be done except during the period mentioned above and also on Sundays and National holidays viz. 26th January, 15th August & 2nd October.

3. Quantity of bituminous aggregate mix to be laid shall be restricted to 250 tones per day for 30/40 capacity plant and may be more or less depending upon the rated capacity of the plant.

4. The work of laying asphalt mix shall start latest within 60 days from the date of issue of work order except when work is closed for few days due to breakdown of machinery and during such period the contractor has not shifted paver plant to any other paver work not carried out by the same plant and will be completed as per time limit. Reasons for delay in starting of work after 60 days shall result into sufficient cause for levying compensation for disproportionate progress. However, the period from 15th June to 15th October monsoon shall not be counted for the purpose of disproportionate progress and consequent cause for levy of compensation. The contractors shall commence the work of laying pavement on or before the last date of the period mentioned above failing which he shall pay to every day that he shall delay the commencement of the work as above in accordance with clause-2 of the contract.

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5. The Contractor shall invariably get the job mix formula for the mix approved by the Engineer-in-charge before starting the work.

6. These special conditions shall be applicable to the specifications of all the items included in this contractor where work is to be carried out with Hot Mix Plant and paver finisher.

7. No asphalt work shall be executed in monsoon as per condition 4 of same Item 24. However in critical circumstances asphalt work may be executed during monsoon with permission of Superintending Engineer who may give permission after ascertaining the proportion of moisture in existing surface & atmosphere (R & B.D. G.R. dated 24-10-94 & No. S.S.R.-102004 (23)-C dated 23-6-2004).

SCHEDULE OF WORK TO BE EXECUTED SHALL BE AS UNDER

Time Limit: -

Sr.No.	Period	Description of items to be executed
1	Month.....Month	1. Collection of Materials on site
2	From Month 2 to 4 Month	2. Erection of Plant Machinery as required
3	From Month....to...Month	3. Laying of asphalt work carpet & Seal coat & Flushing of sand over surface, side with filling with earth as required and directed.

ITEM - 25 Dismantling [Road and bridge items.]

1. The work shall consist of removing, as herein after set forth, existing, culverts, bridges, pavement, kerbs and other structures like guards-rails, fences, utility poles, manholes, catch basins, inlets, etc. Which are in place but interfere with the new construction or are not suitable to remain in place and of salvaging and disposing of the resulting materials and backfilling the resulting trenches and pits.

2. Existing culverts, bridge, pavements and other structures which are within the highway and which are designated to be removed, shall be removed upto the limits and extent specified in the drawings or as indicated by the Engineer-in-charge.

3. Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and other work to be left in tact.

4. All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.

5. The structures shall be dismantled carefully and the resulting materials so removed as not to cause and damage to the serviceable materials to be salvaged, the part of the structure to be retained and any other properties or structures nearby.

6. Unless otherwise specified, the superstructure portion of culverts/bridges shall be entirely removed' and other parts removed to below the ground level or as necessary depending upon the interference they cause to the new construction. Removal of overlying of adjacent material if required in connection with the dismantling of the structures shall be incidental to this item.

7. Where existing culverts/bridges are to be extended or otherwise incorporated in the new work only such part of parts of the existing structure shall be removed as are necessary to provide a proper connection to the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Reinforcing bars which are to be left in place so as to project into new work as dowels or ties shall not be injured during removal of concrete.

8. Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes.

9. Steel structures shall unless otherwise provided be carefully dismantled in such a manner as to avoid damage to members thereof. If specified-in the drawing or directed by the Engineer-in-charge that structure is to be removed in a condition suitable for re-erection all members' shall be match marked by the contractor with white lead paint before dismantling. End pins, nuts, loose, plates, etc. shall be painted with a mixture of white lead and tallow and loose parts shall be securely wired to adjacent members or packed in boxes.

10. Timber structures shall be removed in such a manner as to avoid damages to such timber or lumber as is designated by the Engineer-in-charge to be salvaged.

11. In removing pavements, kerbs, gutters, and other structure, like guards rails, fences, manholes, catch, basins, inlets etc. where portions of the existing construction are to be left in the finished work, the same shall be

removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer-in-charge.

12. All concrete pavements base course in carriage way and shoulders etc. designated for removal shall be broken to pieces whose volumes shall not be exceed 0.02 cubic metre and stockpiled at designated locations if the material is to be used later or otherwise arranged for disposal as directed.

13. Where directed by the Engineer-in-charge holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials and thoroughly compacted in line with surrounding area.

14. All materials obtained by dismantling shall be the property of Government. Unless otherwise specified, materials having any salvage value shall be placed in neat stack of like material within the right-of-way as directed by the Engineer-in-charge, for which contractor will remain responsible for its safe custody and preservation for 60 days after recording measurements of the salvaged material.

15. Pipe culverts that are removed shall be cleared and neatly piled on the right-of-way at points designated by the Engineer-in-charge.

16. Structural steel removed from old structure shall, unless otherwise specified or directed be stored in a neat and presentable manner on blocking in locations suitable for loading. Structures or portions thereof which are specified in the contract for re-erections shall be stored in separate piles

17. Timber or lumber from old structures which is designated by the Engineer in-charge as materials to be salvaged shall have all nuts and bolts removed from and shall be stored in neat piles in locations suitable for loading.

18. All the products of dismantling operations which in the opinion of the Engineer-in-charge cannot be used or auctioned shall be disposed as directed, within 100 metres.

19. The work of dismantling structure shall be paid for in units indicated below by taking measurement before and after, as applicable ;

(i)	Dismantling brick/stone/concrete (Plain and Reinforced) masonry	Cubic Metre
(ii)	Dismantling flexible and cement concrete pavement	Cubic Metre
(iii)	Dismantling steel structure	Tonne
(iv)	Dismantling timber structure.	Cubic Metre
(v)	Dismantling pipes, guard rails, kerbs gutters and fencing	Linear metre
(vi)	Utility poles	Nos.

20. The contract unit rates for the various items of dismantling shall be for payment in full for carrying out the required operations including full compensation for all labour, materials, tools equipment, safeguard and incidentals necessary to complete the work. These will also include excavation and backfilling where necessary and for handling, salvaging, piling and disposing of the dismantled material within all lifts and upto a lead of 100 metres.

ITEM-26 Excavation for foundation up to 1.5 m depth including sorting out and stacking of useful material and disposing stuff 50 metre lead. (A) in loose of soft soil (B) in dense or hard soil.

1. Excavation for structures shall consist of the removal of material for the construction of foundations for culverts, retaining walls, cut of walls pipe culverts and other similar structures, in accordance with the requirements of these specifications and the lines and dimensions shown on the drawing or as indicated by the Engineer-in-charge. The work shall include all necessary sheeting, shorting, bracing draining an pumping and the removal of all logs, stumps, grubs and other deleterious matter and obstructions necessary for placing the foundations, trimming bottoms of excavations, backfilling and clearing up the site and the disposal of all surplus material.

2. After the site has been cleared the limits of excavation shall be set out true to lines, curves and slopes.

3. Excavation shall be taken to the width of the lowest step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due-regard to. the safety of persons and works and to the satisfaction of the Engineer-in-charge.

4. The depth to which the excavation is to be carried out shall be as shown, on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.

5. Where waters is. met with in excavation due to stream flow, seepage springs, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, constructing diversion channels drainage channels, and other necessary work to keep the foundation trenches dry when so required and to protect green

concrete/masonry against damage by erosion or sudden rising of water level. The method to be accepted in this regard and other details there of shall be left to the choice of the contractor but subject to approval of the Engineer-in charge, Approval of the Engineer-in-charge shall, however, not relieve the contractor of the responsibility for the adequacy of dewatering, and protection arrangements and for the quality and safety of the work.

6. Pumping from the interior of any foundation enclosures shall be done in such manner as to preclude the possibility, of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.

7. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer-in-charge. the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose of bringing the foundation to level. If there are any slips or blows in the excavation these shall be removed by the contractor at his own cost.

8. Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The contractor shall be required to take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.

9. Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause under thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface, making due allowance for settlement in 250 mm loose layers. Which shall be watered and compacted.

10. All the excavated materials shall be the property of the Government. Where the excavated material is directed to be used in the construction of embankment, it shall be directly deposited at the required locations.

11. All useful materials, not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within 50 metres lead. Unsuitable and surplus materials not intended for use in any part of the road shall be disposed off as directed by the Engineer-in-charge.

12. Excavation for structures shall be measured in cubic metres for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer-in-charge. Excavation over increased width, cutting of slopes, shoring, shattering and planking shall be deemed as convenience for the Contractor in executing the work and shall not be measured and paid for separately.

13. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including.

1. Setting out
2. Construction of necessary shoring and bracing and their subsequent removal:
3. Removal of all logs stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations;
4. Foundation sealing, dewatering including pumping;
5. Backfilling, clearing up the site and disposal of all surplus material within all lifts and leads upto 100 metres;
6. All labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work to the specification.

14. Excavation shall be for ordinary soil such as vegetable or organic soil, turf slit, and loam, clay, mud, plat, black cotton soil, soft shale or soft murrum a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging equipment. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor.

ITEM - 27 -DO- in hard murrum

1.0 Para 1 to 13 of the item of excavation for foundation in all softs of soil shall apply.

14. Excavation shall be in hard soil such as stiff heavy clay, hard shale or compact murrum requiring grafting tool or pick or both and shovel. Closely applied and gravel and rubble stone having maximum diameter in any one direction between 75 and 300 mm and soft conglomerate. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor.

ITEM - 28 - DO - in hard rock

1. Para 1 to 13 of the item of excavation for foundation is all sorts of soil shall apply.

14. Excavation shall be in soft rock such as limestone, sand stone, laterite, hard conglomerate or other softer disintegrated rock which may be quarried or split with crow bars, boulders which do not requiring and any rock which in dry state may be hard, requiring blasting but which when wet becomes soft and manageable be means other than blasting. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor.

ITEM - 29 - DO - in hard rock

1. Para 1 to 13 of the item of excavation for foundation in all sorts of soil shall apply.

14. Excavation shall be in any rock or boulders for which the use of mechanical plant for blasting is required. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer-in-charge.

15. In the opinion of the Engineer-in-charge where blasting is prohibited for any reason, excavation shall be carried out by chiselling, wedging or any other agreed method.

16. Blasting shall be carried out with the written permission of the Engineer-in-charge. All the statutory law, regulation rules, etc. pertaining to the acquisition, transport, storage, handling and use of explosives shall be strictly followed.

17. The Contractor may adopt any method or methods of blasting consistent with the safety and job requirements, after approval from the Engineer-in-charge.

18. The magazine for the storage of explosives shall be built to the designs and specifications of the Explosives Department concerned and located at the approval site. No unauthorised person shall be admitted into the magazine which when not in use shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lightning conductor. The following shall be hang in the lobby of magazine.

(a) A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar.

(b) A statement of upto date stock in the magazine.

(c) A certificate showing the last date of testing of the lightning conductor.

(d) A notice that smoking is strictly prohibited.

19. In addition to these, the Contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer-in-charge and shall be responsible for damage to property and any accident which may occur to workmen or the public on account of any perations connected with the storage, handling or use of explosive and blasting. The Engineer-in-charge shall frequently check the Contractor's compliance with these precautions.

20. All the materials, tools and equipments used for blasting operations shall be approved type. The Engineer-in-charge may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a safe length being cut as will permit sufficient time to the fires or reach safely before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder explosives, detonators etc. asphalt be fresh and not damaged due to dump., moisture or any other cause. They shall be inspected totally and removed immediately.

21. The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the handling explosives and blasting operations. ,

22. The blasting shall be carried out during fixed hours of the day preferably during the midday lunch hour or at the close of the works as ordered in writing by the Engineer-in-charge. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only.

23. Red danger flags shall be displayed prominently in all directions during the blasting operations. People except those who actually light the fuse, shall be prohibited from entering this areas. The flags shall be planted 200 meters from the blasting site in all directions and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning whistle being sounded for the purpose.

24. The enlarge holes shall be drilled to required depths and in suitable places. Blasting should be as light as possible consistent with through breakage of the material necessary for economic loading and hauling. Any method of blasting which leads to overshooting shall be discontinued.

25. When blasting is done with powder, th fuse cut to the required length shall be inserted into the hole and powder dropped in. The powder shall be gently tampered with copper roads with rounded ends. The explosive powder shall then, be covered with tamping materials which shall be tampered light but firmly.

26. When blasting is done with dynamite and other high explosives, dynamite cartridges shall be prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end, the detonator gently pushed into the primer leaving 1/3rd copper tube exposed outside. The paper of the cartridge shall then be closed up and securely bound with wire, or twine. The primer shall be housed into the explosive. Bore holes shall be of such size that the cartridge can easily go down. The holes shall be cleared of all debris and explosive inserted. The space of about 20 cm. above the charge shall then be gently filled with dry clay, passed home and the rest of the tamping formed of any convenient material gently packed with a wooden hammer.

27. At a time, not more than 10 such charges will be prepared and fired. The man in charge shall blow a whistle in a recognised manner for cautioning the people. All the people shall then be required to move to safe distances. The charge shall be lighted by the man in charge only. The man in charge shall count the numbers explosions, He shall satisfy himself that all the charges have been exploded before allowing the workmen to go back to the work site.

28. In case of a misfire, the following procedure shall be observed.

(1) Sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charges.

(2) If it is the blasting powder charge it shall be completely flooded with water. A new hole shall be drilled at about 45 cm from the old hole and fired. This should blast the old charge should it not blast the old charge the procedure shall be repeated till the old charge is blasted.

(3) In case of charges of gelatin, dynamite, etc. the man in charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge alternatively the hole may be cleared of 30 cm. of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 15 cm away and parallel of it. This hole shall then be charged and fired. The misfired hole should explode at the same time. The man in charge shall at once report to the contractor's office and Engineer-in-charge all cases of misfire, the cause of the same and what steps were taken in connection therewith.

29. If a misfire has been found to be due to defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority by the Engineer-in-charge for inspection to ascertain whether all the remaining materials in the box are also defective.

30. A careful and day to day account of the explosive shall be maintained by the contractor in the approved register and manner which shall be open to inspection by the Engineer-in-charge at all times.

31. Excavation shall be measured after removal of over burden by taking cross sections at suitable intervals in the original position before the work starts and after its completion, and computing the volumes in cubic meters by the methods of average end areas. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods. At the option of the Engineer-in-charge, the Contractor shall leave depth indicators during excavation of such shape and size, and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken. Where cross sectional measurements could not be taken due to irregular configuration, or where the rock is admixed with other classes of materials, the volumes shall be computed on the basis of stacks of excavated rubble after making 40 percent deduction therefrom.

ITEM 30 Providing and laying uncoursed rubble masonry with hard stone of approved quality in foundations and plinth in cement mortar 1:6 (1 cement : 6 course sand) including levelling up etc. complete.

1. Stone shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used. The stones when immersed in water for 24 hours shall not absorb water by more than 5 percent of their dry weight when tested in accordance with IS : 1124. The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourths of the thickness of wall nor less than 15 cm.

2. Cement and sand shall be mixed in proportion as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3. The mixing shall be done intimately. The operation shall be carried out on a clean water tight platform, and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has stiffened because of evaporation of water the same shall be tempered by adding water as frequently as needed to restore the requisite consistency, but this tempering shall be permitted only, within thirty minutes from the time of addition of water at the time of initial mixing.

4. The dressing of stone shall conform to the general requirements of dressing of stone covered in IS : 1129. Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar. The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and in vertical joints and settled carefully in place with a wooden mallet immediately on placement so that it is solidly bedded in mortar before the same has set. Clean chips and spalls shall be edges into the mortar joints and beds wherever necessary to avoid thick beds or joints of mortar. Whenever foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar. Vertical joints shall be staggered as far as possible. Sufficient transverse bond shall be provided by the use of bond stones extending from the front to the back of the masonry. In case of thick walls bond stones shall overlap each other in their arrangement. Bell shaped bond stones or headers shall not be used.

5. At all angular junctions, stones at each alternate course shall be well bonded into the respective course of the adjacent wall. All connected masonry in structure shall be carried up at one uniform level throughout as far as possible, but when breaks are unavoidable, the masonry shall be raked in sufficient long steps to facilitate joining or new work with old. The stepping of taking shall not be more than 45 degree with horizontal wing walls. Abutments and piers etc. shall be carved up truly plumb or with the specified batter. Face work and hearting shall be brought up evenly. The top of each course, however, shall not be levelled up by use of flat chips.

6. Stone shall be hammer dressed on the face, the sides and beds to enable it to come in proximity with the neighboring stone. The bushing on the face shall not be more than 4 cm on exposed face chips and spalls of stone may be used where necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stone to bring these up to the level of face stone. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

7. The hearting or interior filling of wall face shall consist of rubble stones not less than 15 cm. in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in the mortar. The hearting should be laid nearly level with facing and backing. Through bond stone shall be provided in masonry upto 60 cm. thickness and in case of masonry above 60 cm .thickness a set of two or more than bond stones overlapping each other at least by 15 cm shall be provided in a line from face to back. In case of highly absorbent types of stone (Porous lime stone and sand stones etc.) the bond stone shall extend only about two third into the wall, as through stone in such cases may give rise to penetration of dampness and therefore for all thickness of such masonry a set of two or more bond stones, overlapping each other by at least 15 cm shall be approved. One bond stone or a set of bond stones shall be provided for every 0.5' square metres of the masonry surface. Bond stones shall be stacked separately and marked to distinguish from other stones. Masonry work shall be started after sufficient number of bond stones are collected on site as directed by the Engineer-in-charge.

8. The quoins shall be laid header and stretcher alternately. Every stone shall be fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints, as such as possible and to avoid long vertical lines of joints.

9. The face joints shall not be more than 20mm thick, but shall be sufficiently thick to prevent stone to stone contact and shall be completely filled with mortar.

10. Greenwork shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly wet on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day. During hot weather if all finished or partly completed work shall be covered for wetted in such manner as will prevent rapid drying. The racking of joints where necessary shall be done at the end of day's work when mortar is green.

11. The scaffolding shall be sound and strong to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

12. When fresh masonry is to be placed against existing surface of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer-in-charge so as to effect a good with the new work.

13. Stone masonry shall be measured cubic meters.

14. The contract unit for stone masonry work shall include the cost of all labour, materials, tools and plant, Scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above.

ITEM-31 Providing and laying coursed rubble masonry hard stone of approved quality for super structure and plinth in cement mortar 1:5 (1 cement :5 course sand) etc. complete.

1. Para 1 to 14 of item of U.C.R. masonry shall apply.

15. Masonry shall be laid with course, where there is variation in the height of course. Large courses shall be placed at lower levels with height of courses decreasing gradually towards the top.

16. In case of abutment and wing walls, weep holes shall be provided in the masonry to drain moisture from the backfilling, Weep holes shall be 8 cm wide, 15 cm high or circular of 15 cm. diameter and shall extend through the full width of the masonry with slopes of about 12 vertical to 20 horizontal towards the draining face. The spacing of weep holes shall be generally 1 metre in either direction with the lowest one at about 15 cm. above the low water level or ground level whichever is higher or as directed by the Engineer-in-charge.

ITEM-32 Providing and laying Brick work using common burnt clay building bricks having crushing strength not less than 35 kg/sq.m. in foundation and plinth in cement mortar 1:5 (1 cement : 5 fine sand)

1. Burnt clay bricks shall conform to the requirements of IS: 1017, except that the minimum compressive strength when tested flat shall not be less than 35 Kg/square cm. and that the size may be according to local practice with a tolerance of 5 percent.

2. Cement and sand shall be mixed in proportions as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3. The mixing shall be done intimately. The operation shall be carried out on a clean water tight platform, and cement sand shall be first mixed dry in the required proportion to obtain uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has suffered because of evaporation of water the same shall be re-tempered by adding water as frequently as needed to restore the requisite consistency but this retempering shall be permitted only within thirty minutes from the time of addition of water at the time of initial mixing.

4. Bricks shall be soaked in water for a minimum period of one hour before use. When bricks are soaked they shall be removed from the tanks sufficiently in advance so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not spoiled by dirt, earth etc.

5. All brick work shall be laid in English bond, even and true to line, plumb level and all joints accurately kept. The bricks used on the face shall be selected whole ones of uniform size and with true rectangular face.

5.1 Bricks shall be laid frogs up, if any, on a full bed of mortar, When laying bricks shall be slightly pressed so that the mortar gets into all the surface pores of bricks to ensure proper adhesion. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left.

5.2 Before laying bricks in foundations, a layer of not less than 12 mm. of mortar shall be spread to make the surface on which the work will be laid even.

5.3 The brick work shall be built in uniform layer, corners and other advanced work shall be raked back. Brick work shall be done true to, plumb or in specified manner. No part of it, during construction, shall rise more than one metre above the general construction level to avoid unequal settlement and improper jointing.

5.4 Tothing may be done where future extension is contemplated but shall be used as an alternative to raking back.

5.5 The thickness of joints shall not exceed 12 mm.

6. When fresh masonry is to be placed against existing surface of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer-in-charge so as to effect a good bond with the new work.

7. Green work shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day.

7.1 During hot weather, all finished or partly completed work shall be covered or wetted in such manner as will prevent rapid drying of the brick work.

8. The scaffolding shall be sound and strong to withstand all loads to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs or arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

9. In case of abutment and wing wall, weep holes as shown on the drawing or directed by the Engineer-in-charge shall be provided in the masonry to drain moisture from the backfilling. Weep holes shall be 8 cm. wide, 15

cm. high or circular 15 cm. diameter and shall extend through the full width of the masonry with slope of about 1 vertical to 20 horizontal high or circular of 15 cm towards the draining face. The spacing of weep holes shall be generally 1 m. in either direction with the lowest one at about 15 cm. above the low water level or ground level whichever is higher or as directed by the Engineer-in-charge.

10. All brick work shall be measured in cubic metres.

11. The contract unit for brick work shall include the cost of all labour materials tools and plant, scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above and provision of weep holes.

ITEM-33 **Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per Indian Railway Standard specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slope) of class NP3 of following internal diameters. (i) 300 mm dia. (ii) 450 mm dia. (iii) 600 mm dia. (iv) 750 mm dia (v) 900 mm dia. (vi) 1050 mm dia. (vii) 1200 mm dia.**

1. The work shall consist of furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer-in-charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item. Each consignment of cement concrete pipes shall be inspected, if necessary and approved by the Engineer-in-charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP2, NP1 pipes are used for R. C. C. Pipes, where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from his responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work on account of defects found subsequently during the execution. It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various test as per IS : 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We _____ manufacturer of R.C.C. pipes produce R.C.C. pipes as per the requirement of IS: 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carryout test at our factory sites.

We have experience of manufacturing of pipes of _____ years The' pipes supplied by us to M/s. _____ satisfy the requirement of IS : 458

Date : _____

Place : _____

Manufacturer's Sign. _____

3. No pipe shall be placed in position until the foundations have been approved by the Engineer-in-charge. Where two or more pipes are to be laid adjacent to each other, they shall be separated by a distace equal to at least half the diametre of the pipe subject to minimum of 450 mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at there cost of Contractor.

4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diametre of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

5. R. C. C. pipe shall be measured along their centre between their inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe 'including loading, unloading, handling storing laying •in position and joining complete.

ITEM-34 Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and jointing the pipes in C. M. 1:2 watering and laying (to level or slope) of I.S. class of NP2 of following internal diameter. (i) 300 mm dia. (ii) 450 mm dia. (iii) 600 mm dia. (iv) 750 mm dia (v) 900 mm dia. (vi) 1050 mm dia (vii) 1200 mm dia.

1. The work shall be carried out as per item of NP3 pipes except that the pipes will be of NP2 class instead of NP3 class conforming to requirements of IS : 458 and of the dia as specified in this item.

ITEM-35 Supplying and fixing NP1 class R.C.C. pipes

1. The work shall be carried out as per item of NP3 pipes except that the pipes will be ordinary irrigation pipes of NP 1 class instead of NP 3 class conforming to requirements of IS:458 and of the dia. as specified in this item. Please see Item No. 53 for detailed information.

ITEM-36 Filling around the pipes with murrum including dressing, tampering etc. complete.

1. Area around pipes shall be filled with murrum, chhara or other gritty material immediately after the pipes have been laid and the joining material has hardened. The material shall be clean, free from boulders large roots, excessive amount of sods or other vegetable matter, and lumps and shall be approved by the Engineer-in-charge. Filling upto 0.3 metre above the top of the pipe shall be carefully done and the soil thoroughly rammed, tampered or vibrated in layers of not exceeding 150 mm. particular care being taken to thoroughly consolidate the materials under the haunches of the pipe. Filling shall be carried out simultaneously on both sides of the pipes in such a manner that unequal pressures do not occur. In case of high embankments, after filling upto the top in the above said manner a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layers are added and compacted. Materials shall be filled in pharas 3m. x 1.5m x 0.5m size and shall be measured in cubic metres. Unit rate includes cost of materials and spreading including labour and tools needed for the above operations.

ITEM-37 Providing and laying ordinary (unreinforced) concrete 1:2:4 (1 cement :2 coarse sand :4 crushed stone aggregate 20 mm nominal size) & curing complete including cost of form work (without reinforcement)

1. In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume as given in table below for different four grades designated as ordinary M.100; M.150; M.200 and M.250.

2. In the designation of a concrete mix .letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in kg./cm.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg.of cement as 0.035 cubic metre in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done, proportioning of sand be as per its dry volume. In case it is damp allowance for bulking shall be made as per IS:2386 (Part III).

4. In gradients required for ordinary concrete cotaining one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of Concrete	Mix by Volume	Total quantity of dry aggregate by volume per 50 Kg. cement to be taken as sum of individual volume of fine % coarse aggregate maximum (1 cubic metre = 1000 Litres)	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 Kg. of cement maximum
1.	2.	3.	4.	5.
Ordinary M200	1:3:6	300	Generally 1 :2 for fine aggregate coarse aggregate by volume but to a upper limit of 1:1.5 and lower limit of 1:3	34
Ordinary M150	1:2:4	220		32
Ordinary M200	1:1.5:3	160		30
Ordinary M250	1:1:2	100		27

***Note :** The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

Example : For an average grading of fine aggregate (that is Zonell of IS:383-1963) the proportions shall be 1:1 1/

2, 1:2 and 1:3 for maximum size of aggregates 10 mm, 20 mm and 40 mm respectively.

Note : A mix leaner than M 100 (1:3:6) may be used for non structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall be the same.

5. Following shall be the maximum nominal size of coarse aggregate for the different items of work.
 - i. Plain C.C. 63 mm
 - ii. Soild type piers, abutments and wing walls, and their per caps. 40 mm
(Coarse aggregate of size upto 40 mm shall be machine crushed.)
 - iii C.C. Wearing Coat M-150 20mm
(Coarse aggregate of size upto 40 mm shall be machine crushed.)

6. Fine aggregate shall be clean, hard coarse sand. It shall be free from dust and such other substanes. The sand shall be got approved by the Engineer-in-charge.

7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work.

8. Cement shall be stored above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that it satisfies the acceptability requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials at edges of the pipes.

9. The water for mixing shall be potable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

10. For all work, concrete shall be mixed in a mechanical mixer along with other accessories shall bekept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and an uniform colour of the entire mass is obtained and each individual particles of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

11. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform. Dry coarse and fine aggregate and cement. Then shall be mixed thoroughly by turning over to mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

12. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the first batch of concrete from the mixer shall contain only two third of normal quantity of course aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge

Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started with 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a

compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.

15. Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted, and cleaned with a 13mm.thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the new surface with wire or bristle brushed. Care being taken to avoid dislodgement of particulars of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corner and close spots.

16. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting under water, where vibrator cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipments is always available in the event of break downs.

17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibrations due to traffic, rapid temperature changes, fast drying put process. It shall be covered with wet sacking hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete . shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Forms for concrete shall be constructed of metal or timber suitably lined and be of substantial and rigid construction true to shape and dimensions shown on the drawings. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provided a smooth, plain surface. Where timber is used it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mark the cement surface of concrete. For exposed concrete faces, limber for shuttering shall be wrought on all faces in contact with concrete.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occuring during and after placing rhe concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of surface specially in long spans to counteract the effects of any deflection. The frame work shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in ihe desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed. Chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of f ram work to avoid sharp corners.

20. The inside surface of forms shall, except in the case of permanet form work or where otherwise agreed to by the Engineer-in-charge, be coated with an approved material to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in form work of concrete which will be visible in the finished works.

21. Special measures shall be taken to ensure that the farmework does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Where applicable arrangements must be made to ensure that the form does not restrain the shortening and hogging of the beams of slabs during tensioning of the tendons. The formwork should take due account of the calculated amount at positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignmnet and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formworks, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete the removal of the load supporting or soffit forms may commence when concrete has attained strength and of the materials used in the ix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads, When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All form work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any stock or vibrations. Supports shall be removed in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the farmwork it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement Concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins cause by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which have been pointed shall be kept moist for a period of 24 hours. If rock, pockets/honeycombs, in the opinion of the Engineer-in-charge are of such an extent and character as to affect structure materially or to endanger the life of the strength of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected. Joint shall be filled up with bitumen as directed by Engineer-in-charge in case of C.C. wearing surface.

24. The unit rate for concrete shall include the cost of all materials, labour, tools and plants required for mixing, placing in positions, vibrating and compacting, finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown in the drawings and according to these specifications. The rate shall also include the cost of making, fixing and removing of all centering and forms required for the work centering.

25. The payment will be made on cmt. basis of the finished work.

Item No. 37 A : Providing & laying C.C.1:4:8 (1=Cement, 4=coarse sand, 8=grade agg 40 m.m. nominal size) and curing comp of form work.

Item No. 37 B : Providing & laying C.C.1:5:10 (1=Cement, 4=coarse sand, 8=grade agg 40 m.m. nominal size) and curing comp. incl. cost of form work.

Materials : Specification for all the ingredients to be used shall be as per the details given in the central specifications for materials attached.

PROPORTION : The concrete shall consist for the part of cement, sand and metal as per (40 to 63 m.m. size) the above description of items.

MIXING : Mixing of the materials shall be done as for specified volumetric proportion as a possible after water is added, so that every place of agg, is uniformly coated by cement plaster. The concrete must be used immediately after it is prepared and in any case shall be used after the cement has attained final set. Generally concrete prepared before more than half an hour shall not be permitted to be used.

LAYING : Consolidation shall be rapidly carried out sufficient labour being employed to permit of ramming reading be spreading etc. being comp. within as short items as possible causing the mortar to cream up in no case shall ramming be prolonged after the cement has been to take its initial sets.

CURING : As soon as the concrete has set sufficiently i.e. after about an hour of laying the surface must be protected from rapid curing out by being covered with at sand wet sunny of where possible curing shall done by forming the shall be allowed pools of water by means of sand pollics. The curing shall be continued or atleast 10 (ten) days broadly two or three weeks and where possible for longer period. The rate includes all necessary equipments, labour etc. Payment shall be made on cubic measurement of cement concrete. The entire work shall be carried out as per the specification for the PWD Hand book Vol. I Page No. 166 to the satisfaction of the Engineer-in-charge.

ITEM-38 Providing and laying ordinary (reinforced) concrete 1:2:4 (1 cement :2 coarse sand :4 crushed stone aggregate 20 mm nominal size) & curing complete (excluding cost of reinforcement)

1. Para 1 to 25 of ordinary concrete [without reinforcement] shall apply.

26. In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency which must depend upon the nature of work and methods of vibration of concrete, shall be determined by regular slumps test. Following test slump. shall be adopted for different types of works:

	Type of work	Stumps where vibrators are used	Stumps Where vibrators are not used.
(i)	Mass concrete in R.C.C foundation, footings and retaining walls.	10mm to 25 mm	80mm
(ii)	Beams, slabs and column simply reinforced	25 mm to 40 mm	100 mm to 120 mm
(iii)	Thin R.C.C. section or sections with congested steel	40 mm to 50 mm	125 mm to 150 mm

Maximum nominal size of the concrete aggregate shall be 20 mm. and shall machine crushed.

Works strength test shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens five of which shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre to concrete or a part thereof. However, if concreting done in a day is less then 15 cubic metre. the minimum number of cubes can be reduced to 6 with the 15 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works test shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer -In charge, when procedure of test given above reveals a poor quality to concrete and in other special cases.

28. All necessary labour, materials, equipment, etc. for sampling, preparing test cubes, curing etc. shall be provided by the contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

29. The average strength of the group of cubes for each day shall be less then the specified works cube strength 20 percent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

30. R.C.C. work shall have exposed concrete surface. Centering design and it erection shall be approved by the Deputy Engineer-in-charge. One carpenter with helper will invariably be kept present through out the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different part as suitable platforms shall be provided so that steel reinforcement in positions is not disturbed. For ensuring proper cover, mortar blocks of suitable oLd shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concerting of important structural members shall always be done in the presence and under the supervision of department person not below the rank of Junior Engineer/ Supervisor/Overseer. After removal of form work and shattering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete of good quality. Plastering shall not be allowed to the exposed face of concrete.

31. In reinforced concrete, the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

ITEM-39 Providing steel reinforcement.

(a) Providing & placing in position mild steel bar reinforcement including cutting, bending, Hooking & tying complete as per details.

(b) High yield strength deformed bars reinforcement.

1. The work shall consist of furnishing and placing iainforcement of the shape and dimensions shown on the drawings or as directed by the Engineer-in-charge.

2. Steel shall be clean and free from loose rust and loose mill scale at the time of fixing in position and of subsequent concreting.

3. Reinforcing steel shall conform accurately to the dimensions given in bar bending schedules shown on relevant drawings. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer-in-charge using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be

bent or straightened in manner that will injure the material. Bars bent during transporting or handling shall be straightened before use on work; they shall not be invariably provided. The radius of the bend shall not be less than twice the diameter of the round bar and length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In the case of bars which are not round and in the case of deformed bars, the diameter shall be taken as the diameter of a circle having an equivalent effective area. The work shall be suitably encased to prevent any splitting of the concrete.

4. All reinforcement bars shall be accurately placed in exact position on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm. in size and conforming to IS : 280 and by using stay blocks or metal chairs, spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals. Bars will not be allowed to sag between supports or displaced during concreting or any of their operations over the work. All devices used for positioning shall be non-corrodible material. Wooden and metal supports will not extend to the surface of concrete except where shown on the drawings. Placing bars on layers of freshly laid concrete as the work progress or adjusting bar spacing will not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, precast mortar block, or other approved device. Reinforcement after being placed in position shall be maintained in clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To protect reinforcement from corrosion, concrete cover shall be provided as indicated on the drawings. All bars protruding from concrete and to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.

5. Bars crossing each other, where required, shall be secured by binding wire (annealed) of size not less than 1 mm, and conforming to IS : 280 in such a manner that they do not slip over each other at the time of fixing and concreting.

6. As far as possible, bars of full length shall be used. In case this is not possible, overlapping of bars shall be done as directed by the engineer-in-charge. When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm or 1.25 times the maximum size of the coarse aggregate which ever is greater, by concrete between them. Where not feasible, overlapping bars shall be bound with annealed steel wire, not less than 1 mm. thickness twisted right. The overlaps shall be staggered for different bars and located at points, along the span where neither shear nor bending movement is maximum.

7. Whenever indicated on the drawings or desired by the Engineer-in-charge, bar shall be joined by couplings which shall have a cross-section sufficient to transmit the full strength of bars. The end of the bars that are joined by coupling shall be upset for a sufficient length so that the effective cross-section at the base of threads shall be standard white iron threads. Steel for coupling shall conform to IS : 226.

8. When permitted or specified on the drawings joints of reinforcement bars shall be butt welded so as to transmit their full strength. Welded joints shall preferably be located at points where steel will not be subject to more than 75 per cent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 per cent of the rods are welded. Only electric arc welds using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work will be accepted. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. Electrodes used for welding shall conform to IS : 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency to test shall be as directed by the Engineer-in-charge.

9. Wastage shall be permitted upto 5 per cent maximum. Useful pieces of steel, as may be decided by the Engineer-in-charge shall be taken back by the Government at issue rate and at P.W.D. Store from where the steel was supplied. All the expenses of loading, carting, unloading and returning the waste will be borne by the contractor.

10. Reinforcement shall be measured in length separately for different diameters as actually used in the work. From the length so measured the weight of reinforcement shall be calculated in tones on the same basis of IS: 1732 even though steel is supplied to the contractor by the Department on actual weightment. Lengths shall include hooks at ends. Wastage and annealed steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

11. Rate for reinforcement shall include cost of all steel, its carting from P.W.D. Store to work site, its bending, placing binding and fixing in position as shown on the drawings and as directed by the Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position, cost of joining as per

approved methods, and all wastage, and spacer bars, and also returning the useful wastage to the Department.

ITEM-40 Providing Cement Pointing on uncoursed/coursed stone/brick wall masonry with cement mortar 1:3 (1 cement :3 sand) (A) Flush Pointing (B) Ruled Pointing

1. For a surface which is to be subsequently jointed, the joints shall be squarely raked out to a depth of 15 mm. while the mortar is still green. The raked joints shall be well brushed to removed dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

2. Cement and sand shall be mixed in proportions as specified in the item. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3. The mixing shall be done intimately by hand-mixing. The operation shall be carried out on a clean watertight platform and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has stiffened because of evaporation of water, the same shall be re-tempered by adding water as frequently as needed to restore the requisite consistency but this re-tempering shall be permitted only with thirty minutes from the time of addition of water at the time of initial mixing.

4. For pointing, the mortar shall be filled and pressed into the raked out joints before giving the required finish. The pointing shall then be finished to proper type given on the drawings. If type of pointing after the mortar has been filled and pressed into the joints and finished off level with the edge of the bricks, it shall while still green be ruled along the centre with a half round tool of such width as may be specified by the Engineer-in-charge. The superfluous mortar shall then be cut off from the edges of the lines and the surface of masonry shall also be cleaned of all mortar.

5. Curing shall be started as soon as the mortar used for finishing has hardened sufficiently not to be damaged when watered. It shall be kept wet for a period of at least 7 days. During this period it shall be suitably protected from all damage.

6. Stage scaffolding shall be approved for the work. This shall be independent of the structure.

7. The work of pointing shall be measured in square metres of the surface treated.

8. The rate for pointing shall include erecting the removal of scaffolding all labour, materials and equipment incidental to complete the pointing, raking out joints, wetting filling with mortar, troweling, point and watering.

ITEM-41 Providing and laying 22.50 cms. thick rubble stone pitching including preparing surface, lying 15 cms thick murrum layer over prepared surface and arranging rubbles on it by hand packing and in level & lined surface in slope camber including filling the interstices between adjacent stone by spalls of proper size & wedged for right packing as directed etc complete without cement pointing.

1. The work shall consist of covering the slopes of guide banks, training works and road embankment with stone or boulders, over a layer of murrum bedding.

2. Stone subject to marked deterioration by water or weather will not be accepted. The stone shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of pitching as specified in the item and thickness of the stone at any place shall not be less by 15% of the thickness specified. The largest stones procurable shall be supplied on site. The sizes of spalls shall be minimum 25 mm and shall be suitable to fill the voids in the pitching. Thickness of the pitching shall be as specified in the pitching item.

(G.C.No. SSR/2080 IB 547/28/C, dated 6th March, 1982)

3. Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 metres to ensure regular straight work and uniform slope throughout. Depressions shall be filled and thoroughly compacted.

4. Murrum for bedding shall be laid over the prepared base and suitably compacted to a thickness 150 mm. Quality of murrum will be as per its relevant specifications.

5. The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimensions are greater than the specified thickness of pitching. The largest stones shall be placed in the bottom courses and for use as headers for subsequent course. When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing. Pitching shall be done in

panles of 3.0 M x 3.0 M with a 30 CM wide and 8 Cm. deeper band all around.

6. Payment shall be made on Square Meter basis of the finished work. If directed by the Engineer-in-charge, for measurement the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking. Preparation of base for laying bedding shall be deemed indicated to the work.

7. The rate shall include the cost of preparing the base, putting to the profiles, providing, laying and compacting the murrum bedding and stone pitching of dry rubble as per embankment slopes to specified thickness, lines, curves, slopes levels and all labour and materials as well as tools and plant required of the work.

ITEM-42 Providing 12 mm thick premoulded asphalt filler joints as per drawings.

1. Open joints shall be constructed at the location as directed by the Engineer-in-charge using a wood strip metal plate or other suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the corners of the concrete. The edge of the concrete, at the joints, shall be well finished. Reinforcement shall not extend across an open joint.

2. When preformed filler is to be provided, the filler shall be placed in correct position before concrete is placed against the filler. The filler material shall form part of the joint and while concreting the slab. Care shall be taken to prevent the former form being displaced, After the work is completed, the exposed face of the joint shall be cleaned of all loose materials sticking to it.

3. The material used for filling expansion joint shall be bitumen impregnated felt. Impregnated felt shall conform to the requirement of IS:1838, and shall be got approved from the Engineer-in-charge. The joint shall consist of large pieces and assembly of small pieces to make up the required size shall be avoided.

4. The expansion joint shall be measured in running metres. Thickness of the expansion joint will be 20 to 25 mm. Width of expansion joint shall be equal to full depth of the slab.

5. The rate shall include the cost of all materials, labour, equipments 'incidental charges for fixing the joints complete in all respects as per these specifications and as shown on the drawings.

ITEM-43 Providing parapet of controlled cement concrete M 150 as per detailed drawing with necessary reinforcement including shuttering laying, vibrating & finishing to line level complete precast consistency.

1. Railings shall not be placed until the centering or false work for the span has been released, and is self supporting. The type of railing to be constructed shall be as shown on the drawing. The railing shall be carefully erected true to the line and grade. Posts shall be vertical with a tolerance not to exceed 6 mm in 3 metres.

2. The portion of the railing or parapet which is to be casting in place shall be constructed in accordance with the relevant specification for reinforced cement concrete. Forms shall either be of single width boards or shall be lined with suitable materials duly approved by the Engineer-in-charge. Form joints in plane surfaces will not be permitted. All moldings, panels in the finished work shall be constructed according to the details shown on the drawings. All corners in the finished work shall be true, sharp and clean cut and shall be free from cracks, spall or other defects.

3. Railing shall be measured in running metres.

4. The rate of railing shall include the cost of all labour, material, tools and plant required, for doing the work complete in all respects in accordance with these specifications, and as shown on the drawing. **ITEM-44 Providing 15 mm thick cement plaster in single coat on brick/Concrete wall for interior plastering up to floor two level finished even and smooth in (i) Cement mortar 1:3 (1 cement :3 sand) (ii) Cement mortar 1:4 (1 cement :4 sand) (iii) Cement mortar 1:6 (1 cement :6 sand)**

1. For a surface which is to be subsequently plastered the joints shall be squarely racked out to a depth of 15 mm, while the mortar is still green. The racked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

2. Cement and sand shall be mixed in proportion as specified in the item, Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3. The mixing shall be done intimately by hand mixing. The operation shall be carried out on a clean watertight platform, and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed thoroughly after addition of water.. In case of cement mortar that has stiffened because of evaporation of water, the same shall be retamped by adding water as frequently as needed to restore the requisite consistent but this retamping shall be permitted only within thirty minutes from the time of addition of initial mixing.

4. Plastering shall be started from top and worked down. All pit/holes shall be properly filled in advance

of the plastering as the scaffolding is being taken down. Wooden screeds 75 mm wide and of the thickness of the plaster shall be fixed vertically 2.5 metres to 4 meters apart to act as gauges and guides in applying the plaster. The mortar shall be laid on the wall between the screeds using the plaster float and pressing the mortar to the raked joints are properly filled.

The plaster shall then be finished off with a wooden straight edge reaching across the screeds. The straight edge shall be worked on the screeds with a small upward and sideway motion 50 mm or 75 mm at a time. Finally, the surface shall be finished off with a plaster's wooden float. Metal floats shall not be used.

5. When recommencing plastering beyond the work suspended earlier the edge of the old plaster shall be scrapped, cleaned and wetted before plaster is applied to the adjacent areas. No portion of the surface shall be left out initially or be patched by later on. The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required by the Engineer-in-charge. The average thickness of plaster shall not be less than the thickness specified in the item with a tolerance of 3 mm thickness which appear in the surface and all portions, which sound hollow when tapped, or are found to be otherwise defective, shall be cut out in rectangular shape and re-done as directed by the Engineer-in-charge.

6. Curing shall be started as soon as the mortar used for finished has hardened sufficiently not to be damaged when watered. It shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages.

7. Stage scaffolding shall be provided for the work. This shall be independent of the structure.

8. The work of plastering shall be measured in sq. metre of the surface treated.

9. The rate of plastering shall include the cost of all labour, materials tools and plant scaffolding and all incidental expenses as described herein above.

ITEM-45 Box cutting of the road surface to proper, slope and camber for making a base for road work including removing the excavated stuff and depositing the road side as directed upto 50 M. lead etc. comp.

1. Specification No. 162 and 553 of P.W.D. Hand book volume II and the following additional specifications shall be applicable here.

2. Cutting shall be done in proper grade & camber as per measurements given. Care must be taken the tall slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level in proper grade and the camber. If extra depth of cutting is done due to negligence of contractor the same shall be refilled with approved quality of materials duly consolidated to the satisfaction of the Engineer-in-charge (without extra cost) Box cutting for soling and metalling in required width the depth shall be done.

3. The stuff received from the cutting shall be utilised for filling cuts and correcting side slopes of bank with all lead and lift as directed. Useful stuff shall be carefully stacked separately as directed.

4. The measurement shall be taken as per cross section measurement of the cutting based on length, breadth, depth measured with tape at every 25 metres interval.

5. The payment shall be made on Cmt. basis.

ITEM - 46 Providing open graded carpet with Premix H.M.P. &-P.F.:

1. The work shall consist of construction in a single course of 20, 25 mm thick open graded carpet on a previously prepared base. Single course shall also include additional material @ 20% to remove unevenness of the existing surface.

Para 1 to 4 of item of semidense carpet (Item -18) shall apply.

5. Proportioning of materials. The material shall be proportioned as quantities given below.

(a) Stone chipping 12 mm size and retained on 10 mm sieve. 67%

(b) Stone chipping 10 mm size passing 12.5 mm sieve and retained on 6.3 mm sieve 33%

Para 6 to 11 of item of semidense carpet (Item -18) shall apply.

12. Open graded carpet shall not be laid during rainy weather or when the base course is damp or wet.

13. The base on which open graded carpet is to be laid shall be thoroughly swept and scrapped clean and free of dust and foreign matter.

14. The work shall consist of application of single coat of bituminous material to an existing road surface preparatory to bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160 degree centigrade to 175 degree centigrade.

15. Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed at the rate specified below. The rate of spread of straight run bitumen for tack coat shall be 5/10 Kg / 10 Sq. metre are for an existing B.T./W.B.M. surface. The binder shall be applied uniformly. The tack coat shall be applied, just ahead of the coming bituminous constructions.

16. The binder content for premixing shall be 3.50/3.28 percent by weight of the total mix unless otherwise specified.

The quantities of aggregate shall be sufficient to yield the specified thickness after compaction.

Para 17 to 35 of item of semidense carpet (Item No. 18) shall apply.

36. The contract unit rate of open-graded carpet shall be paid in full for carrying out the required operations including full compensation for:

1. Making arrangement of control and safety of traffic.
2. Preparation of base.
3. Providing all materials to be incorporated in the works with all lead and lift.
4. All labours, tools, equipments and incidental to complete the works to the specification.

ITEM-47 Providing & laying bituminous mix seal coat surfacing considering 0.66 cmt /1 M.T. with m/c stone chipping as per gradation and asphalt of 4.25% by wt. of mixing by heating asphalt & mixing by continuous batching of hot mix plant and spreading by paver finisher consolidation by power roller & providing & operating plant machineries with cost of fuel, oil, lubricants etc, with sand / dust flushing at 0.30 cmt /100 smt.

1. The work shall consist of constructing in a single course of mix seal surfacing as course on a previously prepared base of carpet, single course shall also include additional thickness. If any, to remove unevenness" of the existing surface.

Para 3 to 4 of item No. 18 shall apply.

5. The aggregates shall be so graded or combined as to conform to the grading as under.

Sieve Designation	Percent by weight passing Sieve for type 'A' Mix seal surfacing
20mm	100
7.75mm	40-85
7.36mm	5-10
75 micron	0-4

Para 6 to 11 of item of Semi-Dense carpet (Item No. 18) shall apply.

12. Mix seal surfacing shall not be laid during rainy weather or when the base course is damp or wet.

13. The base on which mix seal surfacing is to be laid shall be thoroughly cleaned and free of dust and foreign matter.

14. The work shall consist of application of mix seal surfacing of single coat of bituminous material to an existing carpet surface preparatory to, bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160 degree centigrade to 175 degree centigrade.

16. Tack coat for mix seal surfacing shall be applied as the work of laying mix seal surfacing is being preceded by a bituminous open graded carpet.

17. The binder content for pre mixing shall be 4% by weight of the total unless otherwise specified in item of schedule B of the work. Quantity of aggregate shall be sufficient to yield the specified thickness after compaction.

Para 18 to 35 of the item of Semi-dense carpet (item 18) shall apply.

36. The contract unit rate for mix seal surfacing shall be paid in full for carrying out the required operation including full compaction for:

1. Making arrangement of control and safety of traffic.
2. Preparation of base.
3. Providing all materials to be incorporated in the works with all lead and lift.
4. All labours, tools, equipments and incidental to complete the works to the specification.

ITEM-48(A) Providing and laying 20 mm. thick (completed asphalt carpet using asphalt for tack coat at the rate of 5-10 kg./10 sq. mt. using crushed stone aggregates as per the gradation and bitumen at the rate of 3.28% by wt. of total mix for binder using hot mix plant and laid by paver finisher including consolidation by Power road roller providing and operating plant, machineries and equipment, cost of fuel oil, lubricant and charges, including flushing sand @ 0.30 cmt/100 sq. mt. at directed etc. complete.

The specification of this item, shall be the same as per item No. 18 except for aggregate gradation and weather and seasonal limitation which shall be as below and the binder shall be as specified.

2. Table Aggregate gradation for Asphalt carpet.

Sieve Size	% by weight passing the Sieve
20mm	100
10.0mm	70-100
4.75mm	20-40
2.36 mm	0-5

3.1 Weather and seasonal limitation : Carpet shall not be laid during rainy weather or when base course is damp or wet.

ITEM-48(B) Providing and laying 25 mm. thick (completed asphalt carpet using asphalt for tack coat at the rate of 5-10 kg./10 sq. mt. using crushed stone aggregates as per the gradation and bitumen at the rate of 3.28% by wt. of total mix for binder using hot mix plant and laid by paver finisher including consolidation by Power road roller providing and operating plant, machineries and equipment, cost of fuel oil, lubricant and charges, including flushing sand @ 0.30 cmt/100 sq. mt. at directed etc. complete.

The specification of this item, shall be the same as per item No. 18 except for aggregate gradation and weather and seasonal limitation which shall be as below and the binder shall be as specified.

2. Table Aggregate gradation for Asphalt carpet.

Sieve Size	% by weight passing the Sieve
20mm	100
12.5mm	70-100
10.0mm	20-40
4.75 mm	0-5
2.36mm	

3.1 Weather and seasonal limitation : Carpet shall not be laid during rainy weather or when base course is damp or wet.

ITEM-49 (1) Surface dressing one coat with paving bitumen using 18 kg. bitumen per 10.0 Sq.m. with 0.15 cum of Stone chipping 12 mm. nominal size per 10.0 sq.m of road surface excluding rolling and consolidation (stone chipping and bitumen shall be paid separately).

(2) Surface dressing in two coats with bitumen using 18 Kg. per 10sqm. with 0.15 sqm of stone chipping 12mm nominal size per 10sqm. for first size 11kg. of bitumen with 0.10cum of stone chipping 10mm nominal size per 10sqm. of road surface for second coat excluding consolidation etc. complete, (stone chipping and bitumen shall be paid separately)

1. DESCRIPTION

This work shall consist of the application of one coat of surface dressing, consisting of a layer of bituminous binder sprayed on a base prepared previously followed by a cover of stone chipping properly rolled to form a wearing course to the requirements of these specifications.

2. MATERIALS

2.1 Stone chipping : The machine crushed B.T. stone chipping shall consist of fairly cubical fragments of clean, hard, tough and durable rock of uniform quality throughout. These shall be obtained by crushing B.T.stone. The chipping shall be free of elongated or flaky pieces, soft or disintegrated stone, salt, alkali, vegetable matter, dust and adherent coatings.

2.2 Binder : The binder shall be straight run bitumen of 80/100 or 60/70 penetration and satisfying the requirement of I.S. 73 or other type of bitumen as may be approved by the Department.

Necessary storage arrangements i.e. provision of tanks etc. for bulk asphalt shall be done by the contractor without any extra charges.

In the case of bitumen is to be supplied by Department in bulk at the rate and place shown in Schedule "A" for bulk asphalt, contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site. according to requirement. If the asphalt is supplied as bulk on plant site, the rate of conveyance for lead difference from store to plant site shall be recovered at S.O.R. for Qty of asphalt supplied.

2.3 Keeping Records : The Department shall keep a day account of the supply and use of the asphalt in separate bound register having numbered pages in the proforma prescribed by the Department. Day to day signature of the responsible contractor or his representative as may be directed by Engineer-in-charge shall be obtained in this register. The register shall be maintained by the Department and shall be produced with each bill.

TABLE
Physical requirements of aggregates

1	Los Angeles Abrasion Value*	IS : 2386 (Part IV)	40% Maximum
2	Aggregate Impact Value*	-do-	30% Maximum
3	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4	Stripping Value	IS : 6241	25% Maximum
5	Soundness		
	(i) Loss with Sodium Sulphate 5 cycles		12%
	(ii) Loss with Magnesium		18%
6	Water Absorption	IS : 2386 (Part III)	1% Maximum

* Aggregate may satisfy requirements of either of the two tests.

Note : If crushed slag is used, Clause 404.2.3 shall apply.

Requirements of stone chipping and binder content for surface dressing for 10 sq. mt.

Sr. No.	Type of Construction	Nominal size of stone chipping	Specifications percent passing through Sieve and retained on Sieve	Quantity of materials	Binder content
1.	Single coat surface dressing of first coating of two coat surface coating	12 mm	Passing 20 mm Sieve & Retained on 10 mm Sieve	0.15 CM	18kg
2.	Second Coat of two coat surface dressing	10 mm	Passing 12 mm Sieve & retained on 4.5 mm sieve	0.10 CM	11 kg

3. CONSTRUCTION OPERATION

3.1 Weather & seasonal limitations : The surface dressing work shall be carried on only when the atmospheric temperature in shade is above 15° C. No bituminous materials shall normally be applied when the surface of cover material is damp when the weather is foggy or rainy or during dust storms.

3.2 Preparation of base : The base on which surface dressing is to be laid shall be prepared, shaped and conditional to the specified lines, grade and cross section as directed by the Engineer-in-charge.

The surface shall be thoroughly swept and scraped clean of dust and any other extraneous matter before the spraying of binder. As necessary the clean; g shall be Hone first with hard brushed, then with softer brushes and finally by blowing with sacks or gunny bags.

3.3 Application of binder: Binders shall be heated to 163° C to 177° C. and sprayed on the dry surface in uniform manner with the help of self-propelled mechanical sprayers having, self-heating arrangement and bitumen pressure pump and spray nozzle bar capable of spraying bitumen uniformly at specified rate as given in above table. Excessive deposits of binder caused by stopping or starting of the sprayer or Through leakage or any other reasons shall be suitably corrected before the stone chipping are spread.

3.4 Application of stone chippings : The cover material i.e. machine crushed B. T. chips of 11.2 mm. nominal size shall be stacked on road side by filling standard boxes of 2.0 m x 1.50 m x 0.50 m the measurement shall be recorded in the measurement book after collection in two kilometre length is complete. The material shall be cross checked by another D.E.E. as per rules. There after, the spreading shall be allowed. The permission of Engineer-in-charge shall be obtained before spreading.

Immediately after the application of binder, stone chippings in a dry and clean, state shall be spread uniformly on the surface, preferably by means of mechanical gritter, otherwise, manually so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform spread of chippings.

3.5 Rolling : Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tones three wheeled roller. Rolling shall commence at the edges and progress towards the centre except in supper elevated portions, where it shall proceed from the inner edge to the other. Each pass of the roller shall uniformly be not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up irregularities. Rolling shall continue until aggregate particles are firmly bedded in the binder and present a uniform closed surface.

3.6 Application of second coat of surface dressing : Where surface dressing in two coats is specified the second coat shall be applied immediately after laying the first coat. The operation shall be the same as describe in para 8.3.3 to 8.3.5.

4. OPENING TO TRAFFIC

Traffic shall not be permitted to run on any newly surface dressed area until the following day. In circumstances, however, the Engineer-in-charge may open the road to traffic immediately after rolling, but in such cases its speed shall be limited to 16 k.m.per hour till the following day.

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to requirements of M.O.'S.T. No. 902 Specification. Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with section 900.

6. ARRANGEMENTS FOR TRAFFIC

During the period of construction flow of traffic shall be maintained as per clause-112.

7. MEASUREMENTS FOR PAYMENT

Surface dressing shall be measured as finished work in square metres.

8. RATE

The contract until rate for surface dressing shall be payment in full for carrying out the required operations including full compensation for all components listed in item No. 1 para 2.8

ITEM 50 Providing & laying with built up spray grout (B.S.G.) base course in one layer with asphalt for tack coat at rate of 5kg/10sq.mt and then bitumen at the rate of 15kg/10sq.mt. with 0.50 CMT aggregate per 10 SMT of road surface for first layer and then spraying over it key aggregate at the rate of 0.13 cmt per. 10 smt. including rolling and consolidation.

1. Description :

This work shall consist at a one layer/two layer composite construction of compacted crushed coarse aggregates with application of bituminous binder after each layer and key aggregates on the top of the second layer, in accordance with requirement of these specifications and in conformity with the lines, grades and cross-sections shown on the drawing or directed by the Engineer-in-charge.

2. Materials :

2.1 Binder: The binder shall be straight run bitumen of a suitable grade, 60/70 or 80/100 as directed by the Engineer-in-charge, satisfying the requirements of IS-73 or approved cutback.

2.2 Aggregates : The aggregates shall, durable, of fairly cubical shape and free of disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set fort in Annexure-B except that the upper limit for Los Angeles Abrasion Value and Aggregate impact Value shall be 50 and 40 respectively. The coarse and key aggregates for built-up spray grout shall conform to the gradings given below.

Gradings requirements of coarse and key aggregates for built-up spray grout.

Sieve Designation	Percent by weight passing the Sieve	
	Coarse Aggregate	Key Aggregate
50.0 mm	100	-
25.0 mm	35-70	—
20.0 mm	—	100.0
12.5mm	0-15	35-70
4.75 mm	-	0-15
2.36 mm	0-5	0-5

3. Construction Operations

3.1 Weather and seasonal limitations : Built-up spray grout shall not be constructed during rainy weather, when the base is damp or wet or when the atmospheric temperature in shade is 16° C or below.

3.2 Preparation of base : The base on which built-up spray grout is to constructed shall be prepared, shaped and conditioned to the specified lines, grades and cross-sections as directed by the Engineer-in-charge. The surface be thoroughly swept and scrapped clean of dust and other foreign matter.

3.3 Tack coat : A tack coat as per item No. 21 para 3.3 shall be applied over the base preparatory to construction of the spray grout course.

3.4 Spreading and rolling coarse aggregates : Immediately after the application of tack coat the coarse aggregates in a dry and clean from shall be spread uniformly, and evenly at the rate of 0.5 cum per 10 Sq. m. area. The surface of the layer shall be carefully checked with templates and all high and low spots remedied by removing or adding as may be required.

Immediately after spreading of the coarse aggregates, dry rolling shall be done with a 8-10 tonne smooth wheeled roller. Rolling shall commence at the edge and progress towards the centre except in super-elevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass.

After initial rolling the surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate followed by rolling.

Rolling shall be stopped before voids in the aggregate layer are close to such an extent as to prevent free and uniform penetration of the binder.

3.5 Application of binder - First spray : The binder shall be heated to the temperature appropriate to grade of bitumen approved by the Engineer-in-charge and sprayed on aggregate layer at the rate of 15 kg/10 m² (in terms of straight-run bitumen) in a uniform manner with the help of mechanical sprayers. Excessive deposits of caused by stopping or starting of the sprayers or through leakage or any other reason shall be corrected promptly.

3.6 Spreading and rolling for coarse aggregate for the second layer : Immediately after the first application of binder the second layer of coarse aggregates shall be spread and rolled to 3.4 above.

3.7 Application of binder - second spray : The second aggregate layer shall then be given a binder spray at the rate of 15 kg /10 m² (in terms of straight-run bitumen) to 3.5 above.

3.8 Application of key aggregate : Immediately after second application of the binder key aggregate in a clean and dry state shall be spread uniformly at the rate of 0.13 m³ / 10m² so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform application of the key aggregates. The entire surface shall then be rolled with a 8-10 tonne smooth wheeled roller. While rolling is in progress, additional key aggregates where required shall be spread by hand. Rolling shall continue until the entire course is thoroughly compacted and the key aggregates are firmly in position.

4. Surface Finish and Quality Control : The surface finish of construction shall conform to the requirements of 902 of M.O.S.T.

5. The built-up spray -grout shall be provided with final surfacing without any delay.

6. Arrangements for Traffic : During period of construction, arrangements of traffic shall be done as per para 112 of M.O.S.T. Specification.

7. Measurements for Payment : Built-up spray grout shall be measured as finished work in square meters.

8. Rate : The contract unit rate for built-up spray grout shall be payment in full for carrying out the required operations including full compensation for all components as follows :

(1) Providing all materials to be used in the work including royalty charges, fees, rent where necessary with all lead & lift.

(2) All labour, tools, plants, equipments and incidental to complete the work to the specification.

(3) Providing and maintaining diversion and controlling traffic.

Asphalt if used less than as specified on account of deviation in tack coat or modification in rate of asphalt consumption in the item, it will be recovered at the rate as mentioned in Schedule "A" for quantity used less.

ITEM-51 Providing & Laying L.C.C. from working foundation & plinth.

(A) Providing and laying C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregates, of 40 mm. nominal size) & curing etc. complete excluding cost of form work in foundation & plinth.

Material : The specifications for graded stone shall be as per details given in the General Specification for materials attached.

Proportions : The concrete shall consist of one part of Cement, Five parts of Sand and Ten parts of Metal (40 to 63 mm size)

Mixing : Mixing of the materials shall be as thorough as possible after water is added so that every pieces of aggregate is uniformly coated by cement. The concrete must be used immediately after it is prepared and in no case shall it be used after the cement has achieved final set. Generally concrete which has been standing for more than half an hour shall not be permitted to be used.

Laying : The concrete must be laid gently (not dumped from height) as not to permit the segregation of the concrete.

Consolidation : Consolidation shall be strictly carried out. Sufficient labour shall be employed to permit ramming, rodding, spreading etc. being complete within as short time as possible causing the mortar come up. In no cases shall ramming be permitted after the cement has begun to take initial set.

Curing : As soon as the concrete has set sufficiently i.e. about an hour of laying the surface must be protected from rapid drying out by being covered with sand quarry dust or where possible the curing shall be done by forming pond. The watering shall be continued for at later 10 (Ten) days usually two to three weeks and where possible for longer period.

The rate includes all necessary equipment etc. complete., Payment shall be made on cubic measurement of concrete

The entire work shall be carried out as per the specification for PWD HandBook Vol. 1 to the satisfaction of the Engineer-in-charge.

(B) Providing & laying L.C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded brick bats of 40 to 50 mm. nominal size) & curing complete excluding cost of form work in foundation and plinth.

The specification shall be same as per item No. 51 (A) except that coarse aggregate shall be brick bats of 40 mm to 50 mm nominal size instead of graded metal.

(C) Providing & laying L.C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40 to 63 mm. nominal size) including curing etc. complete excluding cost of form an work in the foundation and plinth.

The specification shall be same as per item No. 51 (A).

ITEM - 52 White washing :

White washing with lime on wall surface two coat to give an even shade including thoroughly brooming the surface to remove all dirt, and mortar drops and other foreign matter.

1. General : Lime shall be hydraulic lime of approved quality.

The slaked lime, if stored, shall be kept in a weather proof and damp roof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any ways shall be rejected and all rejected materials shall be removed from site of work.

2. Workmanship : The lime shall be slaked at site and shall be mixed and stirred with about five liters of water and 1 Kg of unslaked lime to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be added to each cubic meter of lime cream. Small quantity of ultra marine blue shall also be added to the last two coat of white wash solution and the whole solution shall be stirred thoroughly before use.

3. Preparation of surface : The surface shall be thoroughly cleaned of all dust mortar dropping and other foreign matter before white wash is to be applied. Oil or grease spots shall be removed by suitable chemicals and smooth, surface shall be rubbed with wire brush.

All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly.

4. Application of white wash : On the surface so prepared the white wash shall be applied with brush. The first stroke of the brush shall be from top to downwards and another from bottom to upwards over the first stroke and similarly one stroke from the right and another from the left over the first stroke before it dries.

Each coat shall be allowed to dry before next coat is applied number of coats as specified in item shall be applied.

5. Mode of Measurement & Payment : All work shall be measured in the decimal system i.e. in sq. meters. Deduction for pipe openings shall be made fully both sides of openings. The rates shall includes the cost of all materials, labour, scaffolding protective etc. involved in all the operations described. The rate shall be for a unit of one sq. meter.

ITEM-53 Providing and fixing 4" (100 mm) dia, G.I. water spouts 2'6" long in CM necessary iron grating as per design etc. complete (10 CM dia pipe)

The galvanized water spouts of the size 10 cm dia and the Galvanize iron gritting shall be of the approved quality and type, and shall be first got approved from the Engineer-in-charge before actual use.. The G.I pipe shall be of sufficient length projecting. Out beyond the concrete surface for sufficient discharge. Iron grating shall be fixed rigidly into the concrete. The galvanized pipe iron as well as gratings shall be painted with two coats of anticorrosive paint.

The measurement shall be recorded and paid on the basis of each No. of pipe fixed in position. ITEM-54 Providing and fixing 30 cm x 22 cm x 2.5 cm thick year plate of marble stone set in cm 1:4 including finishing and engraving letters etc complete.

Providing and fixing 30 cms x 22 cms x 2.5 cms No and year plate of marble and of standard lettering with leads or paint including finishing etc. complete

Marble plate shall be white and of approved quality and shall be 25 mm thick and of standard size as

directed by the Engineer-in-charge of the work.

Lettering shall be done by U-shape engraving and shall be filled with black paint of approved quality. Lettering shall be done as directed by the Engineer-in-charge. The marble plate shall be fixed in neat cement at a place as directed by the Engineer-in-charge. Cement shall conform to relevant I.S. specification.

Measurement shall be per number of marble plate fixed.

Unit rate includes cost of all material, labour etc. for complete work.

ITEM-55 Numbering the C.D. works with approved paint including all materials for painting etc. complete.

Numbering the C.D. works shall be carried out as per relevant I.R.C. specification. Oil paint of approved quality and make shall be used for the purpose. Numbering shall be very neat and clean Arrow shall be marked on the Head wall in the correct direction of flow of water. Payment shall be made on the number basis. Unit rate includes the cost of all materials, labours for painting & lettering as directed by Engineer-in-charge.

ITEM-56 Providing and fixing junction Board of R.C.C. precast as per standard design of I.R.S. including fixing in C.C. block of 1:4:8 with necessary excavation enamel painting, lettering figures etc. complete.

1. These boards should be fixed at a distance of 120 metre from the centre line of the crossing and they should be located on the left hand side of the road in the direction of the traffic and facing the traffic.

2. The board will be located in such a way that the edge of the board towards the centre of the road will be at a distance of 4.57 metres from the centre of a National Highway and 3.66 meters from the centre of State Highway or Major District Road.

3. The bottom of the board should be 1 metre above the road surface and the board shall be at right angle to the centre line of the road facing the direction of traffic.

4. The board shall be of the size of 107 c.m. in length and 91 c.m. in height for "T" and "Y" junctions shall be 145 C.M. in length and 91 C.M. in height for cross roads.

5. The board shall be painted by two coars, the Board and posts shall be R.C.C. as shown in the type design.

6. The post shall be fixed in concrete and the projection of this above the road level shall be 45 cm x 45 cm and height of 24 cms. above the road level and the top to be finished in plaster from the height of 15 cm.

7. The size of letter and figures shall be 8 cm. for English and 10 C.M. for devnagri and Gujarati scripts.

8. The post shall be painted in black and white reflective strips 23 cm. in height.

9. The board shall be painted in white with border 2 C.M. wide.

10. On this board tablets shall be painted in yellow with black and the tablets shall have 5 cm. clear distance from the board,

11. Each such tablet shall be 61 cm. in length and 33 C.M. in height, arrow lines indicating the direction of the road at the junctions shall be painted in black and shall have a thickness of C.M. for National Highway and 4 C.M. on a State Highway and aC.M. for a Major district road.

12. All letters and figures shall be painted in black.

13. The work shall be carried out as per design as per the instructions of the Engineer-in-charge. The measurements shall be recorded and paid on number basis for board fixed in position.

ITEM-56 A Providing & fixing Board of M.S. Plate with two angles iron post and fixing in C.C. Concrete 1:4:8.

The size of the board shall be 110 cm in length & 60 cm in height. It shall be prepared from M.S. Plate of 6 mm thickness. The angle iron post shall be of size 75 mm x 75 mm and 6 mm thick. The length of iron post shall be 2.1 metres. The post shall be fixed to the board by welding. The welding shall be true and strong and neat in appearance.

The board shall be fixed in C.C. 1:4:8 concrete. The concrete block for each post shall be 30 cm x 30 cm in size. The depth of the concrete block shall be 85 cm of which 60 cm will be below ground and 25 cm above ground level. The exposed concrete block i.e. its portion above ground level shall be neatly finished and its shape should be truly square.

The post shall be painted with two coats of paint, alternatively in black & white strips 23 cms in height after applying one coat of anticorrosive paint. The paint shall be of approved quality. The board shall be painted with colour, as directed by Engineer-in-charge. The information as per instruction of Engineer-in-charge shall be written on board with letters & signs in accordance with I.R.C. The information may be one or more of the three script, viz. Hindi, English & Gujarati.

The board shall be fixed truly vertical & workmanship of the board shall be neat, clean & good in

appearance.

The measurement for payment shall be for number of board fixed in position & complete in all respect. The unit rate includes cost of material, labour, tools, welding, concreting, painting, lettering etc.

ITEM-57 Providing & fixing Boundary stone as per I.R.C. type design including painting, carving, lettering etc. complete. (i) Fixing in earth / Fixing in C.C. 1:5:10

1. Boundary stone shall be of the size 20 x 15 x 75 cms. true to all the faces.
2. Boundary stones shall be neatly finished shall be chisel dressed on all the sides and at top.
3. Boundary stones shall be fixed at the border line of acquired length so that the land width is properly demarcated. The width between boundary stones shall be fixed at a distance of 330 feet (100 mt.) a part in the direction of length of the road.
4. The letter B.B. of (Border) as directed by the Engineer-in-charge shall be carved on the face of the boundary stone & letter shall be painted with black Japan.
5. The measurement shall be recorded per No. of boundary stone fixed in position and paid accordingly.

ITEM-58 Clearing the site before commencement and after completion of the work :

1. Before starting the work, the site shown on plans shall be cleared of all obstructions, loose stones and materials, rubbish of all kinds as well as all trees and brush wooden except those marked for preservation, the roots being entirely grubbed up. No trees are to be cut down before obtaining the instruction from Engineer-in-charge.
2. The stuff obtained from clearance shall be stacked in such a place and in such a manner as ordered by the Engineer-in-charge and the ground shall be left in a perfectly clean condition.
3. In jungle clearing, all trees, not specifically marked for preservation, bamboos, jungle wood and brush wqod shall be cut down, their roots rubbed up. Alt wood and material available as directed by the Engineer-in-charge.
4. All holes or hollows, whether originally or produced by digging up roots shall be carefully filled up with earth, well rammed and leveled up neatly as directed.
5. After completion of the work, but before its acceptance, the site shall be cleared of all scaffolding, surplus materials and rubbish etc. as per contract. No extra payment shall be made for site.
6. The rate for this item of work shall be for the complete job and shall be paid at the lump sum rate tendered for the work on completion of the entire work.

ITEM-59 Supplying and fixing rough kota stone 60 to 80 mm size including fixing in line & level etc. complete.

The stone to be used shall be approved quality kota stone. It shall be sound, hard, durable and fairly regular in shape and its thickness of the stone at any place shall not be less by 15% of the thickness specified. The stone shall be laid in line and level with camber as directed & set properly in sand. The whole work shall be generally carried out to the entire satisfaction of Engineer-in-charge of the work. The rate shall include the cost of all materials and labour involved in all the operations described above. The kota stone flooring shall be measured in square metre correct to two places of decimal. Length and breadth shall be measured correct to be centimeter & between the finished faces of skirting or Dado and no deduction shall be made for extra paid for any opening in floor of a unit of one Sq. M.

ITEM-60 Providing & laying Kota stone for kerbing on both sides of stone paving Incl. fixing kota stone kerbing in 0.30 Mtrs.. depth (Kerbing stone of 60 to 80 MM thick size)... etc. complete.

The stone shall be of approved quality kota stone. Specifications for the materials & laying as per item No. 59 above. The rate shall per unit of one Rmt. ITEM-61 Supplying and stacking hard murrum on site of work etc. as directed.

1. Hard murrum should be of approved quality. Any material which is found inferior shall be rejected and contractor shall remove such rejected material from the site at his own cost. The material of Hard murrum shall be collected from quarries approved by the Executive Engineer.
2. The materials shall be got approved by the Executive Engineer prior to collection on site and shall be free from all, rubbish, dust and any organic materials as well as clods of black cotton soil. Material shall bot be allowed to be collected from within the road boundary. The materials to be used shall be got tested prior to its use in road construction.

For road work complete stacking of materials as per requirement shall be carried out in 2 K.M. length before spreading. The materials stacks shall be got cross checked by other Deputy Executive Engineer as per rules before

spreading. The collection shall always commence at one end of K.M ana be carried continuously towards the other end

The materials shall be stacked by filling standard boxes of size 2m x 1.5m x 0.5m on a fairly level ground. It shall be stacked on road land beyond the top of the bank and on a level ground. The rate includes supplying the hard murrum with all lead and lift on road site and stacking the same in regular pharas of the required dimensions. Materials shall be collected in required quantity only at required site of work.

The payment shall be made on cubic metre basis.

TEM-62 White stone Bela masonry in C.M. 1:5 including curing etc. complete.

The stone shall be fine dressed chisel draft one incl. the drafts on all beds and joints.

The stone shall be laid in regular course. The height of the course shall be as approved by the Executive Engineer. All the course shall be of same height unless otherwise ordered but no course will be thicker than any course below it. No stone shall be less in breadth than in height and less in length than twice the width.

The stone shall break the joints in each course and to carried out in cement mortar 1:6 and thickness of the joints shall not be more than 10 mm. The side joints and beds of all stone shall be vertical and horizontal respectively and all stones shall be rough, true and square.

The work shall be measured and paid for cubic measurements of the work carried out as per approved | drawing or as directed by the Engineer-in-charge.

ITEM-63 40 mm. thick asphalt carpet :

1. This work shall consist o1 laying an open graded carpet ot 40 mm thickness in a single course and seal coat (excluding cost of asphalt) composed of suitable small sized aggregates premixed with a bituminous binder on a previously prepared basis.

2. The materials shall be proportioned as per quantities given within the following table.

Quantities of materials required for 10 Smt. of road surface for 4 cm. thick open graded premix carpet with seal coat.

Aggregate for carpet:

(A)	Stone chipping-20 mm size	0.27 Cum.
(B)	Stone Chipping-12 mm size	0.24 Cum.
(C)	Stone Chipping-10 mm size	0.06 Cum.

Aggregate for Seal Coat:

Stone Chipping-6mm size	0.09 Cum.
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Binder for premixing (Quantities in item of strengthenss bitumen)

1.	For Carpet	
(A)	For 0.27 Cum. of 20mm size stone chipping at 48 kg./Cum.	12.96kgs
(B)	For 0.24 Cum. of 12 mm size stone chipping ol 52 kg./Cum	12.48 kgs
(C)	For 0.06 cum of 10 mm size stone chipping at 56 kg/Cum	3.36 kgs

Seal Coat:

For 0.09 Cum. of 6 mm size grit at 80 kg ./Cum	7.20 kgs
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36.00 kgs

3. Carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16% degree centigrade or below.

4. The underlying base on which the bituminous carpet is to be paid shall be prepared, shaped and conditioned to the specified line, grade and cross-section as directed by the Engineer-in-charge. The surface shall be well wire cleaned with brushes. Sweeping with brooms and finally dusting with sacks as necessary.

5. Tack coat : This work shall consist of application of a single coat of bituminous material to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160.0 deg,. centigrade.

6. Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge at the rate specified below. The rate of spread in terms of straight run bitumen shall be 9.75 Kgs per 10 square meter area for a surface untreated water bound macadam surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the oncoming bituminous construction. For the purpose of

calculating consumption wastage of bitumen will not be permitted beyond 2.5% Excess consumption over 2.5% will be charge at penal rate.

7. Mixers of approved type shall be employed for mixirii the aggregates with the bituminous binder. The binder shall be heated to the temperature approved by the Engineer-in-charge, avoiding local overheating and ensuring a continuous supply. The aggregates shall be dried before they are placed in the mixer. After about 15 seconds of dry mixing the heated binder shall be distributed over the aggregates at the rate specified. Kerosene to an extent of 4% to 6% of asphalt shall be provided the contractor according to the requirement at the contractor cost. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of using suitable vehicles or wheel barrows. The vehicle employed for transport shall be clean and be covered over in transit if so directed.

8. The premixed materials shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader, without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evented out. As soon as sufficient length of bituminous material has been laid, rolling shall commence (rolling shall be done departmentally) when the roller has passed over the whole area once any. Stops or depressions which become apparent shall be corrected by removing or adding premixed materials. The contractor shall provide necessary labour for keeping the roller wheels damp during rolling so as prevent the premix from adhering to the wheels and being packed up. The edges both longitudinal and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with thin surface coat of appropriate binder before the new mix is placed against.

9. Seal coat : for preparation of premix and spreading etc. para 7 & 8 above shall apply. The coat shall be applied immediately after the laying of bituminous course of carpet. Before application of seal coat materials surface shall be cleaned free of any dust of other extraneous matter.

10. Coarse sand or stone dust flush in as the rate of 0.03 Cmt/10 Smt. Shall be done on asphalt surface at the contractor's own cost.

11. Traffic may be allowed stood after final rolling when the premixed material had cooled down to surrounding temperature.

12. Control on quality of works shall be exercised by the Engineer-in-charge by carrying out the following tests as shown against each.

Sr. No.	Type of Const. Material	Test	Frequency
1.	Tack Coat	(i) Binder temperature for application (ii) Rate of spread of binder of aggregate	At regular close intervals Two test per day
2.	Open graded premix carpet with seal coat	(i) Temperature of binder at application (ii) Binder Content (vide As/TM:D2172) (iii) Rate of spread o} mixed material	At regular close intervals Two test per day for work of every 3 Km length in one lane Regular control through checks on material and layer thickness.

13. Para 13 to 17 as regards arrangements for traffic para 29 to 33 of semidense carpet shall apply.

18. Open graded carpet and seal coat shall be measured in cubic metres on the basis of stone chips actually used.

19. The contract unit rate for open grade carpet and seal coat (excluding cost of asphalt, stone chips and rolling) shall be payment in full for carrying out the required operation including full compensation for

(1) Preparation of base.

(2) Providing all materials like fuel, lubricants, kerosene and coarse sand or stone dust for flushing with all lead and lifts.

(3) All labours, tools equipment and incidentals.

(4) Making arrangements for control and safety of traffic.

ITEM-64 Providing 75 mm thick premix asphalt macadam using 61 1.00 Kg. Asphalt 10.80 CU.MT. chips for 100 Sq.M.

1. This work shall consist of laying an open graded carpet of 7.5 cm. thickness in a single course and seal coat (excluding cost of asphalt stone chips) composed of suitable small aggregated premixed with a bituminous

binder on a previously prepared base.

2. The materials shall be proportioned as per quantities given in the table.

Quantities of materials required for 100 Smt. of road surface for 7.5 cm. thick open graded premixed carpet.

Aggregate for carpet :			
(A)	Stone chipping	40 to 50 mm size	4.80 Cum.
(B)	Stone Chipping	25 to 40 mm size	3.60 Cum.
(C)	Stone Chipping	12 to 20 mm size	2.40 Cum.
			Total 10.80 Cum.
	Asphalt	61 1.00 Kg per 100 SM.	

3. Carpet shall not be laid during rainy weather or when the base course is damp or whether or when the atmospheric temperature in shade is 16 0 Centigrade or below.

Asphalt Requirement

Size of Chips	Quantity of Chips	Rate of Asphalt	Total Qty. of Asphalt
1. Tack coat	-	73.40 Kg./Cu.m.	73.40
2. 50 to 40 mm	4.80	48.0 Kg./Cu.m.	230.40
3. 40 to 20 mm	3.60	58.8 Kg./Cu.m.	172.80
4. 20 to 10 mm	2.40	56.0 Kg./Cu.m.	134.40
			611.00 Kg.

i.e. 0.611 tones as per 100 Sq. meters.

4. The underlaying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified line, grade and cross section as directed by the Engineer-in-charge. The surface shall be well cleaned with brushes. Swipping with brooms and final dusting with sacks as necessary.

5. Tack coat : This work shall consist of application of a single coat of bituminous material to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in range of 160. 0 deg. centigrade to 175.0 deg. centigrade.

6. Binder shall be heated to the appropriate temperature grade of bitumen used and approved by the Engineer-in-charge at the rate of specified below. The rate of spread in terms of straight run bitumen shall be 611 kgs.. per 100 sq. mt. area. The binder shall be applied uniformly. Wastage of bitumen will not be permitted beyond 2.5%

7. Mixers of approved type shall be employed for mixing the aggregate with the bitumens binder. The binders shall be heated to the temperature approved by the Engineer-in-charge avoiding local overheating and ensuring a continuous supply. The aggregates shall be dried before they are placed in the mixture. After is seconds of dry mixing the aggregates at the rate specified. Kerosene to an extent of 4% to 6% of asphalt shall be provided by the contractor or all to the requirement at the contractors cost

8. The premixed materials shall be spread on the road surface with rates to the ,equired thickness and camber and distributed evenly with the help of a drag spreader, without any induce loss of time. The camber shall be checked by means of camber boards and inequalities evented out. As soon as sufficient length of bituminous material has been laid rolling has pass over the whole area once height, spot or depression which become apparent shall be corrected by removing or adding premixed materials. The contractor shall provide necessary labour for keeping the roller wheels clean during rolling so as to prevent the premix from adhering to the wheels and being packed up. The edge along and of carpet laid and compacted earlier shall be cut to their depth so as to expose fresh surface which will be cut to their full depth so as to expose fresh surface which shall be pointed with a thin surface coat of appropriate binder before the new mix is placed against.

Control on quality of the works shall be exercised by the Engineer-in-charge by carrying out the following tests at the frequencies shown against each.

SR. No.	Type of Const. Material	Test	Frequency
1.	Tack Coat for application	(i) Binder temperature (ii) Rate of spread of binder	At regular close intervals Two test per day
2.	Open graded premix carpet with seal coat	(i) Temperature of binder at application (ii) Binder Content (videAs/TM:D2172) (iii) Rate of spread of mixed material.	At regular close intervals Two test per day for work of every 3 Km length in one line. Regular control through checks on material and layer thickness.

13. Para 13 to 17 as regards arrangements for traffic para 29 to 33 of semidense carpet shall apply.

18. Open graded carpet and seal coat shall be measured in cubic metres on the basis of stone chips actually used.

19. The contract unit rate for open grade carpet and seal coat (excluding cost of asphalt, stone chips and rolling) shall be payment in full for carrying out the required operation including full compensation for

(1) Preparation of base.

(2) Providing all materials like fuel, lubricants, kerosene and coarse sand or stone dust for flushing with all lead and lifts.

(3) All labours, tools, equipment and incidentals.

(4) Making arrangements for control and safety of traffic.

ITEM-65 Earthwork in cutting including preparing the slope and camber and stacking or utilising the cutting stuff in bank as directed up to 200 mt. from the end of cutting with all lead and lift (i) Hard Murrum

(1) Para 1 to 8 of Item "Earth work in cutting in all sort of soil" shall apply except that the work shall be carried out in hard murrum.

(9) Earth work in cutting shall be made in hard soil such as stiff heavy clay, hard shale or compact murrum, requiring grafting tool or pick or both and shovel, closely applied and gravel and rubble stone having maximum diameter direction between 75 and 300 mm and soft conglomerate. The classification of cutting shall be decided by the Engineer-in-charge and his decision shall be binding on the contractor. Mode of measurement shall be measured after removal of over burden by tucking cross section at suitable intervals in the original position before the work starts and after its completion areas. Payment shall be made in CMT basis. The rate shall include the cost of labour tools to complete the job.

ITEM - 66 U.C.R. Masonry for super structure in C.M.:

Para* 1 to 14 item No. 30 of the roads specification booklet shall apply for the work of this item.

ITEM-67 Earthwork in cutting including preparing the slope and camber and stacking or utilising the cutting stuff in bank as directed up to 200 mt. from the end of cutting with all lead and lift (i) Soft Roack (not requiring blasting)

(1) Para 1 to 8 of Item "Earth work in cutting in all sort of soil" shall apply except that the work shall be carried out in soft rock.

(9) Earth work in cutting shall be in soft rock such as lime stone, sand stone, limestone, hard conglomerate or other soft rock which may be quarried or split with crow bars, boulders which do not require blasting and any rock which dry state may be hard, requiring blasting but which when wet becomes soft and manageable by means other than blasting. The classification shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.

(10) Mode of measurement shall be measured after removal of over burden by taking cross sections at suitable intervals in the original position the work starts and after its completion and computing the volumes in cubic meter by method of average and areas, payment shall be made on CMT basis. The rate shall include the cost of labour, tools to complete the job, Name of the works :

ITEM-68 Supplying and Stacking Rubble on site of work etc. as directed.

The stone shall be hard, sound free from cracks decay and weathering and shall be freshly quarried from and approved quarry stone with round surface shall be used. The stone when immersed in water for 24 hours shall not absorb water by more than 5 percent of their dry weight when tested in accordance with I.S. : 1124. The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourth of the thickness of wall. The rubble shall be stacked on fairly levelled ground.

Slacking shall be done as per the instruction given by Engineer-in-charge. 15% deductions for voids shall be made from the gross measurement. The payment shall be made on cubic meter basis.

ITEM-69 Carting and stacking of scarcity hand broken metal on site with all lead including filling the boxes.

The stone metal shall be obtained from stacking of security metal which is broken in previously scarcity period carting shall be done as per instruction of Engineer-in-charge.

Stacking shall be done by filling the standard steel boxes of 2m x 1.5 m x 0.5 m size which shall be supplied by the Department, if available, on rent otherwise contractor shall make his own arrangement and no.

deduction for voids shall be made from the gross measurements. Where any doubt exists as to whether the quantity of stacks of metal in any hectometer is not confirming with the cubical content of the standard para (2m x 1.5m x 0.5 m) shall be got corrected by the contractor, if so order by the Engineer-in-charge, for which extra payment shall be claimed by the contractor. If the quantity of metal in any stack in particular Hectometer is found to be less than the standard measurement viz 1.5 cm, the entire collection the Hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge. The standard size box measurement for aggregate will be recorded as final and no subsequent change will be permitted.

The payment shall be made on cubic meter basis without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole materials are collected, measured and finally accepted by the Department. The rate includes conveyance to the site with all load and lift and filling the boxes including all labour, tools, equipment and other incidental expenses.

ITEM-70 Providing and laying 50 mm thick compacted bituminous macadam with tack coat at 5 kg/10 sq. mt. using stone aggregate as per M.O.S.T. gradation specification and asphalt mixing at the rate of 4% (40 kg/M.T.) using hot mix plant and spreading the same with paver finished including consolidation with power rollers including fuel, labour charges, equipments etc. complete.

1. DESCRIPTION

The work shall consist of construction, in a single course, of 50 mm/75 mm thickness of compacted crushed aggregates premixed with bituminous binder, laid immediately after mixing, on a base prepared previously in accordance with the requirement of these specification and in conformity with lines, grades and cross sections shown on the drawings or as directed by the Engineer-in-charge.

2. MATERIALS

2.1 Binder : The binder shall be straight run bitumen of a suitable grade as directed by the Engineer-in-charge complying with IS : 73

2.2 Aggregates :-The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable of fairly cubical shape and free of disintegrated pieces, organic and other deleterious matters and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity. The aggregates shall satisfy the physical requirements set forth in Table hereafter.

Table-1 PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

1	Los Angeles Abrasion Value*	IS : 2386 (part IV)	35% Maximum
2	Aggregate Impact Value*	-do-	30% Maximum
3	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4	Stripping Value	IS : 6241	25% Maximum
5	Water Absorption	IS : 2386 (Part IH)	2% Maximum

* Aggregates may satisfy requirements of either of the two tests.

The aggregate for bituminous macadam for different thicknesses shall conform to the Grading A or B given in Tables 2 and 3. The actual grading to be used shall be specified in the contract).

TABLE 2 AGGREGATES GRADING FOR 75 mm COMPACTED THICKNESS OF BITUMINOUS MACADAM

Sieve Designation	Percentage by wt passing through Sieve	
	For type 'A'	For Type 'B'
63 mm	100	-
50mm	90-100	-
40 mm	35-65	100
25 mm	20-40	70-100
20 mm	-	50-80
12.5mm	5-20	-
4.75 mm	-	10-30
2.36 mm	-	5-20
75 micron	0-5	0-4

TABLE 3 AGGREGATES GRADING FOR 50 MM COMPACTED THICKNESS OF BITUMINOUS MACADAM

Sieve Designation	Percentage by wt passing through Sieve	
	For type 'A'	For type 'B'
50 mm	100	—
40mm	90-100	-
25 mm	50-80	100
20 mm	-	70-100
12.5 mm	10-30	-
10 mm	—	35-60
4.75 mm	-	15-35
2.36 mm	—	5-20
75 micron	0-5	0-4

2.3 Proportioning of materials : The binder content for pre mixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate grading A and B respectively, except when otherwise directed by the Engineer-in-charge. The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

2.4 Variation in proportioning of material : The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content of ± 0.3 percent by weight of total mix shall, however, be permissible for individual specimens taken for quality control tests vide Section 900*.

3. CONSTRUCTION OPERATION

3.1 Weather and seasonal limitation : Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of the base : The base on which bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross sections in accordance with Clause 501*, as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free from dust and foreign matter.

3.3 Tack coat : A tack coat as per Clause 503* shall be applied over the base except when the laying of bituminous macadam is being proceeded by a bituminous leveling course.

3.4 Preparation and transport of mix : Hot mix plant of adequate capacity shall be used for preparing the mix.

The temperature of binder at the time of mixing shall be in the range of 150° to 165° C, Provided that the difference in temperature between the binder and aggregate at no time exceeds 25° C.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly.

The mixture shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be dean and be covered over in transit if so directed by the Engineer-in-charge.

3.5 Spreading : The mix shall be spread immediately after mixing by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grade and cross sections. However, in restricted and in narrow widths, where the available plants cannot operate in the opinion of the Engineer-in-charge, he may permit manual laying of the mix.

The temperature of the mix at the time of laying shall be in the range of 110° to 135° C. In multi layer construction the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the most layer shall be at the center line of the pavement.

Longitudinal joint and edges shall be constructed true to the delineating line parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen placing fresh material.

3.6 Rolling : After the spreading of mix, rolling shall be done by 8 to 10 tonne power rollers or other approved plant. Rolling should start as soon as possible after the material has been spread. Rolling should be done with care to keep from unduly roughening the pavement surface.

Rolling of the longitudinal joints shall be done immediately behing the paving operation. After this the rolling shall commence at the edge and progress towards the centre longitudinally except that on super elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial or break down rolling shall be done, as soon as it is possible to roll the mixture without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as lossely as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh material. The rolling shall then be continued till the entire surface has been rolled to compaction, there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. in no case shall fuel lubricating oil be used for the purpose.

Rolling operation shall be completed in every respect the temperature of the mix falls below 80° C. Rollers shall not stand on newly laid material while there is a risk that it will be deformed thereby. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

4. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of Clause 901.

Control on the quality of materials of materials and works shall be exercised by the Engineer-in-charge in accordance with Clause 902*.

5. The bituminous macadam shall be provided with final surfacing without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 511 before allowing any traffic over it.

6. ARRANGEMENTS OFTRAFFIC

The provision of Clause 105 shall apply as regards the flow of traffic during construction.

7. MEASUREMENTS FOR PAYMENT

Bituminous macadam shall be measured as finished work in cubic metres.

8. RATE

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations including full compensation for:

(i) making arrangements for traffic to clause 105 except for initial treatment to shoulders and construction of diversions.

(ii) preparation of base except for laying of levelling course but including filling of potholes;

(iii) providing all materials to be incorporated in the work, including all royalties, frees, rents where necessary and all leads and lifts.

(iv) all labour, tools, equipments and incidentals to complete the work to the specifications; and

(v) carrying out the work in par widths where directed.

ITEM-71 Providing and laying C.C. 1:5:10 (1 Cement : 5 Coarse sand : 10 graded stone aggregate of 40 mm nominal size) and curing etc. complete excluding cost of form work in foundation and plinth.

1.0 Material.

1 Water

1.1 Water shall not be salty or brackish and shall be clean, resonably clear and free from objectionable quantities of slit and traces of oil and injurious alkalis, salts organic matter and other deleterious material which will either weaken the mortar or concrete or our cause efflorescence or attack the steel in RCC contrainer for transport, storage and handling of water shall be clean water shall conform to the standards specifications in I.S. 456-1978

1.2 If required by the Engineer-in-charge it shall be tested by comparison with distilled water. Compression shall be and means of standard cement tests for soundness, time of setting and mortar strength as specified in I.S. 269-1976. Any indication on unsoundness, change in time of setting by 30 minutes or more of decrease or more than 10 percentage of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled wate shall be sufficient cause for rejection of water under test.

1.3 Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly effect the hydration reaction or otherwise interface with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or

mortar surfaces.

1.4 Hard and bitter water shall not be used for curing.

1.5 Portable water will generally be found suitable for curing mortar or concrete.

2.0 SAND

2.1 Sand shall be natural sand, clean well graded, hard strong durable and gritty particles free from immures amounts of dust, clay Ranker modules, soft or flaky particles shall alkali salts, organic matter, learn mica or other deleterious substance and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of slit as determined by field test. If necessary the sand.

2.2 Course Sand

The fineness modules of coarse sand sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand shall be as under:-

I.S. Sieve Designation	% by wt. passing
4.75 mm	100
2.36 mm	90 to 100
1.18mm	70 to 100
600 MC	30 to 100
300 MC	85 to 70
150MC	00 to 50

2.3 Fine Sand

The fineness module shall not exceed 1.0 the sieve analysis of fine sand be as under :-

I.S. Sieve Designation	% by wt. passing
4.75 mm	100
2.36 mm	100
1.18mm	75 to 100
600 MC	40 to 85
300 MC	05 to 50
150MC	00 to 10

3.0 Cement

3.1 Cement shall be ordinary portland slab cement as per I.S. 1975 pr portlar alag cement as per I.S. 455 1976. 4.0 Stone coarse Aggregate for Nominal Mix Concrete :

Coarse aggregate shall be or machine crushed stone of black trap of equivalent and hand, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

4.1 The aggregate shall be generally be cubical in shape unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best blacktrap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement. The concrete shall generally be as per the table given below. However in case of reinforced cement concrete the Minimum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars or 6 mm. less than the cover whichever is smaller.

IS Sieve designation	Percentage passing for single sized aggregate of nominal size		
	40mm	20mm	16mm
80mm	-	-	-
63mm	100	-	-
40mm	85-100	100	-
20mm	0-20	85-100	100
16mm	-	-	85-100

IS Sieve designation	Percentage passing for single sized aggregate of nominal size		
	40mm	20mm	16mm
12.5mm	-	-	-
10mm	0.5	0.20	0.30
4.75mm	-	0.5	0.5
2.35mm	-	-	-

Note : This percentage may be varied some what by the Engineer-in-charge when consdiered necessary containing better density and strength of concrte.

4.3 The grading test shall be taken in the beginning and at the change of source of material. Theis necessary that indicates in I.S. 383-1970 and I.S. 456-1978 shall have to be carried pit to ensure the acceptability. Aggregate shall be stored separately and handled in such a member as to prevent the intermixing diff. aggregate if

the aggregate are covered with dust, they shall be washed with water to make them clean.

2.00 Workmanship :-

2.1 General :-

2.1.1 Before starting concreting the bed of foundation trenches shall be cleared of all loose materials, level, watered and rammed as directed.

2.2 Proportion of Mix :

2.2.1 The proportion of cement sand and coarse aggregate shall be one part of cement 5 parts of sand and 10 parts of bricks bats aggregate and shall be measured by volume.

2.3 Mixing :-

2.3.1 The concrete shall be mixed in a mechanical mixer at the site of hand mixing may however be allowed for collar quantity work if approved by the Engineer-in-charge when hand mixing is permitted by Engineer-in-charge in case of break down of machineries and in the interest of work it shall be carried out on water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However in such cases 10% more cement extra case. One mixing in mechanical mixer shall be done period of 1.5 to 2 minutes and the quantity of water shall be just sufficient to provide a dense concrete of required workability for the purpose.

2.4 Transporting and Placing the Concrete :-

2.4.1 The concrete shall be handled from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final position, completed and finished within 30 minutes of mixing with water i.e. before the setting commences.

2.4.2 The concrete shall be laid in layer of 15 cms to 20 cms. 2.5 Compacting

2.5.1 The concrete shall be rammed with heavy iron rammend and rapidly to get the require compaction and to allow all the interstices to be filled with mortar.

2.6 Curing :-

2.6.1 After final set the concrete shall be kept continuously wet if required by ponding for a period of not less than 7 days the date of placement.

2.7 Mode of Measurements and Payments :

2.7.1 The concrete shall be measured for its length, breadth and depth limiting dimensions to those specified on plan or as directed.

2.7.2 The rate shall be for a unit of one cubic metre. ITEM-72 Supplying and stacking unscreened gravel on site of work etc. as directed.

The unscreened gravel shall be obtained from quarries approved by Executive Engineer prior to collection. The material shall be of approved quality with all lead and lift. The material shall be clear and free from organic material, site, clay etc. and shall be got approved from Engineer-in-charge.

Wherever any doubt exists as to whether the above requirements are satisfied in work or any part of the collection, it shall be rectified by the contractor at his own cost, if so ordered by Engineer-in-charge.

Slacking shall be done by filling in the standard steel boxes of 2 mt. x 1.5 mt. x 0.5 mt. size which shall be supplied by the department if available on rent otherwise contractor shall make his own arrangements. No deduction for voids shall be made from the gross measurements. Where any doubt exists as to whether the quantity of stacks of material in any hectometer is not confirming with the cubical content of the standard pharas (2 mt. x 1.5 mt. x 0.5 mt.) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of material in any stack in a particular Hectometers is found to be less than the standard measurements viz. 1.5 cmt. the entire collection in the Hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on fairly level ground. Stacking of material shall done in a manner as directed by the Engineer-in-charge.

For road work complete stacking of material as per requirements shall be carried out in 2 k.m. length before spreading. The material stacks shall be measured and recorded and got cross checked by the other Deputy Executive Engineer as per rules before spreading. The collection shall always commence at one end of the k.m. and be carried out continuously towards the other end unless the Engineer-in-charge direct otherwise.

The payment shall be made on cubic metre basis without deduction for voids/ The contractor shall maintain all stacks in regular and proper size till the whole materials shall not be measured and finally accepted by the Department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometer wise.

The rate includes cost of collection, conveyance to the site with all lead and lift and firing-telboxes including all labour, tools, equipments and other incidental expenses. The rates quoted are inclusive of all such tools, duties, fees, royalties, taxes etc.

ITEM-73 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm. in depth consolidating each deposited layer by ramming and watering.

1.0 The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

2.0 As soon as the work in foundation has been completed and measured, the site of foundation shall be cleared of all debris, stone, mortar droppings etc. and filled with earth in layers not exceeding 20 cms. each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with the butt ends of crow-bars, where rammer can not be used. With iron rammers finished level, the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

3.0 The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth under no circumstances black cotton soil be used for filling.

4.0 The payment shall be made for filling in trenches and plinth. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.

5.0 The rate shall be for a unit of one cubic metre.

ITEM-74 Providing and fixing junction board of M.S. Plate and angle as per standard I.R.C. design including fixing in C.C. 1:4:8 with necessary excavation, painting, lettering, figuring and lettering on board etc. complete.

1.0 The boards shall be fixed at a distance of 120 mtr. from the centre line of the crossing and they should be located on the left hand side of the road in the direction of the traffic and facing the traffic.

2.0 The board will be located in such a way that the edges of the board towards the centre line of the road will be at a distance of 4.57 mt. from the centre of a N.H. and 3.66 mtr. from the centre of a S.H. or M.D.R. or as directed by the Engineer-in-charge.

3.0 The bottom of the board shall be 1 m above the road surface and the board shall be at right angles of the centre line of the road facing the direction of the traffic.

4.0 The size for the junction board M.S. plate and angles shall be as per standard confirming to I.R.C. type design.

5.0 The board shall be fixed in concrete and the projection of this above the road level shall be 4 cms x 45 cms. and a height of 24 cms. above the road level and the top is to be finished tapering from the height of 15 cms.

6.0 The board shall be supported by the angle iron parts of M.S. angle as shown in the standard type design.

7.0 The size of letters and figures shall be 8 cm. for English and 10 cms. for Devnagri and Gujarati scripts.

8.0 The post shall be painted in black and white alternative strips of 23 cms. in height.

9.0 The board shall be painted in white with blackboard 2 cm. wide.

10.0 On this board tablets shall be painted in yellow with a black border and the tablets shall have 5 cms. clear distance from the board.

11.0 Each such tablets shall be 61 cms in length and 33 cms. in height arrow lines indicating the direction of the road at a junction shall be painted in black and shall have a thickness of 5 cms. for N.H. and 4 cms. of S.H. and 2.5 cms. for M.D.R.

12.0 All letters and figures shall be painted in black.

13.0 The work shall be carried out as per design and as per the instructions of the Engineer-in-charge.

ITEM-75 Scarifying gravelled macadam of bitumen macadam surface 6 cm to 10 cm. depth including stacking useful materials on road side and depositing or remaining stuff.

1.0 The layer of the existing layer metalling shall be excavated and shall be screened on site of work. Stacking of 75% of metal obtained from screening shall be done by filling in the standard steel boxes of 2 m x 1.5 m x 0.5 mt. size which shall be supplied by department if available on rent, otherwise contractor shall make his own arrangements. No deductions for voids shall be made from the gross measurements. Where any doubt exist as to whether the quantity of stacks of metal in any hectometer is not confirming with cubical content of the standard pharas (2m x 1.5 m x 0.5 m) shall be got corrected by the contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the contractor. If the quantity of metal in any stack in a particular hectometer is found to be less then the standard measurements viz. 1.5 cmt. the entire collection in the hectometer shall be paid on the basis of the quantity so found. Regular stacks shall be done by the contractor on a fairly level ground. Stacking of the metal shall be done in a manner as directed by the Engineer-in-charge.

2.0 The remaining material except 75% of. metal obtained from screening process shall be used in embankment with all lead and lift. It shall be directly deposited at the required location in specified layers. No handling or conveyance charges shall be paid if the materials is temporarily deposited else where and subsequently convey to site of deposition. The sequence of operations should be arranged properly. Material not required for any use whatsoever may be disposed off by the contractor at his own cost in manner approved by the Engineer-in-charge. The material utilised in the embankment will be deducted from the net quantity of earthwork in embankment arrived at within the chainage measured.

3.0 The payment shall be made on sq. mt. basis, the contractor shall maintain all stacks in regular and proper size till the whole materials shall not be measured and finally accepted by the department. The spreading of materials shall not be allowed till the materials are fully stacked and completed kilometerwise.

4.0 The rate includes the cost of scarifying macadam, screening, depositing, conveyance with all lead and lift, filling the boxes including all labour, tools, equipments and all other incidental expenses.

ITEM-76 Extra for dewatering in foundation etc. as directed.

1.0 Where water is met within excavation due to stream flow, seepage, springs, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, to keep the foundation trenches dry when so required and protect green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the contractor but subject to approval of Engineer-in-charge shall, however, not relieve the contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the work.

2.0 Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for any period of atleast 24 hours thereafter, unless it is done from a suitable pump separated from the concrete work by a water height wall or other similar means.

3.0 The measurements shall be paid on Cubic Meter basis for each class of materials encountered. 4.0 The rate includes the cost of dewatering including pumping.

ITEM-77 Supplying and stacking of rubble including rubble dumping as and where required as directed.

1.0 Stone shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used. The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourth of the thickness of wall nor less than 15 cm. The rubble shall be stacked in chhattas manner on fairly levelled ground as and where directed as per the instruction of the Engineer-in-charge. 16% for voids shall be deducted from gross measured quantity. The rate includes all labours, materials, tools and equipments, dumping the rubble and all other incidental expenses occurred. The payment shall be made on cmt. basis.

ITEM-78 Jungle cutting for road side clearance on road site as directed.

The land width shall be cleared i.e. cutting of trees of any diameter, grass, vegetation etc. as per the instruction of the Engineer-in-charge. The wood obtained if any by clearing off the jungle shall be the property of department and the same shall be casted and stacked to the place and hand over the same to the Deputy Executive Engineer as per the instructions laid by him.

CONTRACTOR'S SIGNATURE

EXECUTIVE ENGINEER

SCHEDULE FOR TESTING OF MATERIALS

For ensuring quality control and workmanship, Various tests prescribed below for materials shall be taken at periodical intervals as stipulated below.

The materials shall be a got tested at Government recognised Laboratory, (R & B) or field Laboratory of GERI (R & B) for which 1% of the estimated amount put to Tender shall be recovered from the contractor from the ,R. A. bills and final bills at the testing charges shall be paid to the GERI by the Government. However if the charges increase over 1% no excces recovery shall be mado from the contractor as per resolution of B & C Department dated 10th May. 1985 Vide TNC/1085 (4) s.

Item No as per schedule 'B'	E&ief Description of Materials to be tested	Qty. of Materials	Prescription of test which shall be cariedout	Frequency @ which test shall be carried out	Total No. of Test to be taken
1	25 to 90 H. B. Metal 40 to 63 H. B. Metal 40 to 50 M. C. Metal 20 to 50 M.C. Metal Kapachi		- Gradation Test - impact value - Flakiness Index	1 to 1 00 Cmt - 1 Test 100 to 500 Cmt-3Test 500 to 1500 Cmt- 5 Test 1500 to 5000 Cmt - 7 Test	
2	Grit		- Stripping Value	-----Aa above -----	
3	Murrum		- P. I. Value	One test per / 50 cmt	
4	Sand Quarry Spaul CBR- 1test per work		- Silt Content - Gradation	One test per work One test per 200 cmt.	
5	Asphalt		1 Penetration Test as per	No. of Tanker Test 1 to 10 1 1 1 to 20 2 21 to 50 3 51 to 100 4 Remaining every50tankar 1 As per I.S. 1208 As per I.S. 1202 As per I.S. 1204 As per I.S. 1206	
6.	Tack coat		- Binder temperature for application. - Rate of spread of binder.	Irregular close in intervals Two tests per day.	
7.	Carpet & seal coat mix		- grading -temperature of binder in boiler, aggregates in the dryer and mix at the time of laying and rolling (Binder content vide 45 IMD 2172) - Rate of Spreaded mix materials	One Test on individual contituents and mixed aggre gates from the dryer for each 100 tonnes of mix subject to minimum of Two tests per plant per day. One Test for each 100 tons of mix subjects to mini, of Two per day plant Regular control through checks on layer thickness.	
8.	Bricks		- Water absorption - Efflorence -Size - Compressive Strength	1 test per 50,000 Bricks	

Item as per schedu 'B'	Brief Description of Materials to be tested	Qty. of Materia	Prescription of test which shall be cariedout	Frequency @ which test shall be carried out	Total No. of Test be taken
9.	Cement		- Consistency - Setting time - Compressive Strength - Fineness - Chemical analysis - Soundness	Upto 50 T 1 test (As per 100T 2 tests GERI 200 T 3 tests Manual 300 T 4 tests 2002) 500 T 5 tests 800 T 6 tests 1300T 7 tests and 8 test for larger consingment	
10.	Steel		- Tensile Strength - Yield Stress - Elongation - Size	1 test / 40 tonnes / per category	
11.	C.C. cube 1:2:4		- Compressive Strength (I. S. 516 - 1959)	Qty. C.C.M3 No. of test 1 to 5 - 1 no. 6 to 15 - 2 no. 16 to 30 - 3 no. 31 to 50 - 4 no. 51 & above - 4+1 (For each additional 50 M3 or part thereof).	

The number of tests will be as per Manual of Quality Control or latest Govt. G.R. / Circulars will be final.

The contractor shall have to pay 1% of the estimate cost put to tender towards all testing of materials & the same shall be deducted from their bills for the works. The testing of various materials shall be carried out in GERI and result received shall be binding to all i.e. the contractor and Govt.

Testing charges of GERI shall be born by Govt. No refund be made nor extra charges over 1 % shall be recoverable from the contractor.

SIGNATURE OF CONTRACTOR

EXECUTIVE ENGINEER

: Also Available at :



Gujarat Book Stores Private Limited

B-20, District Shopping Centre, Sector-21, Gandhinagar-382021. Ph. : 2323221195

CONTRACT NO.

**Bhavnagar Municipal Corporation
BHAVNAGAR**



(A WHOLLY OWNED BHAVNAGAR MUNICIPAL CORPORATION UNDERTAKING)

ESTIMATED COST

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

ESTIMATED COST: RS. 14,70,03,332.00/-

VOLUME – IIIC

**TECH. SPECIFICATIONS –
ELECTRO-MECHANICAL WORKS**

SR.NO.	PARTICULAR
1	INFORMATION OF THE TENDER
2	EXTENT OF WORK
3	TECHNICAL SECTION
4	ITEM WISE SPECIFICATION

CONTRACTORS TO READ CAREFULLY

- 1.0 Guarantee: All the materials / equipment shall be governed by guarantee of 12 months from the date of taking over of installation against any manufacturing defects, design & workmanship. Also any malfunctioning of equipment / system due to faulty installation / design manufacturing process etc. shall be rectified free of cost by Contractor.
- 2.0 Tenderers are requested to furnish the information required in TECHNICAL DATA SHEET without fail. In case of not furnishing the details, tenders will be out rightly rejected.
- 3.0 Delivery of pumps within **45 days from the date of successful inspection** shall be confirmed by the Original Manufacturers.
- 4.0 The quantities indicated in the minimum BoQ are tentative to appraise the bidder about magnitude of the work & likely to vary during execution and the contractor shall have no objection to such minor or major changes or deletion or addition of the item. The sizing indicated in the minimum BoQ is binding to contractor and size smaller/ lower than this shall not be permitted. However, in case higher/ larger size is required as per Conceptual Design Report, it shall be provided at no extra cost. Quantities given for electro-mechanical items are indicative but minimum required to be supplied. However, bidder shall execute the items as per requirement in field. Payment shall be made on the unit rate determined for particular item on the basis of ratio of estimated cost put to tender and rate approved for award of contract. This being turnkey tender, any item specifically not mentioned in the BoQ, but required for approval of the competent authority is deemed to be covered in the project.
- 5.0 Contractor has to maintain minimum pump efficiency as offered by them at the time of tendering for all works under this project throughout their contractual period. Contractor has to produce certificate along with results for efficiency every six month from ERDA Baroda. If efficiency is found less then penalty will be levied & it will be binding to the contractor. Expenditure for measuring the efficiency, if any shall have to be borne by the contractor; no extra claim will be given.
- 6.0 Contractor has to provide make of pump, motor, valves, panel etc. from approved make prior to submit the document for approved of drawings amongst approved vendor list and Quality Assurance Procedure etc. make will be finalized by competent authority. Quantity of items in schedule can be deleted as per site requirement/ at the time of execution. Contractor has no right to claim for deletion of items.

Extent of Work

Extent of work

The scope includes Supply, Installation & testing at manufacturer's works, delivery to site, Unloading & Storage at site, Installation testing at site, Commissioning final painting at site, under at Various Head works.

1. MECHANICAL WORKS:

- (a) Supply, Installation, Testing and Commissioning of Submersible Non-Clog Vertical Pump, sets as per details attached with Base plate, foundation Bolts, Flexible couplings, priming arrangements etc. with suitable capacity of electric motor.
- (b) Pump house piping system for suction, delivery and common header line consisting of M.S. pipes, specials, flanges, etc., inclusive of connection of common header line with rising main outside the pump house with nut bolts, gaskets, joining material etc., as per requirement.
- (c) C.I. Butterfly / Sluice valves on Suction/ Delivery / Header Line
- (d) Dual Plate Check Valve / Non-return Valve on Delivery / Header Line
- (e) Expansion bellows (as per relevant IS)
- (f) Electro-magnetic flow meter
- (g) Pressure Gauge at outlet of each pump and on header line.
- (h) Chain pulley block for lifting the pump or motor from the Under-Ground Tank

2. ELECTRICAL WORKS:

- (a) Suitable capacity L.T. motor control center designed to accommodate suitable Nos. of motor starter feeders according to motor H.P. with suitable starting incoming MCCB, capacitor banks, overload, earth protection relays metering instruments, indicating lamps etc. complete as per outline single line diagram (SLD) provided
- (b) Suitable size L.T. Power and control cable as per requirement with required accessories such as lugs, glands etc.
- (c) Earthing and lightning protection.
- (d) Miscellaneous items necessary to complete the installation in all respect and as described in specification
- (e) Liaising work, with local electricity authority.
- (f) Maintenance including comprehensive maintenance of pumping station, mechanical and electrical equipment for 2 years
- (g) Miscellaneous items necessary to complete the installation in all respect and as described in Schedule B and Specification.

3. CIVIL WORK:

- (a) Equipment foundation for pump sets, M.C.C. Panels and other electrical and mechanical equipment as per specification.
- (B) Thrust Blocks, Support for pipe and valves, valve chamber & other structural works. Puddle pipe and related civil works.

Technical Section

1. SUBMERSIBLE NON-CLOG VERTICAL PUMP

A. GENERAL

The Pump shall be submersible, non-clog, single stage, centrifugal, wear resistance with vertical shaft suitable for permanent installation in wet-pit / sump along with Submersible motor and submersible cable of specified length. The pump and motor shall be as one unit together with impeller mounted on extended shaft of motor.

The pump shall be designed to pump storm water and operate satisfactorily without detrimental surges, vibration, noise or dynamic imbalance over the required Head-Capacity range. The head-capacity curve of the pump shall have continuously rising head characteristics with decreasing capacity over the whole performance range of pump. The shut off head of the pump shall be at least 120% of the total head.

Each pump must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation's or overload under all operating conditions within the system resistance indicated. All pumps shall have identical performance.

The pump shall be designed to start with delivery valve fully open.

The pump shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to liquid returning through the pump at times when the power supply to the motor is interrupted and the discharge valve fails to close.

Pumps' rotating parts & assembly shall be statically and dynamically balanced as per ISO standards and shall run smooth without undue noise and vibration. The velocity of vibration shall be within the 4.5 mm/sec. Noise level shall be limited to 80 dB at a distance of 1.0 m.

The Sole plates / auto coupling unit with foundation plate shall be grouted with the RCC foundation with the help of "J" type foundation bolts of manufacturer's recommended / approved size.

The power rating of motor to drive pump shall be min. 110 % of power required to meet max. requirement of power for the rated impeller throughout its' performance range considering specific gravity of the liquid rounded up to next standard higher kw rating as per IS.

B. FEATURES OF CONSTRUCTION PUMP

Pump shall be Vertical Submersible centrifugal, single stage, Non Clog suitable for permanent installation in wet-pit / sump. The pump shall have bottom suction and side discharge nozzle. The pump and motor shall be as one unit together with impeller

mounted on extended shaft of motor. The pump having delivery size up to 100 mm shall be designed to handle solids of min. 35 mm to 80 mm size and pump having delivery size up to 100 mm. shall be capable of handling solids of maximum 100 mm size.

CASING

Pump casing shall be volute type of robust construction and designed for high efficiency. Liquid passages shall be designed to allow free passage and finished smooth. The tongue shall be straight across and filed to a smooth rounded edge. Casing shall be provided with wearing rings / wear plates.

Casing shall have inspection hole with cover so as to facilitate removal of clogged material from impeller vanes without dismantling the whole pump.

IMPELLER

Impeller shall be enclosed/semi-open, single suction with smooth and large ways so as to allow free passage to the fluid being pumped. Impeller shall have two / three vanes max. and be capable to handle solids of specified size. It shall be free from sharp corners and projections likely to catch and hold rags and stringy materials. Typical storm water has high content of sand, silt & clay. Hence the pump design shall be of wear resistant type.

Impeller shall be statically and dynamically balanced at rated speed as per applicable standard so as to avoid vibration. The Impeller shall have back vanes or suitable features to balance axial thrust.

Pump having semi open impeller shall be provided with suitable wear plate fixed in casing with adjusting bolts & nuts.

IMPELLER NUT

Impeller shall be fixed on rotating shaft with the help of SS 316 impeller screw or cap top type impeller nut with helicoil insert and washer in such a way that impeller doesn't get loose during rotation of pump in either direction.

SHAFT SLEEVE

Replaceable shaft sleeves shall be provided and shall be securely locked or keyed to the shaft to prevent loosening. Necessary rubber 'O' ring or CAF / Teflon gaskets shall be provided between impeller and shaft sleeve to prevent liquid passage between shaft and sleeve. In no case shaft shall be in the contact with liquid.

MECHANICAL SEALS

Double mechanical seals shall be provided to protect the motor from ingress of Storm water along the shaft. The preliminary and secondary seals shall be oil-lubricated. The seal faces of the preliminary seal shall be of either tungsten carbide or silicon-carbide faces while the secondary seal can be of carbon versus chrome steel or tungsten carbide. Pumps shall be equipped with an electrical monitoring system for seal failure detection. Use of Lip seals or back to back seals is not allowed. The mechanical seals shall be bi-directional.

BEARINGS

Pump set shall have double anti friction grease lubricated bearings. The bearings life shall be minimum 40,000 hrs of operation. Bearings shall be greased for life –i.e. shall not require any re-greasing. Bearings shall be of SKF / FAG make only.

AUTO COUPLING / GUIDE PIPE / LIFTING CHAIN

Each pump shall be supplied with pump connector unit in order to connect connector unit to pump support bracket with rubber diaphragm to make leak proof joint and fixing it to the concrete floor of the suction well. The design of the automatic coupling system shall be such that the joint between the pump discharge flange and the delivery piping shall be made by merely lowering the pump into double guide pipes / wire rope from access level. The pedestal of the automatic coupling system shall be integrally cast with the delivery bend thereby obviating the need of separately bolted CI Duck Foot Bend. It shall be provided with all necessary fixtures like guide wire / double guide pipe for guiding the pumps during lifting/lowering.

Each pump shall be provided with a stainless steel lifting chain conforming to BS 1663 and BS 4942 and stainless steel guide pipe / wire rope of required length.

LIFTING HOOK

To “fish out” a vertical submerged pump set from the wet well (even if a chain has not been attached to the lifting hook prior to the pump set being lowered) the pump shall have a self-centering lifting hook. Its design shall be such that the lifting chain’s hook can be engaged to the pump’s lifting hook without the need for man to enter the wet well. This hook shall be of corrosion resistant stainless steel.

2.0 INDUCTION MOTOR (Submersible)

The submersible motor shall be Induction, Squirrel Cage, and Dry type, designed for continuous operation (S1 duty) capable of working satisfactorily in liquid immersion. Motor shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following electrical Supply conditions:

- (i) Variation of supply voltage from rated motor voltage +/- 10%
- (ii) Variation of supply frequency from rated frequency +/- 5%
- (iii) Combined voltage and frequency Variation +/- 10% Degree of protection of motor shall be IP 68.

The starting current of motor shall not exceed 200% of rated full load current for star/delta starting under any circumstances. Motor shall be suitable for full voltage & star-delta starting. Motor shall be capable of starting and accelerate the load with the applicable method of starting, without exceeding acceptable winding temperature, when the supply voltage is in the range 85% of the rated motor voltage to maximum permissible voltage. The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerance as per the applicable standard) unless otherwise specified. Motors shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation. The motor vibration shall be within the limit specified in applicable standard unless otherwise specified for the driven equipment. Except as mentioned herein, the guaranteed performances of the motor shall be met with tolerances specified in applicable standards.

Any joints in the motor insulation such as at coil connection or between slot and end winding section, shall have strength equivalent to that of the slot section of the coil. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The tropical treatment shall be as per the applicable standard.

The stator winding shall be made from high conductivity annealed copper conductor, super enameled insulated winding wires conforming to IS 8783-1978 for dry type motors. The stator winding shall be of high conductivity annealed copper enameled insulated wires conforming to IS 4800 (part-VII): 1970 for dry type motors. The corresponding Class of insulation shall be "F" for motor ratings up to 120hp & Class "H" for larger ratings – however for motors to be operated on VFD's, only Class "H" insulation is allowed.

The temperature-rise test of the motor may be taken with the pump at the duty point at the full load output of the motor. When the various temperatures are stabilized, the set is stopped and the temperature-rise of the stator winding by the resistance method shall not exceed 80°C even for Class "F" or Class "H" insulated motors.

As the cable resistance method, due care is taken to account for the correct hot and cold resistance of windings.

If these pump's motors are to be used with Variable Speed Frequency drives (VFD's) than :

- ❖ The motor insulation shall be Vacuum Varnish Impregnated instead of Dip Varnishing or Trickle Varnishing with double insulation coating.
- ❖ The motor insulation is to be of Class "H" only
- ❖ Current insulated bearing/s (preferably NDE) are desired & compulsorily required for motor ratings above 200kW.

Terminal box shall be of IP 68 type construction to eliminate entry of storm water and dust. The terminal shall be the stud type with necessary plain washer, spring washers and check nuts. They shall be substantially designed for the current carrying capacity and shall ensure ample phase to phase to ground clearance.

PROTECTION

Protection against increase in stator winding temperature (15 Deg. C) shall be provided. Minimum three number thermostats / bimetallic switches in series shall be provided to sense the stator winding temperature.

Sensors are to be provided to detect if leakage of storm water into the oil housing is above 30% concentration. Bimetallic thermal switch to trip the motor against increase in temperature shall be provided.

The required control unit to process these safeties signals & with potential free contact o/p for alarm / trip shall be provided by vendor for suitable interlocking in starter circuit and /or PLC.

SUBMERSIBLE CABLE

A watertight Cable Junction Box sealed from the motor shall be provided for the motor power and signaling cables. The cable shall be of sufficient length and shall be brought out of the submerged motor without joint to terminate in junction box / control panel, located in LT panel room /outside the wet well.

Power as well as Control Cables shall be of Dual Sheathed EPRS / PVC Armored type with required no. of Copper Core, round type and of required size as per design requirement.

The power cable shall be PVC insulated and PVC sheathed, flexible, 3.5/4.0 core round type. The size of the conductor shall be adequate for continuous use under water and air. Cable half/full core as per design to be used for earthing. The size of the conductor and length of cable shall be suitably selected so that the voltage drop at motor terminals does not exceed 3 percent of the rated voltage.

The control cable shall be PVC insulated PVC sheathed, flexible, round type and shall be adequate for continuous use under water and air. The control cable for stator winding temperature sensor (Thermostats/ bimetallic switches) of 3 core X 1.5/2.5 sq.mm copper conductor and for bimetallic thermal switch with 2 core X 1.5/2.5 sq.mm copper conductor shall be provided or as required as per design. Similarly control cable for level sensor shall be 2 core X 1.5/2.5 sq.mm copper conductor shall be provided or as required as per design. Accordingly, suitable multi core control cable shall be provided with minimum 1 spare core.

Earthing of the motors shall be done in accordance with the relevant provisions of IS:3043- 1966 for the purpose of earthing these motors, earthing connection may be made to discharge pipe.

MATERIAL OF CONSTRUCTION

The specific requirement shall be considered as under:

Casing, Casing Cover ring/wear plate/	CI IS210 Gr FG 260 with 2 % Ni Casing wear
Oil chamber/ Motor casing	CI IS210 Gr FG 260 with 2 % Ni Suction Cover
	CI IS210 Gr FG 260 (not forming a part of Casing Cover/contact in Liquid, otherwise MOC of the same shall be similar to casing)
Shaft	AISI 410
Shaft sleeve	AISI 316 (if applicable)
Impeller / Impeller Nut	CF 8 M
Shaft Seal	Mechanical Seal
Auto Coupling Unit	CI/DI
Min. Permissible solid Size	100 mm size
Motor Cooling	By surrounding liquid
Motor Rotor (up to 90 kW rating) (above 90 kW rating)	Copper Bar base/Aluminum Die cast. Motor Rotor Copper Bar base.
Double Guide rail pipe	Heavy duty, SS 304 of suitable length SS 304
Lifting Chain	Min. equivalent to sump depth + 5 m
Cable length	Equivalent to length up to panel + 5 m

NAME PLATE

Each pump shall be provided with a stainless steel name plate indicating the following details.

- Model
- Manufacturer's special number
- Rated capacity in LPS / M³/HR
- Total head in MWC

- Speed in RPM
- Test pressure
- Weight of equipment
- Material of impeller

3.0 BUTTERFLY / SLUICE VALVES

1.0 SCOPE:

This specification covers the design requirements, features of construction, inspection, testing, painting, delivery, installation and commissioning of manually hand wheel operated sluice valves with gaskets, hardware, etc. at site.

2.0 CODES AND STANDARDS:

The design and manufacture of the valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the vendor of this responsibility. Valves shall be conforming to IS 14846 and other international standards for higher rating than stipulated in IS codes.

3.0 DESIGN REQUIREMENTS FOR SLUICE VALVES:

Valves shall be provided with back seating arrangement.

Renewable body and wedge rings shall be provided.

Collared drain plugs of gunmetal shall be provided for all valves.

Stuffing box gland shall be of bolted type.

Valves shall be with non-rising spindle type.

Valves shall be flanged and drilling shall conform to the standard as specified in data sheet.

Face to face dimension shall be as per IS 14846.

4.0 CLEANING:

Prior to factory inspection, all manufacturing waste such as metal chips, debris and all other foreign material shall be removed from the interior of the valve. All mill scale, rust, oil, grease, chalk and all other material shall be removed from the interior and exterior surfaces.

5.0 PAINTING:

Valves shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and adhere perfectly to the surface. Valves used in pipes carrying water, the inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or odour to the water.

6.0 DIRECTION OF FLOW:

Direction of flow shall coincide with the flow direction indicated by "arrow" cast on the valve body.

7.0 TESTS AND INSPECTION:

Valves shall be offered for visual inspection and dimensional check. Valves shall be tested as per IS 14846 with latest amendments. The hydrostatic testing shall

be witnessed by the purchaser. Valve shall be dispatched only after visual inspection and clearing instruction for dispatch.

4.0 NON RETURN/ REFLUX VALVE

1.0 SCOPE:

This specification covers the design requirements, features of construction, inspection, testing, painting, delivery, installation and commissioning of Non-return valves at site.

2.0 CODES AND STANDARDS:

The design and manufacture of the valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the vendor of this responsibility. The valve shall be conforming to IS 5312 or other international standards.

3.0 DESIGN REQUIREMENTS FOR NON RETURN VALVES:

The Non return valves shall be of swing type single door design.

The valves shall be designed for minimum head loss.

The valves shall have flat faced flanged ends. The back side of the flanges shall be fully or spot faced.

By pass arrangement shall be provided for above 300 mm. valves

The valves shall have non slam characteristic. This is to be achieved by internal design. Dead weight arrangement is not acceptable.

4.0 PAINTING:

Valves shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and shall adhere perfectly to the surface.

Valves used in pipes carrying water, the inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or odour to the water.

5.0 TESTS AND INSPECTION:

Valves shall be tested as per the relevant Indian Standards. Specification IS - 5312 - 1969 PART 1 with latest revisions.

Valves shall be offered for visual inspection and dimensional checks.

The hydrostatic and water tightness testing shall be witnessed by the purchaser.

Valve shall be offered for inspection and following tests. (before painting) at Vendor's shop.

- Visual inspection with dimensional checks.
- Hydrostatic test

INSPECTION AND TESTING AT MANUFACTURER'S PREMISES FOR DIFFERENT VALVES

1.1. Valve (manufactures test Certificate to be furnished.)

- 1.1.1. Testing there shall be no visible evidence of structural damage to any of the valve component.
- 1.1.2. Motorized valve shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable to opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.
- 1.1.3. The following test shall be carried out for sluice valves: (manufactures test certificate to be furnished)
 - a) Seat leakage test at rated pressure
 - b) hydrostatic test at 1.5 times the rated pressure
 - c) Valve operation.
- 1.1.4. The following test shall be carried out for non- return valves: (manufactures test Certificate to be furnished)
 - a) Seat leakage test at rated pressure
 - b) Body hydrostatic test at 1.5 times rated pressure
 - c) Operation.

5.0 C.I. PIPES AND PIPE SPECIALS

Providing and supplying lowering, laying to line, level and slope, cast iron pressure pipes (Class B conforming to IS: 1537 / IS: 1536 with latest amendment) and jointing with specials such as Tees, Bends, Reducers including and other safety provision, cutting the pipes and making joints and hydraulic testing after laying etc. comp.

The Cast Iron pipes shall be Class B conforming to IS:1537 / IS:1536 with latest amendments bearing ISI Mark.

The pipes shall be free from the defects resulting from raw materials, loading, handling, carting and unloading. The pipes shall be free from load, dents or bulges greater than 3 mm in depth and extending over a length in any directions greater than twice the thickness of barrel.

Each lot of pipes supplied by the contractor must be accompanied by the test certificates as specified in IS 1537 / 1536 with latest amendments. The contractors shall have to make arrangement for inspection/testing of the pipes at manufacturer's factory at contractor's own risk and cost.

Each pipe shall have cast, stamped or indelibly painted on it the following marks.

- a) Manufacturer's name, initials or identification mark.
- b) The nominal diameter.
- c) Class reference.
- d) The last two digits of the year of the manufacture.
- e) I.S. Certification mark.

The materials shall be carted to the site by the contractor very carefully. The handling, while carting the pipes, specials, valves etc. shall be done carefully.

In case of heavy pipes, specials etc. lowering shall be done with the help of the chain pulley block.

Caulking:

After a section of convenient length has been leaded, caulking shall be commenced. The lead shall be free from the leading pipe, outside of the socket of the other pipe with flat chisel, and then caulked round 3 separate times with the proper caulking tools of increasing thickness and hammer 4 to 5 lbs. in weight in such manner as to make the joints sound and water tight.

Joints under water shall be made with lead wool inserted in strings not less than 6 mm thick and very thoroughly caulked.

New Flanged Joints:

Flanged joints should be made by painting the facing of the flanges with red lead freely and belting up evenly on all sides.

A thin fiber, of lead wool may be very useful in making the joints water tight, where

facing of the pipes is not true.

Where packing must be used, it should be of rubber insert cloth three ply and of approved thickness. The packing should be of the full diameter of the flange with proper pipe hole and bolt holes cut and even at both inner and outer edges.

Where the flange is not fully faced, the packing may be of the dimension of the facing strip only. Its proper placing should be tested before another pipe is jointed on.

Testing:

After each section of the pipe line has been completed, it shall be tested for water tightness before being covered in. This can be done by closing each end by means of a reliable gauge. When the pipe is laid on any appreciable gradient, the test should be carried out at the lower end of the section. Any leaking joints should be made good, and the above test reapplied until no further leaks are apparent.

Tyton Joints:

After the pipes are examined for line and levels, the C.I pipes shall be jointed with rubber gaskets (Tyton joints) as follows:

The socket and spigot end shall be cleaned with kerosene oil, then grease has to be applied to the spigot and socket ends, duly after inspection of rubber gasket. Then the rubber gasket shall be jacked and fixed in perfect condition such that the gasket will fall in groove correctly and the joint become water tight.

Tyton / Lead jointing shall be carried out after the C.I. pipes and specials are properly laid and approved by the Engineer-in-charge.

The lead shall be more than 99%. It shall be soft bluish grey pig lead free from admixtures of tin or other impurities. The lead shall conform to the Indian Standard 3114/1965.

The spun yarn shall be clean hemp and soaked in hot tar or bitumen, cooled and dried before use.

The outside of the spigot and the inside of the socket shall be thoroughly cleaned with a brush. The spigot shall be carefully centered in the socket by spun yarn twisted into ropes of uniform thickness. The rope shall be well caulked in to the back of the socket to leave a sufficient depth for lead as directed by Engineer-in-charge. The lead shall be used as specified in Table-1 of Indian Standard 3114/1965.

The proper depth of each joints shall be as specified and tested before running the lead by passing completely around it a wooden gauge notched out to the correct depth of lead.

The leading of joints shall be done by means of ropes covered with clay or a by using special leading rings. The lead shall be melted rendering it thoroughly fluid and each joints shall be filled in one pouring.

After a section of convenient length has been leading pipe outside of the socket of the other pipe, with a flat chisel and then caulked round three separate time with the proper caulking tools of increasing thickness and hammer 2 to 3 kg. weight in such a manner as to make the joints sound shall be left flush neat and even with the socket.

The item includes all materials tools, tackles etc. required to carry out the work including fire wood etc.

After each section of the pipe line has been completed it shall be tested for water tightness. The ends shall be suitably closed with a valve, cap or plug or a blank flange. The pipe line shall then be filled with water; pressure shall then be applied with a hand force pump or suitable method up to required test pressure as per IS 3114 or its latest addition. If the pipe is laid on an appreciable gradient, the test shall be carried out at the lower end of the section.

Any leaking joints shall be made good and the test repeated until a perfectly leak proof pipe line obtained.

Consumption of lead for jointing of pipe lines:

The purity of lead must be more than 99% and the contractor shall have to furnish the test certificate and get approval from Engineer-in-charge. The consumption of lead and the depth of jointing shall be as per table listed below:

Sr. No.	Size of pipe line for joint	Consumption of lead in kgs.	Depth of lead joint in cm.
1.	80 mm	1.86	5.00
2.	150 mm	3.62	6.00
3.	200 mm	5.00	6.00
4.	250 mm	6.12	7.75
5.	300 mm	7.70	8.00
6.	350 mm	10.45	8.12
7.	400 mm	11.20	8.25
8.	450 mm	14.30	8.40
9.	500 mm	16.25	8.50
10.	600 mm	19.00	9.15
11.	700 mm	21.00	10.00
12.	800 mm	31.50	10.50
13.	900 mm	41.00	10.50

HYDRAULIC TEST:

It shall be incumbent upon the contractor to give a successful hydraulic test of each and every pipe line before filling of the trench. The test shall be carried out in the approved manner by an approved testing machine and pressure gauge to be supplied by the contractor. All the arrangements for such test shall be made by the contractor at his cost including filling the pipe with water etc. and giving a successful hydraulic test.

Testing of the pipe line in the field shall be carried out after the completion of whole length or in parts as directed by Engineer-in-charge. The trenches shall be partially

refilled except at the joint before starting the test. In each case, the contractor has to plug the both ends of the section of pipeline to be tested either by providing caps or by sluice valves as per direction of Engineer. No extra payment will be made for providing, fixing and removing caps used for testing purpose. If necessary, both the ends shall be properly anchored by providing 1:3:6 c.c. blocks of required dimensions. Contractors shall provide required number of plug points with ferrules of required diameters to serve as injection points, air relief points etc. No payment shall be made for this work. On the completion of the test these points shall be closed by plugs by the contractors without any extra cost.

Testing will be carried out by the contractors under the guidance of Engineer-in-charge. Contractors shall arrange for required machinery, equipments and technical staff for testing the pipe line. Contractors shall also arrange for labour, other materials and tools required to attend the leakage etc. during the test.

The pipe line shall be subjected for following test:

Leakage Test:

The test shall be conducted after satisfactory completion of the pressure test.

There shall not be any leakage in the pipe or at the joint. A seepage allowance of a 2.5 liters per kilometer per hour per centimeter diameter of the pipe shall be permissible and that quantity will not be considered as leakage.

If the retest is delayed for more than 48 hours after any test has proved unsuccessful the Engineer-in-charge, after giving 24 hours' notice, shall have every right to get all defects rectified and carry out other necessary works and take hydraulic test/leakage test to the contractor. Any damage done to the pipes, materials, the other labour cost, etc. incurred there under shall be recoverable from the contractor either from his bill or deposit.

The responsibility of the contractor as specified above in case of unsuccessful hydraulic test shall not cease to exist by his pleading that any materials used by him in the pipe line was having cracked or was otherwise defective, as if he has a reason to believe so, he must refuse to accept such materials right at the stores.

If the first test is not found satisfactory, repeated tests will be taken and procedure mentioned above should be followed for testing till a satisfactory test is given. All testing shall be done at the risk of the contractors and they have to attend be done at the risk of the contractors and they have to attend all defects including repairing bursts, leaks at joints, sluice valve ends, caps etc. removing and replacing cracked pipes etc. These unserviceable articles shall be the property of the contractors and they shall arrange to remove the same from the site as directed by the Engineer.

Any portion of the pipe line that does not stand the specified pressure, shall be rectified by the contractor. Who should make his own arrangement for the water required for the testing.

When the section of the pipe line is tested successfully the contractor shall remove the blank flanges, pump out water from the pipes and back fill the portion as per directions of the Engineer.

The items include all materials and labour required to carry out the work as detailed above.

CAST IRON FITTING & SPECIALS:

Providing and supplying at site of work C.I. fittings/specials conforming to IS 1538/1993 with latest amendments.

The contractor shall have to procure required cast iron specials such as Tees, Bends of required degrees, reducers, collars, caps, plugs, tail pieces, etc. necessary for completion of this item as per site conditions.

The C.I. fittings and specials shall conform to IS 1538/1993 with latest amendments.

The fitting shall be stripped with all the precautions necessary to avoid warping or shrinking defects. The fitting shall be free from defects other than any unavoidable surface imperfection which results from the method of manufacture and which do not affect the use of the fittings.

The fittings shall be such that they could be cut, drill or machine.

The mass of C.I. fittings/specials shall strictly conform to IS 1538/1993 with latest amendments.

The contractor shall have to procure the required C.I. fittings or specials as per the site conditions and as per direction of Engineer-in-charge.

6.0 FULL BORE ELECTROMAGNETIC FLOW METER

1.0 MATERIAL AND MANUFACTURE

1.1 General :

Water meters and their parts in continuous contact with water shall be made of material resistant to corrosion and shall be non-toxic, where cast iron is used, it shall be protected suitably against corrosion.

1.2 Casting and body :

Casing:

The casing of the meter shall be made from cast iron conforming to Grade FG 200 of IS 210-1978

Body:

Body of the water meter shall be made of Grade Cu zn 40 of IS: 1261-1965. In case of enclosed type water meter, the liner shall be made of minimum 1.5 mm thick brass sheet conforming to IS:410-1977. The integral shape of the body shall ensure smooth flow of water and easy dismantling.

1.3 Connections :

The water meter shall be provided with flanges at both the ends. The flanges should be machined flat. The dimension and drilling of the flanges shall be in accordance with IS: 1538 (Part-IV)-1976 and IS: 1538 (Part-VI)-1976. For meters 50 mm size the dimension and drilling of the flanges and tolerances shall be in accordance with table-I of IS : 2373-1981.

1.4 Screws, Studs and Nuts :

Screws, Studs and Nuts shall be of Mild Steel i.e. corrosion resistant material.

1.5 Registration Box :

The registration box shall be made of the same material as specified for the body.

1.6 Cap :

The cap box shall be made of the same material as specified for the body. The cap shall be so designed and fixed to the registration box as to avoid entry of water and dirt. The transparent window which covers the dial, shall be inserted from inside into the cap. The protective lid shall be secured by a robust hinge or other suitable methods of robust construction.

1.7 Strainer :

Strainer shall be made of the same material as meter casing. They shall be rigid, easy to remove and clean and shall be fitted on the inlet side of the water meter. The strainer shall have total area of holes not less than twice the area of the nominal inlet bore of the pipe to which the meter is connected. Where strainer is installed outside the meter, it shall be at such a distance that it does not affect the accurate functioning of the meters.

1.8 Runners (Impellers) :

Runner of the meter shall be accurately balanced. It should be durable and should work with as low a friction resistance as possible. Impellers shall be one piece moulded up to 150 mm dia. water meter.

1.9 Runner Chamber :

The Runner chamber shall be rigid and shall not change its form as a result of internal stresses or with use.

1.10 Gears :

Gears shall be so constructed as to fully and smoothly mesh with each other and shall be firmly fitted on their shaft. Gears coming in contact with water shall be of stainless steel conforming to designation 07 Cr 18 Ni 9 of IS : 1570 (Part-V)-1972. In the helical type meter, the worm type gears shall be fitted on a shaft and the worm wheel shall be enclosed and protected against the incursion of solid particles.

1.11 Bearings:

Impeller bearing shall be suitably ground and polished. The shape of the impeller bearing shall be such as to prevent the penetration of particles of sand and to preclude the deposit of anything in solution or suspension in water and to facilitate the washing away of such deposits by water flow. The shaft of the gears shall revolve freely in their bearings.

1.12 Counting Mechanism :

The pointer shall be made of brass sheet conforming to IS: 410-1977. The indicating device shall be of the straight reading cyclometer type counter. The roller of the cyclometer counter shall be made of plastic especially suitable for the purpose and shall be such that it will not fade away under continued use.

The range of registration shall be as given in the Table-1 below.

Table-1
Range of registration of Flow meter
(Clause 2.3.1 and 2.5)

Nominal Size mm	Ranges of registration of water meters in liters	
	Minimum registration in division not to be more than	Maximum registration not to be less than
50	10	100000000
80	10	100000000
100	100	100000000
150	100	100000000
200	100	1000000000
250	100	1000000000
300	10	1000000000
350	100	1000000000
400	1000	10000000000
500	1000	10000000000

1.13 Dial :

The Dial shall be of vitreous enamel of suitable plastic, ensuring indestructible marking and good legibility. The unit of measurement namely “liters” or “Kilolitres” shall be marked on the dial as “liters” or “Kilolitres” in hold face, the min. cubic meters (m³) may also be used in place of kilolitres.

1.14 Sealing :

Sealing holes shall be provided and the meter shall be sealed in such a manner as render to inaccessible to the measuring unit including registration box and cap without breaking the seal. The sealing wire shall be rust proof such as turned copper.

1.15 Regulator :

Every meter shall be provided either an internal or an external regulator. The external regulator shall be accessible from outside to be operated by a suitable key without dismantling the meter and protected by a sealed cover. The internal regulating device shall not be accessible from outside.

1.16 Location of serial number :

Location of serial number of the meter shall be clearly indicated in any suitable place except the lid.

2.0 PERFORMANCE REQUIREMENT :**2.1 Temperature :**

The meter shall be suitable for use up to 450°C.

2.2 Hydraulic Test :

Meters shall satisfactorily withstand a pressure of 1.6 MPa (16 kgf/cm²).

2.3 Capacity rating for water meter :**2.3.1 Nominal capacity or short period rating :**

Vane-Wheel water meters shall be capable of giving discharge not less than as given in Table-2 without the head loss exceeding 10 Mts. within the meter. The helical meters shall be capable of giving discharge not less than as given in Table-2 without the head loss exceeding 3 mts. Within the meter.

Table-2
Nominal capacity ratings
(Clause 2.3.2 and 2.5)

Nominal Size mm	Capacity rating of water meters in liters per Hour	
	Vane-wheel type	Helical type
50	30000	50000
80	50000	125000
100	70000	200000
150	150000	500000
200	250000	800000
250	400000	1100000
300	500000	1500000
350	-	2000000
400	-	3000000
500	-	5000000

Table-3
Minimum starting flows
(Clause No.2.4)

Nominal Size mm	Minimum starting flows in liters per Hour	
	Vane-wheel type	Helical type
50	250	500
80	500	1000
100	700	1500
150	1000	3500
200	2400	5500
250	3200	9000
300	6400	14000
350	-	20000
400	-	25000
500	-	35000

2.3.2 Recommended capacities for intermediate flows:

Vane Wheel type water meters shall be capable of giving discharge not less than given in Table-3 without the head loss exceeding 3 mts. Within the meter, helical type water meters shall be capable of giving discharge not less than given in Table-3 without the head loss exceeding 1 mts. The head loss within the meter shall be measured in accordance with the method given in Appendix-B of IS: 2373-1981.

2.4 Minimum starting flow :

The minimum flow at which the meter starts registering shall be as give in Table-4.

2.5 Metering Accuracy :

The accuracy at lower limit of flow shall be calculated at 1/13th of the nominal capacities of water meter given in Table-2 at the lower limit of flow, the metering accuracy shall be + 2 % for both types of water meters. The same accuracy shall be compiled with at least up to intermediate floes specified in Table-3.

Note: This accuracy is attainable when the meter is flowing full under pressure.

MARKING:

2.1 Each water meter shall be marked with the following information:

manufacturer's mane of trade-mark;

Nominal size of the meter;

Direction of flow of water on both sides of the meter;

2.2 Each Water meter (With or without strainer)

3.0 TESTS :

3.1 Classification of Tests

Test shall be classified in to three grounds namely

Production routine test

Type test and

Acceptance test

3.1.1 Production routine tests :

These tests are carried out on each and every meter to check the requirements which are likely to vary during production (See 3.3)

3.1.2 Type Test :

These tests are carried out to provide conformity to the requirements of the relevant specifications. These are intended to check the general quality and design of a given type of meter (See 3.4). Once a meter has undergone type test any major or essential alternations, which the manufacturer intends to make shall be reported to the testing authority and further type test shall be carried out in accordance with the procedure laid down in this standard.

3.1.3 Acceptance Test :

Test carried out on samples selected from a lot for the purpose of acceptance the lot.

3.2 Samples for tests :

3.2.1 Type Tests :

Two meters in the case of 50 mm size and one meter in the case of 80 mm size and above shall be sent along with 4 copies of the manufacturer's detailed specification together with figures for the loss of head and accuracy curve to the recognized testing authority for the purpose of type test. The samples shall be picked up at random from stock or routine factory production.

3.2.2 Acceptance Test :

The number of samples shall be minimum one or 10 % of the ordered quantity.

3.3 **Production routine test :**

Production routine test shall be consist of

- a) Hydraulic test (See 2.2) and
- b) Tests conducted to determine the following performance requirements :
 1. Recommended capacity for intermediate flow (See 2.3.2)
 2. Minimum starting flow (See 2.4) and
 3. Metering accuracy (See 2.5)

Note: However, for meters 200 mm and above, flow test may be conducted

3.4 **Type test :**

Besides all the production routine tests outlined in 4.3, the type test shall be comprise those given in 4.4.1 and 4.4.2.

3.4.1 **Constructions :**

The meter shall be dismantled completely to its component parts and checked for conformity with regards to dimension and tolerances with this standard; in the case of meters of 50 mm size only.

3.4.2 **Flow Test :**

The meter (both the meter in the case of 50 mm size) shall then be subjected to the flow test to measure the following:

- a) Loss of head at nominal capacity (See 2.3.1) and recommended capacity at intermediate flows (See 2.3.2).
- b) Minimum starting flows (See 2.1) ad
- c) Metering accuracy (See 2.5)

Note -1: Before the meter is subjected to the flow test it shall be run and brought to normal condition by passing through them water at intermediate flow value for a period of 2 hours.

Note -2:

Type test certificate may be made available in lieu of flow test at manufacturer's premises. Results of the type test shall be reported in the form given in Appendix-C of IS: 2373-1981.

4.0 **Installation diagram or installation instructions should invariably be supplied with each meter to facilitate proper installation of water meters.**

5.0 Installation, Commissioning & malignance of water meters :

The ordered meters shall be installed as per the instruction of the consignee and it shall be commissioned properly. The same has to be maintained by the agency. For this purpose regular calibration shall be carried out as directed by Engineer in charge. Spare kit of water meter shall be kept during maintain period. There should not be a single day without working of water meter as this is required for measurement of flow. Any complained received during maintenance period for non-attendance of complaint the firm will be black listed & action will be taken accordingly. For finding error in calibration, the water meter should be changed within a day and such error found I replication should be considered seriously and the action up to black listing may be done by authority.

6.0 Payment :

Payment shall be made as per terms and condition of the tender agreement.

7.0 SPECIFICATION FOR OUTDOOR SWITCHYARD

2.1 GENERAL

- 2.1.1 The work consists of supply, erection, testing and commissioning of two pole / four pole M.S galvanized, H-frame structure, outdoor transformers, lightning arresters, isolators, dropout fuse, insulators and hardware, galvanized structure for supporting the equipment, ASCR conductors, outdoor cable termination, chain link fencing, pad lockable double gates and filling up sub-station area with rubble of 50 mm size to depth of 100 mm.
- 2.1.2 The substation consisting of transformer yards with L.A's., isolators, transformers, fence gate, 2 pole/4 pole structure shall be properly earthed as per IE Rules 1956.
- 2.1.3 The equipment shall conform to the latest applicable standards. All standards and code of practices referred to shall be the latest edition including all official amendments and revisions.

2.2 CONDUCTORS

- 2.2.1 The overhead line and jumpers shall be made by ACSR (Aluminum Conductor Steel Reinforced) conductor and shall conform to IS 398.
- 2.2.2 Aluminum strands of ASCR conductor shall be hard drawn from 99.5% pure electrolytic aluminum rods with 60% IACS conductivity. The Supplier shall specify the guaranteed minimum and average value of conductivity.
- 2.2.3 Chemical composition of the material shall comply with the requirements of relevant standards.
- 2.2.4 The surface of conductor shall be clean and dry and free from any excess grease that may be used in its fabrication. The surface strands shall be smooth and free from burrs and other projections, which may be cause for increasing corona losses when the conductor is used on extra high voltage lines.
- 2.2.5 No joints shall occur in aluminum wires closer together than 15 meters. No joints shall be permitted in steel wires.
- 2.2.6 The steel wire strands of ACSR conductor and steel conductor shall be hot dip galvanized. Zinc coating shall be evenly and uniformly coated complying with relevant Standards IS 2629/2633.

2.3 ISOLATOR AND EARTHING SWITCH

- 2.3.1 The isolators shall conform to IS: 9921 and IEC 600129.
- 2.3.2 The isolator with earthing switch shall be complete with all parts that are necessary for efficient operation. Such parts shall be deemed to be within the scope of supply, whether specifically mentioned or not.
- 2.3.3 The isolator design shall be such that it is free from visible corona discharge in both closed and open positions at the visible discharge test voltages as per applicable standards.
- 2.3.4 The isolator and earthing switch shall be provided with high current carrying contacts on the hinge and jaw ends. All contact surfaces shall be silver faced copper.
- 2.3.5 Earthing switch shall form an integral part of each pole of the isolator. Two independent earthing pads each with flexible copper braids and suitable

connectors for copper flat earth conductor lead shall be provided at the hinge end of the switch.

- 2.3.6 Isolators and earthing switches shall be provided with padlocking facility to lock them in fully open or fully closed positions. Rust proof padlocks shall be supplied with the isolators.
- 2.3.7 Isolators and earthing switch shall be mechanically interlocked such that it will not be possible to close the earthing switch when the isolator is closed and vice-versa.
- 2.3.8 Insulators used in the assembly of isolators shall be of porcelain and of brown color. Insulator cap and base shall be of high grade cast steel or malleable steel casting and they shall be machine faced and galvanized.
- 2.3.9 The operating mechanism for isolator and earthing switch shall be either manual or motorized as indicated in technical data sheet.
- 2.3.10 Operating mechanism shall provide a quick, simple and effective operation. One man shall be able to operate the isolator/earthing switch without undue effort.
- 2.3.11 The manual operating handles shall be mounted on the base of the supporting structure. Guide bearings shall be provided if necessary at a height of 750 mm above grade level. All brackets, angles, guides, guide bearings or other members necessary for attaching the operating mechanism and operating handles to the supporting structure and foundations shall be supplied as an integral part of the isolator. Rust-proof pins and bearings of the bronze bushing, ball and roller type, shall be furnished. All bearings shall be weather protected by means of covers and grease retainers. Bearing pressures shall be kept low to ensure long life and ease of operation.
- 2.3.12 Isolators and their operating mechanism shall be such that they cannot be dislodged from their open or closed positions by gravity, wind pressure, vibrations, chocks or accidental touching or breaking of the connecting rods or the operating mechanism.
- 2.3.13 All the supporting structures for isolators, earthing switches shall be of Galvanized steel.

2.4 H.V DROP OUT FUSES

- 2.4.1 Fuse assembly shall be complete with fuse carrier, post insulator, jaw and hinge, live parts, terminals, channel base, all fixing bolts, nuts and washers. Fuse links of specified current rating shall be supplied for use with these fuse assemblies.
- 2.4.2 All materials used in the manufacture of drop out fuses shall be suitable for conditions specified and shall withstand variations of temperature and atmospheric conditions without deterioration or distortion of any kind in any part. All non-metallic parts of fuse carrier shall be tough, non-ignitable insulating materials.
- 2.4.3 Mounting of drop out fuses shall be such that its isolation/ removal replacement shall be easy. It shall have positive guides for this purpose.
- 2.4.4 Bird proof construction features shall be provided.
- 2.4.5 It shall be possible to adjust spring pressure of the top contact to ensure consistent performance

- 2.4.6 All current carrying parts shall be of copper alloy. The contacts shall be of gunmetal brass or phosphor bronze. The contact surface shall be silver plated to ensure low contact resistance.
- 2.4.7 Fuse links shall be such construction as to prevent danger from overheating, arcing and scattering of hot metal or powder or emission of flame, when operating in service.
- 2.4.8 When the fuse link ruptures or when the fuse carrier is pulled downwards, the carrier shall swing free to an inverted position. The carrier shall be brought to a cushioning stop to eliminate shock on the carrier and lower insulator unit.
- 2.4.9 The base channel and all ferrous parts shall be hot-dip galvanized conforming to IS 2629/2633.
- 2.4.10 HV drop out fuse base channel shall bear a name plate describing the major technical particulars. Fuse base, fuse link and fuse carrier shall bear the markings as per IS.

2.5 LIGHTNING ARRESTER

- 2.5.1 Lightning arrester shall be of outdoor, metal oxide gapless type and shall conform to IEC 60099-4.
- 2.5.2 Lightning arresters (LAs) shall be of the hermitically sealed type of self-supporting construction, suitable for mounting on steel structures.
- 2.5.3 Outer insulators shall be of porcelain having adequate mechanical strength and rigidity, for satisfactory operation under climatic conditions obtaining at site. Porcelain shall be finely glazed and shall be free from imperfections.
- 2.5.4 LAs shall incorporate anti-contamination feature to prevent arrester failure, consequent to uneven voltage gradient across the stack in the event of contamination of the arrester porcelain.
- 2.5.5 LAs shall be complete with insulating base having provision for bolting to flat surface of supporting structure.
- 2.5.6 LAs shall be complete with line and earth terminals. The terminal clamps/connectors on the earth terminal of the arresters and the discharge counter incoming and outgoing terminals shall also be provided.

2.6 INSULATORS

- 2.6.1 The porcelain post insulators shall conform to IS 2544, IEC 60273, the insulators for overhead lines shall conform to IS 731, BS 60383, IEC 60305, 433 and the insulator fittings shall conform to IS : 2486, BS 3288
- 2.6.2 Porcelain used for the manufacture of insulators shall be homogeneous, free from flaws or imperfections that might affect the mechanical or dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown color, free from blisters, burns and other similar defects. The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed. Insulators shall have compression type glaze with a good luster and of uniform brown color.
- 2.6.3 Insulators shall be designed to avoid excessive concentration of electrical stresses in any section of electrical stresses in any section or across leakage surfaces. Design features which increase radio influence level shall be avoided.

- 2.6.4 All metal parts shall be made of good commercial grade malleable iron or open hearth or electric furnace steel, hot dip galvanized to relevant standards. Casting shall be free from blow holes, cracks and such other defects.

2.7 ACCESSORIES

- 2.7.1 An operating rod with provision at the top for switching and removing fuse carrier shall be provided. The rod shall be minimum 6.0 meter long unless otherwise stated.
- 2.7.2 Multi-bolt (bi-metallic) terminal clamps shall be provided at the top and bottom of fuse base contacts suitable for connection to the ACSR conductor.
- 2.7.3 Fuse kit shall be supplied, consisting of fuse-link assembly, refusing tool and any other item necessary to restore the fuse units to service after an operation.
- 2.7.4 H.V drop out fuse frame shall have two earthing terminals.

2.8 HARDWARE FITTINGS

- 2.8.1 All hardware shall be drop forged from high carbon steel.
- 2.8.2 All ferrous parts shall be hot dip galvanized conforming to IS 2629 & 2633.
- 2.8.3 All clevis fittings and shackles shall be furnished with a high strength high carbon steel galvanized bolt with nut and cutter key.

2.9 CLAMPS & CONNECTORS

- 2.9.1 The material for clamps and connectors shall be as indicated in technical data sheet.
- 2.9.2 The clamps shall be light in weight and easy to handle. Suspension clamp shall have ease of oscillation around horizontal axis and small moment of inertia enabling it to follow freely the movement of the conductor. The clamps shall have low effective power loss.
- 2.9.3 Connectors used for copper to ACSR conductor connections shall be aluminum alloy clamps with necessary cast in copper liners.
- 2.9.4 All casting shall be free from blow holes, surface blisters, cracks and cavities.
- 2.9.5 The Electrical power connectors shall conform to IS 5561, BS 159.

8.0 SPECIFICATIONS OF DOL, S/D and ATS MCC PANEL

Supply of fully automatic air break MCC Panel for operation on 415V, 3Ø, 50 Hz AC supply. The details of the equipment/accessories for the control panel shall be as per the given data sheet and rating chart. **The control panel manufacturer must be Board approved vendor list and must also possess ISO: 9001 certificate with Design, Development, Manufacture and Supply criteria.**

ENCLOSURE:

The MCC panel shall be dust and vermin proof, fabricated out of minimum 14 SWG sheet. It shall be wall mounting cum pedestal type/free standing type. All the items inside the control panel shall be mounted on minimum 16 SWG steel base plates. All the metal parts shall be thoroughly cleaned, degreased and made free from rust after the application of zinc chromate primer. The MCC panel shall be powder coated. The color shade shall be as per shade 631 of IS 5. The degree of protection shall be IP 51. The MCC panel shall have channel/legs/angle iron stand of 300 MM height for easy termination of I/C and O/G cables. The I/C and all O/G cables shall have bottom entry only.

WIRING & TERMINALS:

Power and control wiring shall be done with PVC insulated copper conductors and shall be terminated with adequately sized compression type lugs for connections to the equipment terminals and terminal strips. Each wire shall be identified at both ends by ferrules. Not more than two wires to be terminated at one terminal and size of terminals shall be used keeping in view the components for which they are used, so that adequate surface contact can be achieved. I/C and O/G to be made at terminals only. The minimum distance between the cable gland plate and the termination shall be 300 MM. Control wiring shall be done with 1.5 sq mm only. Wires used shall be of ISO 9001 accredited company.

EARTHING:

2 Nos. of earthing terminals shall be provided for connecting the earth. All non-current carrying metallic parts of the equipment shall be earthed. A separate CU strip 19 X 3 MM shall be provided through-out the width of the panel.

MAIN INCOMING:

A MCB/MCCB/ACB shall be provided as the Main I/C. The switchgear selection shall be as per type 2 co-ordination. Suitable Castell Key interlocks shall be provided for “two incomers and one bus coupler” type of configurations.

Depending on the fault withstand ratings, up to 40A rating, MCBs with suitable tripping characteristics shall be used. Above 40A and up to 630A, MCCB shall be used. Above 630A, ACB shall be used. ACB shall be Manually operated, D/O type with U/V trip, S/C trip and O/L trip.

MCCB shall be TP+N with shunt trip.

Moreover, the following components shall be provided in the MAIN I/C feeder.

- (1) R.Y.B Phase indicating LED lamps.
- (2) 20A X 415V HRC control fuses with 6A HRC links.
- (3) Sq.-96, Digital Voltmeter and Ammeter with selector switch.
- (4) Suitable range CTs for Ammeter.

SUB MAIN INCOMING:

A FSU/Isolator of AC-23 duty with door interlocking facility shall be provided as the Incoming of each feeder panels. The rating of FSU/Isolator and HRC fuses shall be as per the rating chart in IS: 13947 (Part 3) 1993.

CONTACTORS:

Contactors of AC-3 duty of 415V or with wide band coil of 320-480V shall be provided. The ampere rating shall be as per the rating chart and the data sheet.

TIMER:

An electronic timer for S/D change-over having 50 msec pause time delay shall be provided for S/D and ATS control panels only. In case of ATS control panels, a master timer (electronic) shall also be provided. This master timer shall operate within 15 seconds, if the S/D timer fails to operate within 10 seconds.

O/L RELAY:

O/L relay of suitable range shall be provided as specified below. The O/L relay shall have inbuilt SPP feature and must have manual reset facility. In case of DOL and ATS panels, relay range shall be decided by multiplying min. 1.3 times and max. 1.5 times the HP rating of the motor. In case of S/D panels, it shall be decided by multiplying 0.6 of min. 1.3 times and max. 1.5 times the HP rating of the motor.

INDICATING LAMPS:

22.5 dia, clustered LED type indicating lamps with inbuilt resistor shall be provided as specified in the data-sheet.

PUSHBUTTONS:

22.5 dia, Red, Green, Yellow and Black pushbuttons shall be provided for STOP, START, TIMER and O/L RESET respectively for ATS panels. Red, Green and Black pushbuttons shall be provided shall be provided for STOP, START and O/L RESET respectively for DOL and S/D panels.

SINGLE PHASING PREVENTOR:

S.P.P of negative phase sequence principle, voltage operated with U/V and O/V cut off at 320V and 480V respectively shall be provided.

EARTH LEAKAGE RELAY:

ELR having 0.5 seconds time lag to avoid nuisance tripping and with suitable dia C.B.C.T shall be provided of 0.5 to 2.5A range. E.L.R shall have a bypass toggle switch to bypass the same in case of emergency.

AMMETER:

Digital Ammeter of 96 sq. mm size shall be provided. An Ammeter selector switch shall also be provided to read current in each phase.

CONTROL FUSES:

20A X 415V HRC control fuses along with 6A HRC fuse links shall be provided for the control circuit.

AUTO-TRANSFORMER:

Air cooled auto-transformer of 6 starts/hour having 60%, 70%, 80% tapings shall be provided. It shall be copper wound with 'E' class insulation. The winding shall withstand starting current for at least 15 seconds. It shall be vacuum impregnated for longer life. The % regulation shall not exceed 10%. It shall be in accordance as per the latest IS 13947 (Part 4/sec 1) of 1993 (for ATS panels only).

CAPACITOR FOR MOTORS:

A capacitor of 415V shall be provided as per the rating chart. Capacitor shall be MPP type, GEB tested (certificate required). HRC fuses shall be provided before capacitor. The rating of the HRC fuses shall be as per rating chart. An electronic Delay timer along with contactor as per rating chart shall be provided for automatic switching of capacitor. The capacitor shall switch on after one- minute the motor starts. A selector switch for AUTO-MANUAL selection shall also be provided. STOP-START pushbuttons shall be provided in case of manual operation. A LED indicating lamp shall be provided for 'ON' indication.

Alternatively, APFC relays with bulk power factor correction units shall be provided.

In all cases, suitable calculations shall be provided to ensure the rating of capacitors is appropriate for correcting the power factors.

CAPACITOR FOR POWER TRANSFORMER:

In order to take care of Inductive load of Power transformer, a MPP capacitor bank rated for 415V shall be provided along with HRC fuse protection as mentioned in the rating chart. The kVAR of capacitor shall be provided to ensure a power factor of 0.99.

BUSBARS:

TPN Busbars shall be of Aluminum, duly sleeved with heat shrinkable colored sleeves. The current density of the Al. Busbars shall be 1 Sq. mm = 1A. The size of the phase Busbars shall not be less than the Ampere rating of the Main Incoming. The neutral bus bar shall be of 50% of the phase Busbars. Bus bar supports shall be of SMC/DMC type.

LIGHTING FEEDER:

Nos. of 63A FSU/Isolator of AC-23 duty shall be provided along with HRC fuses in a separate compartment for domestic lighting.

THERMISTOR and MLC:

Thermostat and Moisture level controller (MLC) shall be supplied along with bypass toggle switch in case of Sewage control panels only. Relevant indicating lamps for each unit shall also be provided on the front door of the panel. The control panel shall be as per the enclosed rating chart, data sheet and Makes specified only. The contractor shall have to submit 2 copies of GA drawing, Bill of Materials and Wiring diagram for the approval to the Executive Engineer, prior to manufacturing.

Following tests shall be carried out at manufacturer's works at his own cost and risk

- (01) Single phasing in each phase and 15% unbalance voltage tripping.
- (02) U/V and O/V cut off at 320V and 480V respectively.
- (03) Leakage current test.
- (04) H.V test at 2.5 KV for Power circuit & 1.5 KV for Control circuit.
- (05) H.V test between phases.
- (06) Temperature rise test on ATS as per IS 13947 (Part 4/Sec I)-1993.
- (07) Percentage regulation test not exceeding 10%.
- (08) Megger test.

RATING CHART FOR O/G FEEDERS

Sr. No.	HP Up to	SFU/ SWITCH		HRC FUSES		CONTACTORS FOR STAR, DELTA, MAIN CAP.		HRC FUSES FOR CAP.	CAP. KVAR
		3	4	5	6	7	8		
01	DOL 5.0	16A	16A	---	---	16A	16A	10A	2
02	DOL 7.5	25A	25A	---	---	25A	16A	16A	3
03	S/D 10.0	25A	25A	16A	16A	16A	16A	16A	4
04	S/D 15.0	32A	32A	25A	25A	25A	16A	16A	5
05	S/D 20.0	40A	40A	32A	32A	32A	16A	16A	6
06	ATS 25	63A	50A	16A	25A	70A	16A	20A	7
07	ATS 30	100A	63A	25A	32A	70A	25A	20A	8
08	ATS 35	100A	80A	32A	40A	70A	25A	25A	9
09	ATS 40	100A	80A	32A	40A	80A	25A	25A	10
10	ATS 45	100A	100A	32A	40A	95A	25A	32A	12
11	ATS 50	125A	100A	40A	70A	100A	32A	32A	13
12	ATS 55	125A	125A	40A	70A	125A	32A	40A	14
13	ATS 60	125A	125A	40A	70A	125A	32A	40A	15
14	ATS 70	200A	160A	40A	70A	170A	40A	63A	17
15	ATS 75	200A	160A	45A	100A	170A	40A	63A	18
16	ATS 80	200A	160A	50A	100A	200A	40A	63A	19
17	ATS 90	200A	160A	50A	100A	200A	40A	63A	21
18	ATS 100	200A	160A	50A	125A	200A	65A	80A	23
19	ATS 125	250A	225A	70A	140A	250A	65A	80A	27
20	ATS 150	300A	250A	110A	170A	300A	100A	100A	33
21	ATS 170	400A	350A	150A	200A	300A	125A	100A	37
22	ATS 200	400A	400A	170A	200A	400A	125A	125A	42
23	ATS 250	630A	500A	200A	300A	630A	150A	160A	50

Note: - The switchgear and contactors used inside the control panel shall be of one make only. Usage of different makes of switchgear and contactors is not at all permissible.

9.0 TECHNICAL SPECIFICATION FOR 11 / 0.433KV TRANSFORMERS, HIGH VOLTAGE / LOW VOLTAGE EQUIPMENT

SPECIFICATION FOR DISTRIBUTION TRANSFORMER OIL TYPE.

The bidder has to quote for the following types of distribution transformers. The transformer should be as follows:

Specification for 11/0.433kV OIL Type Distribution Transformer

1.0 General Information

All equipment and material shall be designed manufactured and tested in accordance with the latest applicable Indian Standard, IEC standard and CBIP manuals except where modified and / or supplemented this specification.

The electrical installation shall meet the requirement of Indian Electricity Rules as amended up to date, relevant IS code of practice and Indian electricity act. In addition other rules of regulations applicable to the work shall be followed.

The Transformer offered shall in general comply with the latest issues including amendments of the following Indian standards.

2.0 Code and Standards

The transformer shall comply with the latest edition of the following and other relevant Indian Standards / Manual:

IS 335;	Insulating oil
IS 1271:	Thermal evaluation and classification of electrical Insulation
IS 1180:	Specification of Transformers from 100kVA to
2.5MVA	
IS 2026:	Power Transformers
IS 2099:	Bushing for alternative voltages above 1000V
IS 2705:	Current transformer
IS 3347:	Dimension for porcelain transformer bushings.
IS 3637:	Gas operated relays
IS 3639:	Fitting and accessories for power transformers
IS 4201:	Application guide for CTs
IS 6600:	Guide for loading of oil immersed transformer
IS 8478:	Application guide for ON load tap changers
IS 8468:	On load tap changers
IS 10028:	Code practice for selection, installation and Maintenance of transformer
IS 13947:	LV Switchgear and Control gear – Part – I General rules
CBIP Manual	on transformers

IS 2074: priming	Ready mixed paint, air drying red oxide, zinc chrome
IS 5:	Color of ready mix paint
IEC 76:	Power transformer
IEC 76.2 or IEC IEC-76-1 or IEC 726 or IS:2026	Temperature limits (All Parts)
IEC-298, or IEC 466	High voltage Switch gear and Control gear
IEC-947-1, IEC-439-1	Low voltage Switch gear and Control gear
IS:1180 IS:2026	For distribution transformers
IEC-550 (151):1978 IS:1885	SEV Chapter 151 Electro magnitude devices.
IEC-60-1:1989	High voltage test Technique Part-I.
IS:2017 Part I	General definition and test requirements.
IEC-68-2-62:1991:	Environmental testing – part 2, tests impact amendment1(1993)
IEC-71-2:1976 guide IS:3716	Insulation co-ordination Part 2 Application
IEC:76-1:1993	Power transformer Part I general
IS:2026 (Part I)	
IEC 76-2:1993	Power transformer Part 2 temperature rise.
IEC 76-5, 1976	Power transformer Part 5 ability to withstand short circuit test
IEC:243-1,1988:	Methods of tests for Electric strength of solid insulating
IS:258-1	Material Part – I test and power frequencies.
IEC: 354:1991: IS:6600	Loading guide for oil immersed power transformer.
IEC: 551:1987: IS:13964	Determination of transformer and reactor sound level.
IS:2932:	Enamel synthetic, exterior a) under coating b) Finishing
IS:3347:	Dimension of porcelain transformer bushing for use in very heavily polluted atmosphere
Indian Electricity Rules: 1956	
Indian Electricity Act: 1910	
The Electricity Act: 2003	

Transformer shall also conform to the provisions of the latest revisions of the Indian Electricity rules and any other statutory regulations currently in force as per standards.

3.0 DESIGN CRITERIA

The transformers shall be installed in hot, humid tropical atmosphere. All equipment accessories and wiring shall be provided with tropical finish to prevent fungus growth.

The transformers shall be capable of continuous operation of rated output under the operating conditions of voltage and frequency variations as per statutory limits governed by relevant Indian Standard and Indian Electricity Rules, 1956 / IEC with latest amendments in force.

The transformer shall conform to best engineering practice.

The transformers shall be capable of withstanding the short circuit stresses due to terminal fault between phase to phase and phase to ground on one winding with full voltage maintained on the other windings for a minimum period of three seconds.

The transformers shall be free from annoying hum or vibration. The design shall be such as not to cause any undesirable interference with radio or communication circuits.

The equipment offered shall be suitable for continuous satisfactory operation in the state of Gujarat.

4.0 SPECIFIC REQUIREMENT:

- 4.1 **Requirement:** 11000/433 Volt Oil immersed ONAN cooled double wound, core type suitable for outdoor duty.
- 4.2 **Voltage Ratio:** No load voltage 11000/433 volts within tolerance as stipulated in IS: 1180.
- 4.3 **Rating:** The transformer shall have a continuous rating as specified at any of the specified tapping position and with the maximum temperature rise specified. The rated KVA shall be the product of the rated voltage in kV, the corresponding rated current and the phase factor 1.73. When the transformer is operated with the rated primary voltage applied to the terminals of the primary winding, the apparent power (kVA) at the terminals of the secondary winding, when carrying the rated secondary current differs from rated kVA by an amount corresponding to the regulation of the transformer and is the product of the actual secondary voltage, the rated secondary current and phase factor 1.73.
- 4.4 **System:** 11000 volts A.C. supply, on H.V. side and 433 Volts on L.V. side with variations, as per statutory variation governed by relevant Indian Standard and Indian Electricity Rules, 1956 / IEC with latest amendments in force. The 11kV neutral and L.V. neutral is earthed solidly at each transformer substation. The transformers will be connected in a system consisting of both overhead and underground mains (both on HV and LV sides)

- 4.5 **Temperature Rise:** The maximum temperature rise at the specified maximum continuous output shall not exceed 40°C by thermometer in the hottest portion of the oil or 50°C measured by resistance of winding above ambient temperature.
- 4.6 **Type of Load:** The transformer shall be suitable for carrying load within temperature rise indicated in the Indian Standard specification IS: 6600 'Guide for loading of oil immersed Transformer'.
- 4.7 **Overloads:** The transformers shall be suitable for carrying overload within temperature rise indicated in IS: 6600 'Guide for Loading of oil immersed Transformer'.
- 4.8 **Connections:** H.V. Delta and L.V Star connected with neutral brought out on the secondary side for connection to earth; Vector group DYn11 of IS:1180.
- 4.9 **Tapping:** Each transformer shall be provided with Rotary type tap Switch so as to provide for a voltage adjustment on H.V. from +10% to -10% of rated voltage of 11000 volts in 4 equal steps (5 position) to obtain rated voltage of 433 volts on LV side.

4.10 Tank

The transformer tank and cover shall be fabricated from robust M.S. plate steel without pitting and shall have adequate thickness, with external cooling tubes or radiators. The tank and cover shall be of welded construction. All seams shall be welded and where practicable they shall be double welded. All edges shall be double welded. The tank wall shall be reinforced by stiffener to ensure rigidity, so that it can withstand without any deformation

- (a) Mechanical shock during transportation
- (b) oil filling by vacuum.

All removable covers shall be provided with weatherproof, hot oil resistant, resilient gaskets. The design shall be such as to prevent any leakage of water into or oil from the tank.

The tank shall be subjected to a pressure test of **0.35 kg/cm²** with hot oil for **12 hours** when the transformer is complete with all fittings. During the test average oil temperature shall be maintained at 45°C above Ambient temperature throughout test period by circulating suitable current in HV winding and short circuiting L.V. winding. There shall be no leakage of oil during or after the test. Also there shall be no deflection at all when the pressure is removed. The purchaser's representative may be present during these tests for which advance intimation shall be given and **test**

Certificate for this test shall be produced by the supplier in triplicate before dispatching the units.

Air release plugs shall be provided on main tank top cover to cover entire area suitably.

- a) Inspection covers shall be provided to facilitate individual inspection, without lifting the tank cover, for the following:
- b) Connection of primary winding to cable box/disconnection chamber bushings.
- c) Connection of secondary winding to cable box/disconnection chamber bushings.
- d) Main tank center for core/winding inspection.

6.0 Oil: The necessary quantity of new transformer oil according to IS: 335 shall be supplied filled in the transformer tank & up to a height above the minimum filling mark of hermetically sealed tank. The Supplier shall furnish the relevant technical particulars and test certificates of the oil supplied. An additional 10% of the total quantity of oil required shall be supplied loose along with the transformer.

1. **Leakage of Oil:** Suitable approved type of material such as "Neoprene" which has an oil proof agent, as specified in IS: 1866 shall be provided at all joints to prevent leakage of oil during continued operation or during transportation.
2. **Drying-out:** The transformer winding shall be thoroughly dried out & kept immersed in oil to avoid any further drying out by the purchaser & to facilitate immediate commissioning of the transformer on receipt.
3. **Clamping of leads:** All leads from the coils to the terminals shall be suitably clamped to prevent snagging and fouling with other parts and the tank.
4. **Phase Marking:** Phase markings as per IS: 1180 punched on small non-corrosion metallic tags shall be permanently fixed for H.V. just below the cable box or on some suitable removable part of the tank and above L.V. Bushings. Phase markings tags shall be properly fixed with proper alignment.

6.1 Core and Coil

6.2 The core shall be constructed from high grade, cold rolled, non-ageing, low loss, high permeability, grain oriented, cold-rolled grain oriented silicon steel laminations. The transformer shall be so designed as to have minimum humming noise. The percentage harmonic potentials with the maximum flux density under any conditions shall be such that capacitors connected in the system shall not be overloaded.

6.3 The coils shall be manufactured from electrolytic copper conductor and fully insulated for rated voltage.

- 6.4 Insulating material shall be of proven design. The insulating materials shall be class "A" or above specified as per IS: 1271. Coils shall be so insulated that impulse and power frequency voltage stresses are minimum.
- 6.5 Transformers will be connected at the end of 11 kV and 0.433 kV overloaded feeders, in a lightning prevalent area.
- 6.6 The coil assembly shall be supported suitably between adjacent sections by insulating spaces & barriers. Brazing shall be arranged to ensure a free circulation of the coil & to reduce the hot spot of the winding.
- 6.7 All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used wherever practicable.
- 6.8 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer. The core and coil assembly shall be capable of withstanding without injury, the thermal and mechanical effects of short circuit at the terminals of any winding as per IS:2026.
- 6.9 The efficiency of the transformer shall be as indicated in the IS 1180.

7.0 List of Fittings:-

- a. Conservator with filling cap and drain plug.
- b. 2 Nos. of Lifting lugs on top tank lid for lifting the complete transformer.
- c. Silica Gel breather of Minimum 500 Gms.
- d. Drain valve with suitable protection to stop theft of oil.
- e. Shut Off valve between Conservator tank and main tank body.
- f. 4 Nos. of Jacking lug of suitable size
- g. Filter valve with Plug
- h. Rating & diagram plate of stainless steel.
- i. 4 Nos. of Earthing terminals on tank body.
- j. All terminals of HV & LV side should be properly marked.
- k. Off circuit tap changer bridge type for voltage variation on HV side preferably with 5 taps in steps of 2.5%.
- l. Explosion vent
- m. Air release plug on the top tank body for releasing the trapped air.
- n. Corrugated type radiators for cooling on all four sides.
- o. 3Nos. of HV bushings, Porcelain type.
- p. 4Nos. of LV bushings, Porcelain type.
- q. 4Nos. of MS Rollers
- r. 4 nos. of Anchor point for haulage.
- s. Thermometer pocket on top of the tank lid for dial type thermometer (OTI) with alarm & trip contact.
- t. Thermometer pocket for stem type thermometer.

8.0 TESTS for Oil Type Distribution Transformer

ROUTINE TESTS (As per IS 2026)

The following tests are to be carried out as per IS 2026, clause 13.2.

- i. Measurement of winding resistance
- ii. Measurement of voltage ratio & check the voltage vector relationship
- iii. Measurement of impedance voltage (principal tapping), short circuit impedance & load loss all shall be corrected to a temperature of 75 °C
- iv. Measurement of no load loss and current
- v. Separate source withstand voltage
- vi. Induced over voltage withstand
- vii. Dielectric Test of Oil

TYPE TESTS (As per IS 2026)

- i. Measurement of winding resistance
- ii. Measurement of voltage ratio & check the voltage vector relationship
- iii. Measurement of impedance voltage (principal tapping), short circuit impedance & load loss all shall be corrected to a temperature of 75 °C
- iv. Measurement of no load loss and current
- v. Separate source withstand voltage
- vi. Induced over voltage withstand
- vii. Dielectric Test of Oil

SPECIAL ACCEPTANCE TEST (As per IS 2026)

- i. Short Circuit test
- ii. Acoustic Noise Level Test
- iii. Oil Leakage Test by application of pressure.

MISCELLANEOUS

- All components parts and auxiliary equipment such as bushings, tap changing gear, etc. shall be routine tested as per relevant Indian Standards.
- The manufacturer shall have the necessary laboratory grade instruments and equipment for carrying out all routine and type tests and get these calibrated at frequent intervals.
- The transformers (including tap change gear) shall be capable of withstanding without damage the thermal and mechanical effects of short circuits at the terminals of any winding or the periods as provided by latest IS:2026/Part1/1977. The manufacturer shall supply the calculation for short circuits in case required by purchaser.

C .SPECIFICATION FOR LT SYSTEM

LT compartment shall be suitable to house the equipment as per the indicative Single Line Diagrams. The bus bar ratings shall be same as the incoming circuit breaker ratings.

The design should comply for the following standards.

1. IEC-439-1, 1992 Low voltage Switch gear and Control gear assemblies Part-I, type tested and partially type tested assemblies.
2. IEC-947-1, 1998 Low voltage Switch gear and Control gear Part-I general rules.
3. IEC-1180-1, 1992 High voltage test techniques for low voltage equipment Part-I definition test and Procedure requirement
4. IEC-529, 1989 Degree of protection provided by enclosures (IP code)

EQUIPMENT SPECIFICATION

1. Air circuit breaker (ACB)

These shall be fixed type with manually operated mechanism. The short circuit mechanism and breaking capacity as shall be supported by test certificate. The test certificates should be from CPRI / any Govt. approved recognized test house / laboratory.

The circuit breaker shall be fitted with CT operated thermal overload and short circuit releases devices for current rating 1250Amps.

- a) Overload releases should be settable from 50% to 100% of the rated current In.
- b) Ambient temperature compensated type and there should not be de-rating of ACB current carrying capacity at 40°C. The testing of ACB for the temperature rise shall be carried out by the manufacturer as per the prevailing, IS / IEC or any other international standards.
- c) ACB shall be provided with overload and short circuit release. Short circuit release should have settable value of 15kA to 25kA with an adjustable times having setting range of 40 – 460 m seconds, to have a proper co-ordination with short circuit release of outgoing MCCBs.

- 1) 3 phase, 4 wire, neutral earthed having link arrangement.
- 2) Rated current thermal current - As per indicative SLDs
- 3) Service voltage - 415 volts
- 4) No. of break / pole - one
- 5) Frequency - 50 c / s
- 6) Rated insulation voltage - 1000 volts
- 7) Rated short circuit breaking capacity
Rated services S/C breaking capacity Ics (rms) – 50kA

- Rated ultimate S/C breaking capacity I_{cu} (rms) – 50kA
- 8) Break Time - less than 40ms
 - 9) S/C making capacity I_{cm} (peak) - 125kA
 - 10) Rated short time withstand current: I_{cw} 50kA for 1 sec.
 - 11) Suitable for outdoor installation.
 - 12) It shall conform to IS 13947 / pt.2 / 1993 with latest amendment, if any.
 - 13) Performance category: Utilization category – B.
 - 14) The status of open and close shall be clearly visible.
 - 15) The trip indication separated for overload and individual phase wise trip indication for short circuit to be provided.
 - 16) The ACB shall have the provision to lock the operating mechanism in off position.
 - 17) The operating mechanism should be form front and the compartment should have the degree of protection IP – 54.
 - 18) Separator shall be provided between all phases inside. ACB enclosed to prevent travel of arc during short circuit.
 - 19) The CTs mounted for thermal overload release shall have secondary winding inaccessible including tripping mechanism of O/L and magnetic releases to avoid tampering CTs should also have provision of separators.
 - 20) Two nos. earthing bolts for propose of earthing of ACB may also be provided & suitable for G.I stay wire of size 7 / 10 SWG.
 - 21) The bus bar size shall be confirming to relevant IS and the neutral bus bar shall be of same wire of size as phase bus bar and should be suitable for connecting neutral.
 - 22) The ACB shall be tested in accordance with the provision of IS 13947 – Part I or relevant IEC

2. Moulded case circuit breaker (MCCB)

1. The rating for MCCB shall be as per indicative SLD having $I_{cu} = I_{cs}$ with TMD fixed type release.
2. MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing.
3. MCCBs shall have an ultimate short circuit capacity not less than the prospective short circuit current at the point of installation.
4. MCCBs shall have a service short circuit breaking capacity equal to the ultimate short-circuit capacity.
5. Each pole of MCCB shall be fitted with a bi-metallic thermal element for inverse time delay protection and a magnetic element for short circuit protection. Alternatively, they shall be fitted with a solid state protection system. Such a protection system shall be fully self-contained, needing no separate power supply to operate the circuit breaker tripping mechanism. Thermal element shall be adjustable. Adjustments shall be made

simultaneously on all poles from a common facility. Thermal elements shall be ambient temperature compensated.

6. The MCCBs shall be provided with the following features.
7. Common trip bar for simultaneous tripping of all poles
8. Shrouded terminals
9. Time for clearing short circuit current of 20 msec.
10. 2 NO + 2 NC auxiliary contacts

3. Interconnecting bus bar

Bus bar shall be of high conductivity aluminum (E91E) supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in BIS. The main bus bars shall have uniform current ratings throughout their length as specified in data sheet / job specification. The current rating of the neutral shall be half that of the phase Busbars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.

Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar, joints and supports.

The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95°C for normal operating conditions.

The current rating of the bus bars shall be 1600A for design ambient temperature at site conditions and for being inside the cubicle at fully loaded condition. The vendor shall suitably de-rate the nominal rating to suit the above condition.

Minimum clearance between live parts, between live parts / neutral to earth shall be 19mm. However clearances between terminals at components shall be as per applicable individual standard for components.

Interconnections between the main bus bars and individual units shall be made using vertical / horizontal aluminum bus bars of adequate rating.

Auxiliary supply

3 phase with neutral, 440V AC supply shall be tapped from main bus bar after the ACB/MCCB for supply to lighting of the substation. Necessary protection in incomer and outgoing shall be provided.

i. Miniature Circuit Breaker (MCB)

1. MCB shall be hand operated, air break, quick make, quick break type.

2. Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.
3. Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. The magnetic element tripping current classification shall be of the type suitable for the connected load. Where this is not specified, it shall be Type C.
4. The short circuit rating shall be not less than that of the system to which they are connected.

ii. Contactors

1. The power contactors used in the switchboard shall be of, air break, single throw, triple pole, electromagnetic type. Contactors shall be suitable for uninterrupted duty and rated for Class AC3 duty in accordance with the latest edition of IS 13947.
2. Operating coils of all contactors shall be suitable for operation on 240 V, single phase, 50 Hz supply.
3. Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts.
4. Contactors shall not drop out at voltages down to 70 % of coil rated voltage.
5. All contactor shall all be provided with single phasing preventer (SPP).
6. Motor starters shall be complete with auxiliary relays, timers and necessary indications.

iii. Switch Disconnectors and Fuses

1. LV switch Disconnectors shall be of the load break, fault make, group operated type. For use on 3-phase systems, the switches shall be of the triple pole type with a link for neutral wire. For use on single phase system and DC systems, the switches shall be of the two pole type.
2. Switch Disconnectors shall be of the heavy duty, quick make and quick break type. Their contacts shall be silver plated, and contact springs shall be of stainless steel. Their handles shall have provision for locking in both fully open and fully closed positions. Mechanical ON-OFF indication shall be provided.
3. Switch Disconnectors for controlling motor circuits shall be of the load break, fault make type, and shall be capable of breaking locked rotor current of the associated motor.
4. Where combination units of switch Disconnectors and fuses are used, the following interlocks shall be incorporated.

5. The fuses should not be accessible unless the switch Disconnectors is in fully open condition.
6. It should not be possible to close the switch Disconnectors when the fuse cover is open, but an authorised person may override the interlock and operate the switch Disconnectors. After such an operation, the cover shall be prevented from closing if the switch Disconnectors is left in the "ON" position.
7. All fuses shall be of the HRC cartridge type, mounted on plug-in type of fuse bases. Fuses shall be provided with visible indicators to show that they have operated. Current vs. time characteristics of all types of fuses shall be furnished to the Engineer's Representative.
8. Fuses and links functionally associated with the same circuit shall be mounted side by side.
9. An adequate number of spare fuse cartridges of each rating shall be supplied and fitted in clips inside the panel.

iv. Instrument Transformers

1. Current transformer (CT) shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block.
2. CT shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit current.
3. CT core laminations shall be of high grade silicon steel and CT shall be cast resin/tape wound type.
4. Identification labels giving type, ratio, output and serial numbers shall be provided.
5. Secondary winding of voltage transformer (VT) shall be rated for a three phase line to line voltage of 110 V.
6. Protection for primary winding of VT shall be provided with current limiting fuses and secondary winding of VT shall be provided with HRC fuses/ MCB. Primary fuses shall be rated to interrupt short circuit current corresponding to the switchgear rating.
7. It shall be possible to replace the VT fuses easily without having to de-energise the main bus bar.

v. Control and Selector Switches

1. Control and selector switches shall be of the rotary type, having enclosed contacts, which are accessible by the removal of the cover. Control and selector switches for instruments shall be flush mounted on the front of the panels and desks.
2. All control switches shall be of the spring return to normal type and shall have momentary contacts. Selector switches shall be of the stay-put, maintained contact type.

vi. Indicating Instruments & Meters

1. Electrical indicating instruments shall be 96 mm square with 240° scale. Taut band type of instruments is preferred.
2. Instrument dials shall be white with black numbers and lettering.
3. Normal maximum meter reading shall be of the order of 60 % normal full scale deflection. Ammeters for motor feeders shall have suppressed scale to show current from full load up to six times the full load current.
4. Watt-hour meters shall be of the induction type and shall be provided with reverse running stops.
5. Instruments shall have an accuracy of Class 1.0.

RELAY CO-ORDINATION

Bidder shall ensure proper relay co-ordination between 11 kV switchgear & LT ACB & other downstream protection equipment. The bidder shall provide calculation in support of the same.

Routine Test

The tests shall be carried out in accordance with IEC 62271-202 include but not necessarily limited to the following:

- i. Dielectric test on the HV interconnection.
- ii. Test on auxiliary and control circuits.
- iii. Functional tests.
- iv. Verification of correct wiring.
- v. Test after assembly on site.

Type Test

The tests shall be carried out in accordance with IEC 62271-202 include but not necessarily limited to the following:

- i. Tests to verify the insulation level of the prefabricated substation.
- ii. Tests to prove the temperature rise of the main components contained in a prefabricated substation.
- iii. Tests to prove capability of the main and earthing circuits to be subjected to the rated peak and rated short-time withstand currents.
- iv. Functional tests to prove satisfactory operation of the assembly.
- v. Tests to verify the degree of protection.
- vi. Test's to verify the withstand of the enclosure of the prefabricated substation against mechanical stress.
- vii. Internal arc test.
- viii. EMC compatibility tests.

Type test certificate of PSS, if so desired by the customer, shall be furnished.

TEST WITNESS

All tests shall be performed in presence of owner's representatives, if so desired by the Owner. The Contractor shall give at least fifteen (10) days advance notice of the date when tests are to be carried out.

TEST CERTIFICATES

Certified reports of all the tests carried out at the works shall be furnished in three (3) copies for approval of the Owner.

The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.

13.0 DRAWING APPROVAL

The bidder has to take the approval for the various components of the electrical system before start of manufacturing.

MANUAL

The bidder has to provide the complete manual for the operation of the breaker as well as all the other switchgear components.

10.0 CABLES

1.0 SCOPE:

This section shall cover supply and installation of cables.

2.0 STANDARDS:

The following standards and rules shall be applicable:

IS : 1554 PVC insulated electric cables (heavy duty).
IS : 3961 Recommended current ratings for cables.
IS : 8130 Aluminum conductors for insulated cables
Indian Electricity Act and Rules.

3.0 MEASUREMENTS:

The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery

to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable.

4.0 GENERAL:

The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in original drums with manufacturer's name, size, and type, clearly written on the drums.

5.0 MATERIAL:

Medium voltage cable shall be PVC insulated. PVC sheathed, aluminum or copper conductor, armored and unarmored heavy duty, conforming to IS : 694 Part I & II, IS : 1554 Part I.

5.1 TYPE:

The cables shall be circular, multi core, annealed copper, PVC insulated and PVC sheathed, armored.

5.2 CONDUCTOR:

Uncoated, annealed copper / Aluminum of high conductivity, upto 4 mm.² size the conductor shall be solid and above 4 mm.² conductors shall be concentrically stranded as per IEC: 228.

5.3 INSULATION:

Polyvinyl chloride (PVC) or XLPE extruded insulation as per IEC 502.

5.4 CORE IDENTIFICATION:

Two cores	:	Red and Black
Three core	:	Red, Yellow and Blue
Four core	:	Red, Yellow, Blue and Black
Single core	:	Green, Yellow for earthing

Black shall always be used for neutral.

5.5 ASSEMBLY:

Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.

5.6 ARMOUR:

Galvanized steel flat strip / round wires applied helically in single layers complete with covering the assembly of cores.

For cable size up to 25 Sq. mm.

Armor of 1.4 mm dia G.I. round wire

For cable size above 25 Sq. mm:

Armors of 4 mm wide 0.8 mm thick G.I. strip

5.7 SHEATH:

5.7.1 Polyvinyl chloride (PVC), 70 deg. C. Rated extruded as per IEC: 502.

5.7.2 Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables.

5.7.3 Outer sheath shall be of an extruded type layer of suitable synthetic material compatible with the specified ambient and operating temperature of cables and with FRLS compound. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The color of outer sheath shall be black.

5.8 RATING:

up to and including 1100 Volts.

6.0 GENERAL:

All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.

The cable shall be supplied in single length i.e. Without any intermediate joint or cut unless specifically approved by the client.

The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.

7.0 TESTING:

7.1 FINISHED CABLE TESTS AT MANUFACTURER'S WORKS:

The finished cables shall be tested at manufacturer's works. Following routine tests for each and every length of cable and copy of test results shall be furnished for each length of cable along with supply. If specified, the cables shall be tested in presence of client's representative.

7.1.1 VOLTAGE TEST:

Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for duration of 5 minutes.

7.1.2 CONDUCTOR RESISTANCE TEST:

The D.C. Resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20° c. to check the compliance with the values specified in IS 8130 - 1976.

7.2 Prior to dispatching cables, and at the time of delivering the cables at stores, following tests shall be carried out: -

- 7.2.1 Insulation Resistance test between phases and phase to Neutral and phase to earth.
- 7.2.2 Continuity test of all the phases, neutral and earth continuity conductor.
- 7.2.3 Sheathing continuity test.
- 7.2.4 Earth resistance test of all the phases and neutral.

All tests shall be carried out in accordance with relevant Indian Standard Code of practice and Indian Electricity Rules. The Vendor shall provide necessary instruments, equipments and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the client and results shall be recorded in the prescribed forms.

8.0 CABLE MARKING: EMBOSSING ON OUTER SHEATH:

The outer sheath shall be legibly embossed with following legend:

ELECTRIC CABLE: 1100 V, SIZE: 3.5 C x s ----- mm ².

Manufacturer's Name & year of manufacturing.

9.0 SEALING, DRUMMING & PACKING:

After tests at the manufacturer's works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.

Cable shall be supplied in length of 500 ± 10% meters on packed non-returnable drums of sufficiently sturdy construction.

Cables of length more than 250 meters shall also be supplied on non-returnable drums.

The spindle hole shall be 110 mm minimum diameter.

Each drum shall bear on the outside flange, legibly and indelibly in the English literature, a distinguishing number, the manufacturer's name and particulars of the cable i.e. voltage grade, length, conductor size, cable type, insulation type and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow. The drum flange shall also be marked with manufacturer's name and year of manufacturing etc.

10.0 TRANSPORTATION & DELIVERY:

The cable shall be supplied in the actual length as per detailed purchase order.

The cable shall be dispatched at client's stores or at site as per detailed instructions given by client at later stage.

The cable shall be loaded from the main vendor's store and properly stacked as per instruction of client's local representative. All such labour and transportation charges shall be clearly mentioned in the offer.

11.0 EARTHING

1.0 GENERAL

All the non-current carrying metal parts of the electrical installation and mechanical equipments shall be earthed properly. The cables armored and sheath, electric panel boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal shall be bonded together and connected by means of specified earthing system. An earth continuity conductor shall be installed with all the feeders and circuits and shall be connected from the earth bar of the panel boards to the conduit system, earth stud of the switch box, lighting fixture, earth pin of the socket outlets and to any metallic wall plates used. All the enclosures of motors shall be also connected to the earthing system.

2.0 SCOPE OF WORK

The scope of work shall cover supply, laying, installation, connecting, testing and comm. of:

Earthing station with G.I / Copper plate of size as given in BOQ.

Earthing G.I / Copper strips from earthing station to equipotential bar.

Earthing G.I / Copper strips / wires from equipotential bar to power panels, DBs, motors etc.

Bonding of Non-current carrying parts, and metallic parts of the electrical installation.

3.0 STANDARDS

The following standards and rules shall be applicable:

- 1) IS: 3043 - 1966 Code of practice for Earthing.
- 2) Indian Electricity Act and Rules
- 3) IEEE 80

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Codes of Practice in absence of Indian standard.

4.0 TYPE OF EARTHING STATION

4.1 PLATE EARTHING STATIONS

The Equipment neutral earthing shall be with copper plate earthing station and equipment body earthing shall be with hot dip galvanized iron earthing station. The plate electrode shall be 600 x 600 x 3.25 mm copper plate for neutral earthing and shall be of hot dip galvanized iron plate having dimensions 600 x 600 x 6.3 mm thick for body earthing.

The other earth stations shall be as per the standard drawing in IS 3043.

The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

The collective resistance of each earth station should not exceed 1 ohm.

The earth lead shall be connected to the earth plate through Hot Dip G.I. bolts.

The earthing conductors shall be of copper strip in case of copper earthing and hot dip galvanized iron strip in case of G.I. earthing.

G.I. pipe with funnel of approved quality shall be used for watering the earthing electrodes / stations.

The block masonry chamber with Chequered plate shall be provided for housing the funnel and the pipe for watering the earthing electrodes / stations.

The hardware and other consumables for earthing installation shall be of copper/brass in case of copper earthing and shall be hot dip galvanized iron material in case of G.I. earthing.

Test link / test pit cover through Chequered plate.

4.2 PIPE ELECTRODE EARTH STATION:

The earth station shall be as shown on the drawing and shall be used for equipment earth grid and / or street light pole earthing.

The earth electrode shall be 3 M long 50 mm dia class "B", Galvanized steel pipe.

The earth resistance shall be maintained with a suitable soil treatment as shown on the drawing.

The total earth resistance should not exceed 1 ohm.

The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible.

The earthing grid and the earthing conductor shall be hot dip Galvanized iron strips of the size as shown in the drawing.

G.I. pipe with funnel of approved quality shall be used for watering the earth electrode \ station. Alternatively, maintained type earthing with ground enhancing materials shall be provided to meet the required effective earth resistance value.

The block masonry chamber with Chequered plate shall be provided for housing the above referred funnel and pipe.

The hardware and other consumables for earthing installation shall be hot dip Galvanized iron material as shown on the drawing.

5.0 METHOD OF MEASUREMENT:

Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.

The following items of work shall be measured and paid per unit length covering the cost of the earth wires / strips, clamps, labor etc.

- a) Main equipment earthing grid and connection to the earthing station.
- b) Connection to the switch board, power panels, DB, motors etc.

2.0 LIGHTING SYSTEM

2.10 SCOPE

- 2.10.1 This covers supply, installation and commissioning of all equipment necessary for a complete indoor and outdoor lighting system as per the drawings enclosed with the specification and in accordance with relevant Indian Standards, codes of practice, Indian Electricity rules and safety codes in the locality where the equipment/system is to be installed.
- 2.10.2 Nothing in this specification shall be construed to relieve the contractor of his responsibility.
- 2.10.3 The equipment in lighting system shall generally include lighting distribution boards (LDB's), sub-lighting distribution boards (SLDB's), lighting fixtures, street light poles, junction boxes, lighting fixture supports, switches, receptacles, ceiling fans, exhaust fans, conduits, wires, cables, and miscellaneous accessories as necessary for a complete system.

2.11 LIGHTING DISTRIBUTION BOARDS (LDB'S)

- 2.11.1 The lighting distribution boards or sub-lighting distribution boards shall be suitable for wall mounting arrangement unless indicated and shall be supplied along with brackets, nuts and bolts necessary for mounting arrangement.
- 2.11.2 Sheet steel used for fabrication of LDB's shall be cold rolled and comprise of rigid welded structural frames made of structural steel sections. The thickness of the same shall be as per the technical data sheet.
- 2.11.3 Gland plates shall be provided from the top as well as from the bottom of LDB or SLDB so that conduit or cable termination can be possible from either side.
- 2.11.4 All the MCB's, switches, control switches, timers, contactors, metering and indication shall be housed in a metal enclosed cubicle.
- 2.11.5 The material of bus bars shall be tinned copper with phase identification by PVC sleeves of red, yellow and blue colors.
- 2.11.6 The bus bar shall be sized for fault level of 10kA for 1 sec. and rated current equal to the rating of incomer MCB, if not specifically mentioned.
- 2.11.7 All control wiring shall be carried out with 1100/650 V grade, 1.5 sq. mm, single core, stranded copper conductor wires with PVC insulation.
- 2.11.8 All meters, indicating lamps, control switches and MCB's shall be flush mounted.
- 2.11.9 All selector switches, MCB's shall be operable without opening the door of LDB.
- 2.11.10 The degree of protection of LDB shall be minimum IP42, unless indicated.
- 2.11.11 The bus bar supports shall be of SMC / DMC.
- 2.11.12 The front doors shall be hinged type with concealed hinges & door locks while rear covers shall be bolted type.

- 2.11.13 The earth bus shall be of copper and extended outside by 50mm from both sides of LDB for earthing connection to main grid. The size of earth bus shall be 25x3 mm, if not specifically mentioned.
- 2.11.14 LDB's shall be provided with a powder-coated paint. The finished painted appearance shall present an aesthetically pleasing appearance, free from dents and uneven surfaces.
- 2.11.15 The average lighting levels shall be as per the table below:

Areas	Lux (average)
General Process/operating/maintenance Indoor areas/Outdoor areas	300
Mechanical equipment rooms	250
Electrical rooms	300
Process control rooms (CRT screens)	350
Electrical Switchyard	150
Offices	300
Laboratories	500
Workshop with machinery	300
Walkways and stairways	200
Parking lots, yard, plant roads	20

2.12 LIGHTING FIXTURES

- 2.12.1 The lighting fixtures offered shall comply with the following requirements.
- 2.12.2 The fixtures shall be suitable for operation on a nominal supply of 240 V, 1-Ph, 50 Hz, AC with a voltage variation of +/- 10 %.
- 2.12.3 All lighting fixtures shall be supplied complete with lamps and all necessary accessories such as ballast, capacitor, igniter etc. for their satisfactory operation.
- 2.12.4 Starter of the fluorescent light fixture shall be replaceable without disturbing the reflector or lamps and without the use of any tool.
- 2.12.5 The capacitor of the lighting fixture shall have adequate value of capacitance to correct the power factor of its fixture to 0.98 lag.
- 2.12.6 Lamp holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation value, contact resistance or lamp holding quality.
- 2.12.7 Lamp-holders for HPSV lamps shall be of GLS type, manufactured in accordance with the relevant standard and designed to give long and satisfactory service.
- 2.12.8 Lighting fixture reflectors shall generally be manufactured from steel or aluminum sheet of not less than 20 SWG thicknesses.
- 2.12.9 Polystyrene or aluminum egg-box type louvers shall be provided wherever specified.
- 2.12.10 Each fixture shall be complete with a four way terminal block for connection and looping of incoming and outgoing cables. Each terminal shall be able to accept two 2.5 sq.mm copper stranded conductors.
- 2.12.11 Each lighting fixture shall be provided with an earthing terminal suitable for connecting 16 SWG copper stranded conductor.

- 2.12.12 All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal to ensure satisfactory earthing continuity throughout the fixture.
- 2.12.13 The enamel finish shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surfaces. The finish shall be non-porous and free from blemishes, blisters and fading.
- 2.12.14 All reflectors and louvers shall be finished to the same standard as the fixture housing.

2.13 STREET LIGHT POLE

- 2.13.1 The street lighting pole shall be of MS steel welded/sewage tubular type. The cross arm shall be of 1200mm long of 40mm dia. MS pipe. A MS top cap shall be provided at the top of the pole. The pole shall be fixed on a MS base plate of 400x400x6mm size. The work for electrical contractor includes excavation of pit and filling the same with cement concrete of 1:3:6 from the bottom of the pole and up to a height of 500mm above the ground level with the help of steel frame with 400mm diameter around the pole including painting with red oxide primer and aluminum paint/enamel paint in two coats.

2.14

- 2.14.1 The details of pole is given below,

Length in mtrs.	Length of each steps (mtrs)			Outer Dia./Thickness of each step (mm)		
	Top	Middle	Bottom	Top	Middle	Bottom
7.5	1.50	1.50	4.50	76.1/3.25	88.9/3.25	114.3/3.65
8.5	1.75	1.75	5.00	76.1/3.25	88.9/3.25	114.3/3.65
9.0	2.00	2.00	5.00	76.1/3.25	88.9/3.25	114.3/3.65
10.0	2.40	2.40	5.20	88.9/3.25	114.3/4.50	139.7/4.50
11.0	2.70	2.70	5.60	88.9/3.25	114.3/4.50	139.7/4.50
12.0	3.10	3.10	5.80	114.3/3.65	139.7/4.50	165.1/4.50
14.5	4.00	4.00	6.50	139.7/4.50	165.1/4.85	193.7/5.40
16.0	4.50	4.50	7.00	139.7/4.50	165.1/4.85	193.0/5.40

- 2.14.2 The pole shall be supplied with cross arm, galvanized junction box, its internal wiring, clamps, nuts, bolts and 2nos. 50 dia. GI conduits embedded in base concrete block for power cable etc.
- 2.14.3 The junction box shall have hinged door with mechanical lock. The junction box and its clamps shall be painted with red oxide primer and aluminum paint/enamel paint in two coats. The junction box shall be painted internally as well.
- 2.14.4 The degree of protection for junction box shall be IP 55.

2.15 RECEPTACLE UNITS

- 2.15.1 Decorative and industrial type receptacle units of 5 A, 15/16 A and 32 A rating with switches/MCBs shall be supplied. The units shall be suitable for mounting flush on GS sheet boxes.

- 2.15.2 The receptacle shall be suitable for 240 V, 1 Ph, (or 415 V, 3 Ph), 50 Hz AC supply. 1-Phase decorative receptacle shall be provided with a switch of the same current rating while Single phase industrial receptacle shall be associated with a MCB of the same current rating, housed in the same enclosure. Three phase receptacles shall be associated with a MCB of the same rating, housed in the same enclosure.
- 2.15.3 The enclosure for all outdoor receptacles shall be provided with degree of protection of IP 55.

2.16 EXHAUST / SUPPLY FANS

- 2.16.1 The fans shall be of heavy-duty type with the whole body, blades, frame shall be made from CRCA steel. It shall be powder coated and painted with light grey or brown color to appear aesthetically pleasant.
- 2.16.2 All blades shall be aerodynamically balanced and can provide high efficiency, smooth and silent operation.
- 2.16.3 The type of insulation shall be class E. The maximum temperature rise over the ambient temperature shall not exceed 75 deg. C in any case.
- 2.16.4 The rated speed shall be 900 rpm unless specified in technical data sheet.
- 2.16.5 The fan shall be provided with louvers or bird guard to avoid any accident.
- 2.16.6 The fans shall be provided with two ball bearings to meet the heavy duty requirements for continuous running.

2.17 CEILING FANS

- 2.17.1 The ceiling fans shall be of made from CRCA steel with powder coated and painted in chocolate or off-white shade.
- 2.17.2 All blades shall be aerodynamically balanced and can provide high efficiency, smooth and silent operation.
- 2.17.3 The type of insulation shall be class E. The maximum temperature rise over the ambient temperature shall not exceed 75 deg. C in any case.
- 2.17.4 The rated speed and sweep shall be 300 rpm and 1200mm respectively unless specified in technical data sheet.
- 2.17.5 The fan shall be provided with speed regulator, suspension rod (12mm G.I), canopy, cotter pin, nut and bolts and other accessories required to proper and safe suspension and operation.
- 2.17.6 The fans shall be provided with two ball bearings to meet the requirement of continuous running.

2.0 LIGHTING SYSTEM INSTALLATION

2.1 APPLICABLE STANDARDS

- 2.1.1 IS 732, 3646, 6665

2.2 TECHNICAL DATA SHEET

Sl.	Description	Particulars
1.0	Type of wiring	Wall surface conducting
2.0	Conduit type	Minimum 20mm dia., G.I
3.0	Space factor	40%

Sl.	Description	Particulars
4.0	Fixture wiring material & size	2.5 sq. mm, 1100/650 V grade, stranded copper conductor PVC insulated with FRLS compound flexible wire.
5.0	Receptacle wiring material & size	4 sq. mm, 1100/650 V grade, stranded copper conductor PVC insulated with FRLS compound flexible wire.

2.3 SCOPE

- 2.3.1 The scope includes installations, testing and commissioning of lighting distribution boards, sub-lighting distribution boards, lighting fixtures, ceiling fans, exhaust fans, street light poles, flood light towers, battery operated emergency lighting fixtures, call buzzers, receptacles with switch and lighting control switches, multi core power cables for street and boundary lighting and point wiring for all of the above at locations as per the drawing enclosed with the specification.
- 2.3.2 Taking over the material/equipment from purchaser's store and transporting to the erection site in case of equipment supplied by purchaser.
- 2.3.3 Maintaining equipment/materials during storage and being responsible for the equipment/material until they are handed over to purchaser.
- 2.3.4 Cleaning and clearing the area of work due to contractor's installation.
- 2.3.5 All work associated with installation such as providing and fixing of wooden blocks, ball sockets, ceiling hooks, drilling holes in walls, ceilings or any civil work including scaffolding, provision of ladders together with supply of hardware shall form part of the Contractor's work.
- 2.3.6 All work items necessary for completing earthing connections shall be included in the scope of work.

2.4 INSTALLATION REQUIREMENTS

- 2.4.1 The Contractor shall work in coordination with other Contractors at site.
- 2.4.2 The Contractor shall touch-up the painting for lighting panels / boards if the same is damaged during installation handling.
- 2.4.3 Supply and installation of power cables in a built-up trench or in a directly buried manner or clamped on wall or clamped on steel columns between switchboard and LDB, LDB and street light pole/flood light tower junction box, between the two poles or flood lighting towers shall be in the scope of electrical contractor.
- 2.4.4 The accessories required for termination work such as crimping type cable lugs and cable glands at each junction box and fixtures shall be supplied and installed by electrical contractor.
- 2.4.5 Contractor's scope of work also includes excavation of soil, preparation of riddles, soil bedding, supply and installation of protective covers or bricks over the cable, backfilling, ramming, supply and installation of route markers, removal of surplus earth (if necessary).
- 2.4.6 Earthing of street light pole / flood light tower, lighting fixtures, control gear boxes, junction boxes, etc. are also included in the scope of point wiring.

Contractor shall earth street light pole / flood light tower to the nearest earthing grid provided by others.

- 2.4.7 Contractor shall provide all the necessary foundation material & hardware for erecting street light pole / floodlights tower and install the same.
- 2.4.8 Lighting distribution boards shall be installed in the location indicated in the layout drawings. Installation rates quoted for installation of lighting distribution boards shall include supply and installation of base channels, foundation bolts, etc.
- 2.4.9 Outdoor lighting distribution boards shall be installed on a concrete plinth. The top of plinth shall be 1000mm (min.) above the grade level. Cost of construction of concrete plinth shall be included in the unit rates quoted for installation of outdoor lighting distribution board. No cement and steel will be supplied by the client. Installation cost of lighting distribution board shall include cost of installation of earthing conductor from LDB to the nearest earthing grid.
- 2.4.10 Unless specifically noted otherwise, lighting panels, light control switches and receptacles shall be installed at the following mounting heights (up to their bottom) from finished floor/ ground levels.
- a) LDBs : 1200 mm
 - b) Light control switches : 1200 mm
 - c) Receptacle units : 1200 mm for indoor and outdoor.
- 2.4.11 All lighting panels located indoor/outdoor on walls / columns / concrete pedestals shall be installed by the Contractor by fastening to suitably grouted studs of not less than 12 mm diameter.
- 2.4.12 It shall be possible to terminate incoming and outgoing circuits from top and bottom of LDB. Knock-out for cable / conduit entries for all the circuits shall be provided.
- 2.4.13 Separate circuits shall be provided for control of lighting fixtures and receptacles. Each phase shall have at least one spare circuit.
- 2.4.14 Any minor civil work such as chipping / concreting / embedding, etc. required for installation work shall be carried out by the Contractor together with supply of necessary materials.
- 2.4.15 Minimum size of rigid conduits used for wiring shall be 20 mm diameter in case of exposed systems and 25mm diameter in case of concealed / embedded systems. The conduits shall be supported by means of saddles as follows,
- 2.4.16
- a) Rigid Metallic Conduits : Spacing between saddles not to exceed 1 m. In addition, saddles shall be located on either ends of couplers / bends or similar fittings / accessories. In such cases the saddles shall be located at a distance not exceeding 300mm from the fitting / accessory.
 - b) Rigid Non-metallic Conduits : Spacing between saddles < 750 mm. In addition, saddles shall be provided as stated as above.
- 2.4.17
- 2.4.18 It is also in the scope of Electrical contractor to supply & install the required accessories like solid steel suspension rod. It is also scope of electrical contractor to do minor civil work like drilling in concrete or in steel or in wood,

grinding, suspension conduit for fixture, Bakelite or wooden base plate, nuts, screws, washers and GI round junction boxes.

- 2.4.19 Supply of items including 650 V grade, 2.5/4 sq. mm stranded copper conductor PVC insulated flexible wires; 5 / 15A switches; GI / PVC conduits and accessories such as junction boxes, tees, elbows, 16 SWG GS boxes complete with gasket, knockouts for conduit entries, earthing terminal with bolts, nuts and washers; 16 SWG copper earthing wire; flexible conduit etc. shall be included in the Contractor's scope. All work necessary for fixing boxes and conduits together with supply of necessary accessories hardware, shall also be included in the Contractor's work.
- 2.4.20 For street lighting fixtures, steel tubular poles complete with fixing brackets shall be used. These poles shall be coated with bituminous preservative paint on the inside as well as on the embedded outside surface. Exposed outside surface shall be painted with one coat of red oxide primer. After completion of installation, two coats of aluminum paint shall be applied.
- 2.4.21 Contractor shall supply and erect the poles (including excavation & foundation work), mount the assembled fittings and install the necessary cabling.
- 2.4.22 Contractor shall earth street light pole and junction box with 8 SWG GS wire tapped off from the 25x3 mm MS flat earthing grid to be laid along the street lighting cable. The Contractor shall interconnect this earthing grid to plant main earthing grid. Height and type of pole shall be subject for an engineer's approval.

2.5 WIRING

- 2.5.1 The work shall comprise wiring in heavy gauge (minimum 16 SWG) GI/ PVC conduits, fixed and supported at intervals of 500 mm on walls, ceiling etc.; installation of light control switches and receptacles housed in GS boxes; earthing with 16 SWG copper wire run along the conduit and clamped to it at every 500 mm; and termination of cables/wires at lighting panels, light control switches, receptacles, lighting fixtures etc., as required. The minimum size of conduit shall be 20 mm. Space factor (ratio of total wire area to internal conduit area) shall be 40 %.
- 2.5.2 The point wiring shall include supply, installation and testing commissioning of 2.5 / 4 sq. mm copper PVC flexible wires and their terminations including supply of GI/ PVC conduits with all accessories such as bends, reducers, coupler, switches for control, junction boxes, 16 SWG wires, etc.
- 2.5.3 Wiring for lighting, ceiling fans, exhaust fans and call buzzer circuit shall be done by minimum 2.5 sq. mm, 1100/650 V grade, stranded copper conductor PVC insulated flexible wire.
- 2.5.4 Wiring for receptacle circuit shall be done by minimum 4 sq. mm, 1100/650 V grade, stranded copper conductor PVC insulated flexible wire.
- 2.5.5 No motor load shall be supplied from any LDB.
- 2.5.6 There shall be a circuit breaker or a linked switch on each live conductor of supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in neutral wire in the form of switch or fuse unit.
- 2.5.7 For long conduit wiring runs, inspection/pull boxes shall be provided at intervals not extending 10m. Such facilities shall also be provided at conduit bends.
- 2.5.8 Receptacle and lighting fixtures shall be fed from different circuits and wiring for the same shall be done in different conduits.

- 2.5.9 The maximum load on any circuit shall not exceed 1000 W for 6A MCB backed circuits and 1800 W for 16A MCB backed circuits.
- 2.5.10 In large rooms, the lighting system shall be distributed over three phases.
- 2.5.11 Wherever lighting system has three-phase distribution, separate conduits shall be used for different phases. For easy identification of phases and neutral wires the following colour wires shall be used.
- a) R - Phase : Red
 - b) Y - Phase : Yellow
 - c) B - Phase : Blue
 - d) Neutral : Black
- 2.5.12 Wherever DC emergency lighting is provided, emergency lighting wires shall run in a separate conduit. Colour of the wires used shall be as follows,
- a) Positive : White
 - b) Negative : Black
- 2.5.13 Wires belonging to different phases shall not be run in the same conduit. However, more than one circuit on the same phase can be run in the same conduit. For every phase wire, a separate neutral wire shall be run. Neutral wire shall not be looped.
- 2.5.14 Size of wire chosen shall be such as to limit the voltage drop to within 3 %.
- 2.5.15 Generally, not more than 8 to 10 lighting points shall be wired in one circuit. For calculating connected loads of various circuits, a multiplying factor of 1.25 shall be assumed on the rated lamp wattage for sodium vapor and fluorescent lamp fixtures to take into account the losses in the ballast.
- 2.5.16 A loading of 100 watts and 300 watts shall be assumed for each single-phase 5 amps and 15 amps receptacles respectively.
- 2.5.17 The light control switches and receptacle units shall be mounted flush in one common GS sheet steel box.
- 2.5.18 Switches/receptacles wired on different phases shall be separated by a minimum distance of 1.8 m
- 2.5.19 Before a completed installation is put into service, installation tests stipulated in the latest edition of IS:732 and other codes of practices shall be carried out by the Contractor in the presence of the Engineer's Representative.

2.6 POINT WIRING

- 2.6.1 Internal wiring within any cubicle of switch box, receptacle box, lighting fixtures, LDB & main junction box shall not be considered as point wiring.
- 2.6.2 Contractor shall prepare a detailed measurement sheet of point wiring indicating each point and get it approved from consultant's site in charge.

MATERIALS AND WORKMANSHIP

1.0 INTRODUCTION:

This part of the Specification sets out the general standards of materials to be supplied and the workmanship required to be ensured by the Contractor and mention of any specific material or Plant does not necessarily imply that such is included in the Works. All component parts of the Works shall, unless otherwise specified, comply with the provisions of this part or be subject to the approval of the Engineer.

The names of the manufacturers of materials and equipment proposed for incorporation in the Works together with performance, capacities, certified test reports and other significant information shall be furnished by the Contractor.

2.0 COMPLIANCE WITH STANDARDS:

Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'B.S.')

issued by the British Standards Institution of 2, Park Street, London, or to an Indian Standard Specification (I.S.) issued by the Bureau of India Standards, (earlier known as Indian Standard Institution), Manak Bhavan, 9 Bhadur Shah Zafar Marg, New Delhi 110 002, American Society for Testing and Materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American national Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or to any other equivalent standard it shall be to the latest revision of that standard at the tender opening date.

The Contractor may propose at no extra cost to the Employer, the use of any relevant authoritative Internationally recognized Reference Standard, including Indian Standard.

All details, materials and equipment supplied and workmanship performed shall comply with these standards. If Contractors offer equipment to other standards, the equipment / material should be equal or superior to those specified and full details of the difference shall be supplied.

In the event of conflict between this specification and the codes for equipment, provisions of this specification shall govern.

3.0 MATERIALS – GENERAL

All materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of reputed make / approved quality, free from imperfections and selected for long life and minimum maintenance. Nondestructive tests, if called for in the specification, shall be carried out.

All submerged moving parts of the Plant, or shafts, spindles, etc. of the submerged moving parts or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause.

4.0 WORKMANSHIP – GENERAL

Workmanship and general finish shall be of first class quality and in accordance with best workshop practice.

All similar items of the Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items. Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements made to may be readily installed.

All equipment shall operate without excessive vibration and with minimum noise. All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds at any load up to the maximum there shall be no vibration due to lack of balance.

All parts which can be worn or damaged by dust shall be totally enclosed in dust proof housings.

All materials incorporated in the work shall be most suitable for duty concerned, free from imperfections, selected for long life and minimum maintenance.

All necessary accessories required for satisfactory and safe operation of the Plant shall be supplied by the Contractor unless it is specifically excluded from his scope.

All valves shall be closing on clockwise rotation of the hand wheel. The effort required to close / open under all operating conditions shall be limited to 7 kg. The direction of opening / closing shall be cast on the hand wheel.

All flanges shall be drilled in accordance with requirements of IS: 1538 or as specified

All flanges shall be full or spot faces on the back side. The flange thickness shall be uniform throughout.

Flange outside periphery shall be concentric with the bore. Flanges shall be finished smooth on periphery also.

Castings and fabricated materials shall be finished smooth all over.

5.0 WELDING

5.1 Design Approval

Welding shall comply with the latest revision of the BS 5135 code. In all welded fabrications, the Contractor shall submit to the Engineer's Representative before fabrication commences, detailed drawings of fabrication with sizes of weld and weld preparation together with the details of the application codes. No welding shall be carried out before approval of the details by the Engineer's Representative. No alternations shall be made to any previously approved details of weld preparation or size without prior approval of the Engineer's Representative.

5.2 Qualification of Welders and Procedures

Welders shall be qualified in accordance with the requirement of the appropriate section of BS 4871 part1. The Engineer shall have the right to call for further Qualification from time to time from any welder who in the opinion of the Engineer, does not produce weld in accordance with the qualification. Each welder shall be assigned a number and letter. Each weld shall clearly be identified as to its welder marking the welder's code adjacent to the welds. A record chart shall be maintained for each welder showing the procedures for which he has qualified, the date of such qualification, the type of defects produced and their frequency. The Engineer's Representative shall disqualify the welder whose work requires a disproportionate amount of repairs. All procedures where required shall be qualified as per BS 4870 Part 1.

5.3 General Welding Requirements

Inspection and quality of surveillance shall not be limited to the examination of finished welds. All aspects of materials, fabrication procedures and examination procedures shall be subject to the approval of the Engineer's Representative. The equipment used shall be suitable for the quality of work specified. The techniques employed shall be based on methods which are known to produce good results and which have been verified at Site by actual demonstration.

Haphazard striking of the electrodes for establishing arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. In case of any inadvertent strike on place other than the welding, the area affected shall be ground flushed and examined by liquid penetration method.

Generally, a stringer bead technique shall be used with a slight oscillation if necessary to avoid slag and to minimize the number of beads needed to fill the joint. However, the width of the deposited pass shall not exceed 3 times the wire diameter. Vertical welds shall be made in upward direction. For whenever possible, by 2 welders working simultaneously along both sides of the pipe.

All joint fit ups shall comply with the tolerances specified on the manufacturing drawings. The root pass shall have less than 1.5 mm internal reinforcement. Defects like icicles, burn through and excessive "suck back", etc. shall be cause for rejection of welds.

Final welds shall be suitable for appropriate fabrication of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without gouging or thinning of the parent metal in any way. Uneven and excessive grinding may be a cause for rejection. Fillet weld shall preferably be convex and free from undercutting and overlap at the toe of weld. Convexity and concavity shall not exceed 1.5 mm. The leg length shall not exceed the specified size by more than 1.5 mm.

All attachments such as lugs, brackets and other non-pressure parts shall also be done by qualified welders in accordance with the design details and materials specifications. Temporary attachments shall be removed in a manner that will not

damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by ultrasonic or liquid penetration methods.

All tack welds shall be made using qualified procedure and welders, the number of size of tack welds shall be kept as small as to consist of adequate strength and joint alignments. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their starting ends so that they may be satisfactorily incorporated in the welds. Unacceptable defects shall be removed by grinding machine or chipping or gouging. Flame gouging may be permitted provided gouged surfaces are ground at least by 1.0 mm below the deepest indentation.

All weld repairs shall be carried out using the approved welding procedures and welders. Preparation of weld repair shall have the prior approval of the Engineer's Representative. Re-welded areas shall be re-examined by the methods specified for the original welds and repair procedures shall be duly qualified by the Engineer's Representative.

6.0 Pre-heating and Post-Heating Treatment

Pre-heating and post heating treatment shall conform to the relevant application codes. Pre-heating not exceeding 121 deg. C for all carbon steel construction above 25 mm thickness would be mandatory. Such pre-heating would be maintained during flame cutting, flame or arc gouging, welding and repairs and may be done by gas heating by gas torches / gas rings with neutral flame. The temperature shall be checked by temperature will not be necessary for welds less than 6 mm size. In large diameter pipe fabricated out of plate materials, production control test plates in accordance with the BS 4870 Part 1 Table 6 to represent 30% of the long seams and each welder's performance would be mandatory.

7.0 Electrodes

The makes and types of electrodes to be used shall be submitted for approval of the Engineer. All electrodes shall be stored in their original sealed containers under dry conditions. Electrodes shall remain identified until consumed. All electrodes shall be dried before use. Drying ovens shall be provided in work areas for drying purposes. Electrodes withdrawn from oven shall be promptly used and excess unused electrodes shall be promptly returned to oven.

8.0 Examination / NDT / Radiography

The various stages of examination and types shall be as stipulated in the respective fabrication codes. Radiographic examination shall be carried out as per provisions of BS 2600 or BS 2910; ultrasonic tests where called for shall be carried out as per provisions of BS 3923; magnetic particle tests shall be carried out as per BS 6072. Liquid penetration tests shall be carried out as per BS 6443.

9.0 Stainless Steel Welding

All welding consumables such as electrodes, filler wires, argon gas for shielding and purging shall be of high quality and the proposed brand shall be furnished for approval of the Engineer. Weld deposits shall have similar or higher physical properties and similar chemical composition of the members joined.

All electrodes shall be purchased in sealed containers only and stored in their packing intact. The packets opened shall be consumed as early as possible. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by electrode manufacturer. Special care shall be taken in avoiding mixing of electrodes in the oven.

The electrodes and filling wires shall be free from rust, oil, grease, earth and other foreign matter.

Argon gas with purity 99.5% shall be used for shielding and purging. The purity of gas shall be certified by the gas manufacturers.

Nondestructive examination of the welds shall be carried out to ensure quality of weld.

The electric current for welding shall be direct current, straight polarity (electrode negative). The welding current shall be kept minimum possible to ensure minimum heat affected zone in the parent material. Other side of the weld joint shall be periodically flushed with argon gas.

10.0 CASTINGS

Cast iron shall be of standard gray close-grained quality. The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surfaces of castings which are not machined shall be smooth and shall be carefully fettled to remove all foundry irregularities.

Minor defects in depth not exceeding 12.5 percent of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The Engineer's Representative shall be notified of large defects and no repair welding of such defects shall be carried out without prior approval of the Engineer / his representative. If the removal of metal for repair should reduce the stress 25 percent, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then that casting shall be rejected. Test coupons cast simultaneously with the main castings shall be identified by the Engineer / or his Representative to check physical, chemical analysis of casting.

Major defects on casting are not acceptable. Castings repaired by welding for minor defects shall be stress-relieved after such welding. Castings subject to hydraulic pressure shall be pressure tested to 1 ½ times the rated pressure or, twice the working test reports shall be forwarded to the Engineer's Representative as soon as each test has been completed. Non-destructive tests as directed by the Engineer's

Representative will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine where repair welds have been properly made.

Unless otherwise specified casting shall produce to the following standards or equal:

- | | | |
|---------------------------|---|---|
| (a) Grey Iron | : | BS 1452 Grade 220 |
| (b) Carbon Steel | : | BS 3100 Steel Alloy |
| (c) Stainless Steel | : | BS 3100 Steel 316 C16 |
| (d) Copper & Copper Alloy | : | BS 1400 Group A Grade LG2
Group B Grade CT1, AB2
Group C Grade G1 |

11.0 FORGINGS

All major stress-bearing forgings shall be made to a standard specification. Forgings shall be subjected to magnetic particle testing or dye penetration test at the areas of fillets and change in section. The testing shall be conducted after rough machining (10 microns). Any defect which will not machine out during the final machining, will be gouged out fully, inspected by dye penetration or magnetic particle inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. An indication, which proves to penetrate deeper than 2.5 % of the finished thickness of the component, shall be reported to the Engineer giving the details like location, length, width and depth. For the magnetic particle inspection the choice of wet or dry particles shall be at the Contractor's discretion. All forgings shall be demagnetized after test and shall be heat treated for the relief of residual stresses. The name of the maker and particulars of the heat treatment proposed for each such forging shall be submitted to the Engineer's Representative. The Engineer's Representative or the Inspector may inspect such forgings and identify test coupons to check physical and chemical analysis and witness such tests at the place of manufacture with a representative of the Contractor.

12.0 DESIGN LIFE

For Electrical panels – 30 Years, Static electrical equipment – 30 years, Motors / Pumps – 15 Years, Instrumentation and Electronics – 10 Years, piping & mechanical equipment – 40 years.

The works as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing the site, and with the minimum of maintenance. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating of engines, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operating temperatures. The Contractor shall be called upon to demonstrate this for a component part either by service records, or evidence of similar equipment already installed elsewhere or

relevant type tests. Routine maintenance and repair shall as far as possible not require the services of highly skilled personnel.

The Plant shall be designed to provide easy access to and replacement of component parts, which are subject to wear, without the need to replace whole units. No parts in the contact with sewage shall have a life from new to replacement or repair of less than five years. Where major dismantling is unavoidable to replace a part, the life of such part shall not be less than ten years.

Design features shall include the protection of Plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate without undue vibration, and parts shall be designed to withstand the maximum stresses under the most severe condition of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause which may have a detrimental effect upon the performance or life of the Works.

Plant located outside lockable areas/buildings shall have additional features to prevent unauthorized operation.

13.0 LUBRICATION

A complete schedule of recommended oils and other lubricants shall be furnished by the Contractor. The number of different types of lubricants shall be kept to a minimum. The schedule and the name of the supplier of the lubricants shall be submitted to the Engineer's Representative for approval before incorporation in the Instruction Manuals. In the case of grease lubricated roller type bearings a lithium base grease is preferred.

Contractors shall indicate indigenously available equivalent lubricants, with complete duty specification, to enable the Corporation to arrange for regular supply.

Where lubrication is effected by means of grease, preference shall be given to a pressure system which does not require frequent adjustment or recharging. Frequent, for this purpose, means more than once in a month and grease systems having shorter periods between greasing should be avoided. Where necessary for accessibility grease nipples shall be placed at the end of the extension piping, and when a number of such points can be grouped conveniently, the nipples shall be brought to a battery plate mounted in a convenient position. All grease nipples shall be of the same size and type for every part of the Plant. Arrangements shall be provided to prevent bearings being overfilled with either grease or oil.

Where more than one special grease is required, a grease gun for each special type shall be supplied and permanently labeled.

Oil containers shall be supplied complete with oil level indicators of the sight glass type, or where this is not practicable, with dipsticks. The indicators shall show the level at all temperatures likely to be experienced in service. The levels shall be clearly visible in the sight glass type from the normal access floor to the particular item of Plant and they shall be easily dismantled for cleaning. All sight glasses shall

be firmly held and enclosed in metal protection in such manner that they cannot be accidentally dislodged.

All lubrication systems shall be designed so as not to cause a fire or pollution hazard and particular care shall be taken to prevent leakage of lubricants and to avoid leaking lubricants coming into contact with any electrical equipment, heated surfaces or any other potential source of fire.

The Contractor shall supply flushing oil for each lubrication system when an item of Plant is ready for preliminary running and a sufficient quantity of the approved lubricants for the commercial operation of the Plant for two years after the Taking-over Certificate has been issued.

14.0 NAME PLATES

Each item of the Plant shall have permanently attached to it in a conspicuous position, a nameplate and rating plate, each of stainless steel. Upon these shall be engraved or stamped, the manufacturer's name, type and serial number of Plant, details of the loading and duty at which the item of Plant has been designed to operate, and such diagrams as may be required by the Engineer's Representative. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their function and proper manner of use.

Details of proposed inscriptions shall be submitted to the Engineer's Representative for approval before any labels are manufactured. Such nameplates, rating plates and designations shall be of stainless steel with engraved or stamped lettering. Items such as valves shall have direction of rotation for closing and opening indicated.

Nameplates, rating plates and labels shall be of a non-flame propagating materials, either non-hygroscopic or transparent plastic with engraved lettering of a contrasting colour. Fixing shall be by means of non-corrosive screws; drive rivets or adhesives shall not be used.

Warning labels shall be provided where necessary to warn of dangerous circumstances or substances. Inscriptions or graphic symbols shall be black on a yellow background and to internationally recognized standards.

Instruction labels shall be provided where safety procedures such as wearing of protective clothing are essential to protect personnel from hazardous or potentially hazardous conditions. These labels shall have inscriptions or graphic symbols in white on a blue background.

15.0 NUTS, BOLTS, STUDS AND WASHERS

Nuts, Bolts, Studs and Washers for incorporation in the Plant shall conform to the requirements of the appropriate standard. Nuts and bolts shall be of the best quality of specified grade, machined on the shank and under the head and nut. Bolts shall be of one piece construction and shall be of sufficient length so that only one thread shall show through the nut in the fully tightened condition.

Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at site.

Washers, locking devices and anti-vibration arrangements shall be provided where necessary and shall be subject to the approval of the Engineer's Representative. Jointing hardware for the entire Plant shall be provided with sufficient spares to cater for site losses.

Where bolts pass through structural members taper washers shall be fitted, where necessary, to ensure that no bending stress is caused in the bolt. Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any conditions. All bolts, nuts and washers which are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel-bearing stainless steel.

The Contractor shall supply all holding down, alignment and leveling bolts complete with anchorages, nuts, washers and packing required to attach the Plant to its foundations, and all bed plates, frames and other structural parts necessary to spread the loads transmitted by the Plant to concrete foundations without exceeding the design stresses.

16.0 ALLOWANCE FOR WASTAGE

The Contractor shall supply to the satisfaction of the Engineer's Representative reasonable excess quantities to cover wastage of those consumables which will be normally subject to waste during erection, commissioning and setting to work.

17.0 PAINTING – GENERAL

The Contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the Plant at the place of manufacture prior to packing.

Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After test, all surfaces shall be thoroughly cleaned and dried out if necessary by washing with an approved dewatering fluid prior to surface treatment. Except where the specification provides to the contrary all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.

All protective coatings shall be suitable for use in warm humid climates.

18.0 PAINTING AT PLACE OF MANUFACTURE

All stages in painting including cleaning and surface treatment in the manufacturer's works shall be available for inspection.

Steel and cast iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp corners etc. shall be ground to a curve before sand blasting.

A primer coat of a zinc rich epoxy resin based coating with at least a 75 microns dry film thickness is to be provided. In addition the parts are to be provided with adequate number coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns including primer coating.

19.0 PAINTING AT SITE

Immediately on arrival at the Site, all items of Plant shall be examined for damage to the paint coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

Steel and cast iron parts received at site shall be provided with adequate number of further coats of coal tar epoxy polyamine coating to a total dry film thickness of 275 microns including the primer coats. All sharp edges, nuts, bolts and other items difficult to be painted shall receive a brush coat of specified paint before application of each coat of epoxy based coal tar paint giving a total dry film thickness of at least 275 microns. In the case of fabricated steel work this work shall be done after assembly.

Before painting is commenced the Contractor shall submit for the approval of the Engineer's Representative, full details of the paints he proposes to use together with colour charts for the gloss finishes.

All paint and coating thickness shall be measured by approved Elcometer or coating thickness gauge.

20.0 LIST OF STANDARDS

The titles of various standards referred to in the Specification are indicated hereunder for ready reference. This list does not necessarily cover all the Standards referred to:

STANDARD NO.	PARTICULAR
IS 5	Colors for ready mixed paints and enamels
IS 210	Grey Iron Castings
IS 318	Leaded Tin Bronze Ingots and Castings
IS 325	Three Phase Induction Motors
IS 14846	Sluice Valve
IS 807	Code of Practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.
IS 1239	Mild Steel tubes, tubular and other wrought steel fittings.
IS 1536	Centrifugally cast (Spun) iron pressure pipe for water, gas and sewage
IS 1537	Vertically cast iron pressure pipes for water, gas and sewage
IS 1538	Specification for cast iron fittings for pressure pipes for water, gas and sewage
IS 1554	PVC insulated (heavy duty) electric cables
IS 2062	Steel for general structural purposes

IS 2147	Degrees of protection provided by enclosures for low voltage switch gear and control gear
IS 3109	Short link chain, Grade M (4)
IS 3177	Code of practice for electric overhead traveling cranes and gantry cranes other than steel work cranes.
IS 3618	Phosphate treatment for iron and steel for protection against corrosion
IS 3624	Vacuum and Pressure gauges
IS 3815	Point hooks with shank for general engineering purposes.
IS 3938	Electric wire rope hoists
IS 4029	Guide for testing three phase induction motors.
IS 4460	Method for rating of machine cut spur and helical gears.
IS 4691	Degrees of protection provided by enclosure for rotating electrical machinery
IS 5312	Swing Type Non Return Valve
IS 6005	Code of practice for phosphating of iron and steel
IS 8329	Centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage
IS 11592	Code of practice for selection and design of belt conveyors
IS 13349	Cast Iron Single faced thimble mounted sluice gates
BS 436	Spur and helical gears
BS 466	Specification for power driven overhead traveling crane, semi goliath and goliath cranes for general use
BS 545	Specification for bevel gears (machine cut)
BS 721	Specification for worm gearing
BS 970	Wrought steels for mechanical and allied engineering purposes
BS 1397	Specification for industrial safety belts, harnesses and safety
BS 1400	Specification for copper alloy ingots and copper alloy and high conductivity copper castings
BS 1452	Specification for flake graphite cast iron
BS 1663	Specification for higher tensile steel chain Grade 40 (Short link and pitched or calibrated) for lifting purposes.
BS 2573	Specification for classification, stress calculations and design of mechanisms.

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IS 1538	Specification for cast iron fittings for pressure pipes for water, gas and sewage
IS 1554	PVC insulated (heavy duty) electric cables
IS 2062	Steel for general structural purposes
IS 2147	Degrees of protection provided by enclosures for low voltage switch gear and control gear
IS 3109	Short link chain, Grade M (4)
IS 3177	Code of practice for electric overhead traveling cranes and gantry cranes other than steel work cranes.
BS 2600	Radiographic examination of fusion welded butt joints in steel
BS 2903	Specification for higher tensile steel hooks for chains, slings, blocks and general engineering purposes
BS 2910	Methods for radiographic examination of fusion welded circumferential butt joints in steel pipes.
BS 3017	Specification for mild steel forged ram short hooks
BS 3100	Specification for steel castings for general engineering purposes.
BS 3923	Methods for ultrasonic examination of welds.
BS 4360	Specification for weldable structural steels.
BS 4772	Specification for ductile iron pipes and fittings
BS 4870	Specification for approval testing of welding procedures.

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IS 3109	Short link chain, Grade M (4)
IS 3177	Code of practice for electric overhead traveling cranes and gantry cranes other than steel work cranes.
	Part – I : Fusion Welding of Steel
BS 4871	Specification for approval testing of welders working to approved welding procedures Part – I : Fusion Welding of Steel
BS 4942	Short chain link for lifting purposes.
BS 5135	Specification for arc welding of carbon and manganese steels
BS 5316	Specification for acceptance tests Part – 2 for centrifugal, mixed flow and axial pumps – Test for performance and efficiency.
BS 6072	Method for magnetic particle flaw detection
BS 6405	Specification for non-calibrated short link steel chain (Grade 30) for general engineering purposes : Class 1 & 2

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IS 2147	Degrees of protection provided by enclosures for low voltage switch gear and control gear
IS 3109	Short link chain, Grade M (4)
IS 3177	Code of practice for electric overhead traveling cranes and gantry cranes other than steel work cranes.
BS 6443	Method for penetrate flaw detection
ASTM A-36	Specification for Structural Steel
ASTM A-216	Specification for steel castings, carbon suitable for fusion welding for high temperature service
ASTM A-276	Specification for stainless steel and heat resisting steel bars and shapes.
ASTM A-351	Specification for castings, Austenitic-Ferritic (Duplex), for Pressure Containing Parts.
ASTM A-743	Specification for castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel Base corrosion Resistant for General Application

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IS 2062	Steel for general structural purposes
IS 2147	Degrees of protection provided by enclosures for low voltage switch gear and control gear
IS 3109	Short link chain, Grade M (4)
IS 3177	Code of practice for electric overhead traveling cranes and gantry cranes other than steel work cranes.
ASTM A-744	Specification for casting, Iron Chromium-Nickel, Corrosion Resistant
ASTM B-14B	Specification for Aluminum-Bronze Castings.
IEC – 189	Low frequency cables and wires with Part 1 & 2 PVC insulation and PVC sheath
AWWA C 501	Cast Iron Sluice Gates

Erection, Testing & Commissioning

ERECTION, TESTING AND COMMISSIONING OF ELECTRICAL INSTALLATIONS

1.0 SCOPE

The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like transformer, M.V panels, Cables, earthing network, Internal and External lighting, Light fixtures etc. Requirement of this project shall be as specified in bill of quantities / approved drawings / general specifications or as per the battery limits fixed by the owner / consultant.

2.0 STANDARDS

2.1 The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification / codes of practice of the Indian Standards Institution, approved drawings and the instructions issued by the authorized representative, from time to time. Some of the relevant Indian Standards are listed elsewhere in this tender document.

2.2 In addition to the standards mentioned in 2.1, all works shall also conform to the requirement of the following :

- Indian Electricity Act and Rules framed there under.
- Fire Insurance Regulations.
- Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory.
- Regulations laid down by the Factory Inspector of the State / Union Territory.
- Any other regulations laid down by the local authorities.
- Installation & operation manuals of original manufacturers of equipment.

3.0 EQUIPMENT AND ACCESSORIES SPECIFICATIONS:

This defines specifications and requirements mainly for the equipment and accessories, which are generally supplied by the erection agency.

All materials, accessories, consumable to be supplied by the contractor shall be selected from the list of specified make and shall conform to the specification given here under. The equipment shall be manufactured in accordance with current Indian Standard specifications wherever they exist or with the BS or NEC specifications, if

no such IS standards are available. In the absence of any specification, the materials shall be as approved by the owner / consultant or his authorized representative.

All similar materials and removable parts shall be uniform and interchangeable with one another. Makes of bought out items selected by the contractor must be furnished by him as per the proforma given in elsewhere in this tender document.

3.1 CONTROL CABLES:

Control cables for use on 415 V system shall be of 1100 volts grade, copper conductor, PVC insulated, PVC sheathed, armoured and overall PVC sheathed, strictly as per IS: 1554 (Part-I) 1976. Unarmored cables to be used only if specifically mentioned in schedule of quantities.

The size of these cables shall be as specified in bill of quantities or as per approved drawing. The minimum conductor size shall be 2.5 sq.mm. (Cu.).

3.2 CABLE TRAYS:

These shall be channel type, fabricated from structural steel, hot dip galvanized, complete with all accessories such as bends, tees and reducers. Only aluminum flat clamps with G.I. / Chrome plated bolts, nuts/screws to be used for clamping cables. Sizes of these trays shall be as specified in bill of quantities or approved by client.

3.3 CABLE GLANDS:

Cable glands shall be heavy duty compression type of brass, chrome plated. These shall have a screwed nipple with conduit electrical thread and check nut. These shall be suitable for armoured/Unarmored cables, which are being used.

3.4 CABLE CONNECTORS:

Cable connectors, lugs/sockets, shall be of copper/aluminum alloy, suitably tinned, solderless, crimping type. These shall be suitable for the cable being connected and type of function (such as power, control or connection to instruments etc.).

3.5 CABLE INDICATORS

These shall be self-sticking type of 2 mm. thick lead strap for overall cable. PVC identification number, ferrules shall be used for each wire.

3.6 G.I. PIPE FOR CABLES:

For laying of cables under floor, G.I. class "A" pipes shall be used. M.S. conduits are not acceptable for this purpose. All accessories of pipes shall be threaded type. Size of pipe shall depend upon the overall outer diameter of cable to be drawn through

pipe. NO G.I. pipe less than 40 MM. I.D. Shall be used for this purpose. To determine the size of pipe, assume that 40% area of pipe shall be free after drawing of cable.

3.7 PUSH BUTTON STATIONS:

These shall be floor / wall mounted type as specified in bill of quantities. These shall be fabricated from 1.6 mm. thick stainless steel sheets (SS 304). In case of floor mounted station, these shall be supported on 51 mm. "A" class G.I. pipe. Front cover shall be removable type with suitable rubber gaskets to make them dust vermin and moisture proof.

Each feeder shall be provided with "ON" (green) push button, "OFF" (red) push button, name plate (white Bakelite), indication lamp etc. Green & red push buttons shall have contact elements having 1NO + 1NC. "OFF" push button shall be provided with lockable (key operated) arrangements to prevent accidental starting. No. of feeders shall be specified in bill of quantities. The indication lamp can be combined with "ON" push button.

4.0 ERECTION

The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. Equipment shall not be removed from packing cases unless the floor has been made ready for installing them. The cases shall be opened in presence of the client / consultant or his authorized representative. The empty packing cases shall be returned to the stores and any document if found with the equipment shall be handed over to the client's representative. Any damage or shortage noticed shall be reported to the client / consultant in writing immediately after opening of packing cases.

4.1 ONAN TYPE TRANSFORMER

(a) ERECTION

Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections

made. After completely assembling & installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary. All cover bolts shall be checked for proper tightness. All the civil foundation work required shall be in the scope of contractor.

(b) TESTING:

Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary.

Check the polarity of terminals and the phase sequence.

(c) Proforma for transformer tests:

- Transformer name plate.
- Insulation resistance test with 1000 V meager.

- a) between primary to earth
- b) between secondary to earth
- c) between primary and secondary

- Operation of the tap changer.

Operation of the tap at tap No. 1

Operation of the tap at tap No. 2

Operation of the tap at tap No. 3

Operation of the tap at tap No. 4

Operation of the tap at tap No. 5

- Polarity marking and phase sequence.
- Earth resistance : Body as well as Neutral link.

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

MOTOR CONTROL CENTER, DISTRIBUTION BOARDS:

(a) ERECTION:

Electrical panels his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of

Busbars / wiring. Foundation channel shall be delivered in convenient shipping section by the manufacturer. The contractor shall make shall be grouted in the flooring by the contractor. Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the draw out circuit breaker shall be checked for proper alignment and inter changeability.

After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.

Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for labor for such replacements.

(b) TESTING:

Before electrical panel is energized, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.

Before switchgear is energized, the insulation resistance of all control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection.

- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer's instructions.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the consultant/ manufacturer.
- The dielectric strength of insulating oil wherever applicable, shall be checked.

Before switchgear is energized, the following tests shall be performed on each circuit breaker in its test position.

- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energized to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
- Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energized, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer's instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

(c) PROFORMA FOR PCC, MCC, DB, CONTROL PANEL TEST:

- Circuit breaker or contactor module designation / bus no.
- Insulation resistance test (contacts open, breaker racked in position)
 - a) between each phase of bus : Mega ohm
 - b) between each phase and earth : Mega ohm
 - c) DC and AC control and auxiliary circuits: Mega ohm
 - d) between each phase of CT / PT and between CT
& PT circuit if any : Mega ohm
- CT checks :

- a) CT ratio
 - b) CT secondary resistance
 - c) CT polarity check
- Check for contact alignment and wipe.
 - Check / test all releases / relays.
 - Check mechanical interlocks.
 - Check electrical interlocks.
 - Check switchgear / control panel wiring.
 - Check breaker / contactor circuit for :
 - a) Closing - local & remote (wherever applicable)
 - b) Tripping - local & remote (wherever applicable)
 - Opening time of breaker / contactor.
 - Closing time of breaker / contactor.

[This preform shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

4.3 INSTALLATION OF CABLE NETWORK:

Cable network shall include power, control and lighting cables which shall be laid in underground trenches, cable trays, G.I. pipes, or on building structures as detailed in the relevant drawings, cable schedules or as per the client / consultant's instructions. Supply & installation of cable trays, G.I. pipes / conduits, cable glands and sockets of both end isolators, junction boxes, remote push button stations, etc. shall be under the scope of the contractor.

(a) General requirements for handling cables:

Before laying cables, this shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 V megger.

The cables shall be supplied at site, wound on wooden drums as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the

cable laid out from the top of the drum. In no case the cable will be rolled on as it produces kinks which may damage the conductor.

Sharp bending of cable shall be avoided. The bending radius for PVC insulated and sheathed, armored cable shall not be less than $10 D$, where "D" is overall diameter of the cable.

While drawing cables through G.I. pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with cotton / bituminous compound.

High voltage (11 kV and above), medium voltage (240 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes / trays.

Armored cables shall never be concealed in walls / floors / roads without G.I. pipes, conduits or RCC pipes.

Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin tight joint shall be made, without any additional cost.

A minimum loop of 3 mt. shall be provided on both ends of the cable, and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.

Cable shall be neatly arranged in the trenches / trays in such manner so that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.

All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings are indicative only and the same may be rechecked with the client / consultant before cutting of cables. While selecting cable routes interference with structures, foundations, pipelines, future expansion of buildings etc. should be avoided.

All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.

Wherever cable rises from underground / concrete / masonry trenches to motors / switchgears / push buttons, these shall be taken in G.I. pipes of suitable size, for mechanical protection up to 300 mm. distance of concerned cable gland or as instructed by the client / consultant.

The cable pass through foundation / walls of other underground structures, the necessary ducts for opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundation of structures the electrical contractor shall determine the location and obtain approval of the client / consultant before cutting is done.

(b) LAYING OF CABLES (UNDERGROUND SYSTEM)

- Cables shall be so laid in trench that this will not interfere with other underground structure. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the owner / consultant.
- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1200 mm. in case of H.T. from ground level. Excavation will be generally in ordinary soil. The width of trench shall be sufficient for laying of required no. of cables.
- Sand bedding 75 mm. thick shall be made below and above the cables. Layer of bricks (full size) shall be laid above sand bedding on the sides and above the cables to cover cables completely. More than one cable can be laid in the same trench. However, the relative location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction of the client / consultant.
- For all underground cables, route markers should be used :
 - a) Separate route markers should be used for LT, HT and telephone cables.
 - b) Route markers should be grounded in ground with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm.
 - c) Cable markers should be installed at an interval not exceeding 30 mtr. along the straight routes of cables at a distance of 0.5 mtr. away from center of cable with the arrow marked on the cable marker plate indicating

the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.

- RCC Hume pipe for crossing road in cable laying shall be provided by employer. No deduction shall be made for cable laying in Hume pipe for not providing bricks, sand and excavation. RCC hump pipe at the ends shall be sealed by bituminous compound after laying and testing of cables by electrical contractor without any extra charge.

(c) LAYING OF CABLE IN MASONRY TRENCHES

Masonry / concrete trenches for laying of cables shall be provided by employer. However, steel members such as M.S. angles / flats etc. shall be provided and grouted by electrical contractor to support the cables without any extra charge. Cables shall be clamped to these supports with minimum saddles / clamps. More than one tier of cables can be provided in the same trench if the no. of cables is more.

Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

(d) LAYING OF CABLES IN CABLE TRAYS

Cable trays and steel members such as M.S. angle / channel / flats etc. shall be provided and fixed by the contractor.

Cable shall be fixed in cable trays in single tier formation and cables shall be clamped with flat clamps and galvanized bolts / nuts.

Earthing flat / wire can also be laid in cable tray along with cables.

After laying of cables, minimum 20% area shall be spare.

(e) TERMINATION AND JOINTING OF CABLES:

- i. **a) For HT cables suitable size of push on type termination kit shall be used.**

b) Use of glands:

All PVC cables up to 1.1 kV grade, armoured or Unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size single compression type cable glands. Amour of cable shall be connected to earth point. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded

opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

ii. USE OF LUGS / SOCKETS:

All cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs / sockets.

The following is the recommended procedure for crimped joints and the same shall be followed:

- a) Strip off the insulation of the cable and with every precaution, not in severe or damage any strand. All insulation's to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
- b) The cable should be kept clean as far as possible before assembling it with the terminal / socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminum conductors, the socket should be filled with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.
- c) Correct size and type of socket / ferrule / lug should be selected depending on size of conductor, and type of connection to be made.
- d) Make the crimped joint by suitable crimping tool.
- e) If after crimping the conductor in socket / lug, some portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.
- f) For HT cable the manufacturer's recommendation should be followed.

iii) DRESSING OF CABLE INSIDE THE EQUIPMENT:

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene

straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminum cables, the erector shall modify the same without any additional cost.

Cables inside the equipment shall be measured and paid for on lug to lug basis.

iv) IDENTIFICATION OF CABLES / WIRES / CORES:

Power cables shall be identified with red, yellow and blue PVC tapes. For trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear / control panels and control switches.

In case of control cables all cores shall be identified at both ends by their wire numbers by mean of PVC ferrules or self-sticking cable markers, wire numbers shall be as per schematic / connection drawing. For power circuit also, wire numbers shall be provided if required as per the drawings of switchgear manufacturer / supplier.

(f) TESTING OF CABLES:

- i. Before emerging, the insulation resistance of every circuit shall be measured from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
- ii. Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Repeat measurements after splices and/or terminations are complete.
- iii. **DC high voltage test shall be made after installation on the following :**
 - a) All 1100 volts grade cables in which straight through joints have been made.
 - b) All cables above 1100 V grade.

For record purpose test data shall include the measured values of leakage current versus time.

The DC high voltage test shall be performed as detailed below:

Cables shall be installed in final position with all the straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.

19 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid-level of block masonry chamber.

Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe.

The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.

The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.

Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS: 3043, Code of Practice for Earthing Installation.

The earth conductors (Strips / Wires copper / Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.

The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.

Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.

The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

(b) EARTH LEADS AND CONNECTIONS:

Earth lead shall be bare copper or Galvanized steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. G.I strips buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary Hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is at least 8 mm away from the wall surface.

The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

(c) TEST:

The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3043.

The following earth resistance values shall be measured with an approved earth megger and recorded.

- 1) Each earthing station
- 2) earthing system as a whole
- 3) Earth continuity conductors

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.

Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

All tests shall be carried out in presence of the client's rePmc

5.0 SURFACE CONDUIT WORKS:

5.1 CEILING/ WALL OUTLET BOXES FOR LIGHTS / FANS:

Outlet boxes shall be of steel with cover and so installed as to maintain continuity throughout. These shall be protected at the time of laying by filling with jute / earth / cotton etc. so that no cement mortar finds its way inside during concerning or plastering etc. In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaries.

For fixing light fixtures / brackets, outlet boxes complete with knock out for holding conduits shall be used. For lighting fixture suitable for 40/20 watts' fluorescent tubes / incandescent lamps / mercury vapor lamps, only one outlet box is required.

For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.

5.2 DRAW OUT JUNCTION BOXES:

Steel draw out boxes at angle dimensions shall be provided at a convenient point on walls / ceilings to facilitate pulling of long runs of cables / wires. The location of these boxes is to be decided prior to fixing, as per site requirement and following should be treated as general guidance for deciding the location of these:

- (a) These should be provided at a place where these are not in direct view. Recommended place is 400 / 450 mm. below ceiling, if conduits are running vertically.
- (b) Junction box in the offset of bottom of RCC beam and vertical wall should not be provided.
- (c) If junction boxes are coming side by side for two or more conduits, one common M.S. box of proper size can be used to act as junction box.
- (d) If junction box is to be provided in ceiling, its position should be so located that it is in line with other light / fan points.
- (e) Junction boxes should never be used for splitting one conduit into two or more. Junction box for such functions is avoidable and for this, number of conduits to be connected to one switch board should be calculated correctly as per drawing before laying conduits in ceiling.
- (f) Locating junction boxes on outer surface of exterior walls of building should be avoided as these are in direct view and are also exposed to weather.

5.3 SWITCH BOXES:

Steel boxes of required sizes, shall be provided to house speed regulators of fans, switches for lights, fans, plug sockets etc. as per requirement of drawings. These should be so designed that accessories on sheet could be mounted with tapped holes and brass machine screws, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on all walls of the boxes through which the conduits are entering. These shall be completely connected leaving edges flush with finished wall surfaces. Cover should be fixed to these switch boxes by means of brass chrome plated machine screws and cup washers. Utmost care shall be taken by contractor to ensure that all switch boxes are in line and level.

Inside each switch box, one bolt shall be welded to receive earthing wire.

5.4 SWITCH AND SOCKET:

Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings.

The switch controlling the light point or fan shall be connecting on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes

The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws.

Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators.

The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit

The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.

5.5 CLEANING AND PROTECTION OF CONDUIT SYSTEM:

The entire conduit system including outlet boxes, junction boxes and switch boxes shall be thoroughly cleaned after completion of erection and tested for not blockage by air / sound or steel wire prior to finishing of building by air / sound or steel wire prior to finishing of building and before drawing in of cables / wires to safeguard conduit system against filling up with the plaster / cement slurry / water etc. all the outlet and switch boxes will have to be provided with temporary jute / cotton filling, covers and plugs etc.. Within tendered cost which shall be replaced later on by hylem / sheet cover after wiring as required.

5.6 TESTING OF INSTALLATION:

Before a completed installation is put into service, the following tests shall be complied with:

(a) INSULATION RESISTANCE:

The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed.

The insulation resistance in giga-ohms of an installation, measured shall not be less than 50 mega-ohms divided by the number of points on the circuit.

The insulation resistance shall be measured between

EARTH TO PHASE

EARTH TO NEUTRAL

PHASE TO NEURAL

PHASE TO PHASE

(b) EARTH CONTINUITY PATH:

The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

(c) POLARITY OF SINGLE POLE SWITCHES:

A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system.

(d) COMPLETION CERTIFICATES:

All the above tests shall be carried out in presence of client and the results shall be recorded in a prescribed form. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.

On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

6.0 COMPLETION TESTS:

After supply and installation of complete project or a particular building / area, following tests shall be carried out by the contractor before switching on the power to installation and the results shall be recorded and submitted to the Site-Engineer. If results are not satisfactory / as per standards set herewith, the contractor shall identify the defects / short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

6.1 INSULATION RESISTANCE TO EARTH:

This is to be measured with all fuse links in place, all switches ON, all lamps and appliances in position by applying a voltage not less than twice the working voltage (subject to a limit of 500 V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 mega-ohms divided by the number of outlets (points and switch positions) except that it need not exceed one mega-ohm for the whole installation.

6.2 INSULATION RESISTANCE BETWEEN CONDUCTORS:

Tests to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put ON. The result of the test must be 50 mega-ohms divided by the number of outlets (points and switch positions) but need not exceed 1 mega-ohm for the whole installation.

6.3 POLARITY OF SINGLE POLE SWITCHES:

Tests shall be made to verify that all non-linked single pole switches are on phase conductor (live) and not on neutral or earth conductor. This can be done by connecting test lamps between two terminals of switch and earth. If the lamp lights up when switch is ON and either terminal is touched, the switch is correctly installed.

6.4 RESISTANCE OF METAL CONDUITS / SHEETS (EARTH CONTINUITY TEST):

In case of cables encased in metal whether conduit or metallic sheathing, the total resistance of the conduit or sheathing from the earthing point any other position in the completed installation shall not exceed 2 ohms. This can be carried out by following circuit:

One end of the load is connected to the ECC and its connection with the electrode and the other to the farthest point of the ECC. First, current through the circuit is measured with the resistance of 2 ohms short circuited by the link. Next, current is measured through the two ohms resistance by disconnecting the two leads from the ECC and joining them together. If current is more in the first case, the resistance of ECC is less than 2 ohms.

7.0 HANDING OVER / TAKING OVER:

After completion of works and tests specified above, the various installations of the project can be taken over by the employer as and when these are ready in all respects. The defect liability period of 36 months shall start from the date, when all the installations of the project have been executed, tested as described above, successfully commissioned and handed over.

TESTING, ERECTION AND COMMISSIONING OF PLANT & MACHINERY

1.0 TESTING - GENERAL

Tests of the plant at the manufacturer's premises will be required in accordance with the conditions of contract. All inspection, examination and testing shall be carried out in accordance with appropriate standards.

All instruments used for such tests shall be calibrated and certified by an approved independent testing authority not more than 3 months prior the test in which they are used. The engineer's representative reserves the right to impound any instrument immediately after test for independent testing. A certificate shall be produced by the contractor prior to carrying out every test showing the readings obtained, calculations and full details of the calibration certificates referred to.

If the engineer's representative witnesses a test he shall be given a copy of the test results and certificates immediately. Whether he witnesses a test or not, copies of test certificate shall be sent to the engineer's representative. No item of the plant shall be forwarded to the site until its test certificate has been approved writing by the engineer's representative. Six copies of the test certificates shall be supplied in suitable folders with proper index.

Certificates shall be clearly identified by serial or reference number where possible to the material being certified and shall include information required by the relevant reference standard or specification clause.

2.0 INSPECTION AT MANUFACTURER'S PREMISES

The inspection of all equipment required to be supplied to complete the works shall be done as detailed in this specification. Only defect free and sound material meeting the technical requirements of this specification and in accordance with a high standard of engineering would be acceptable to the engineer's representative.

For meeting these requirements of inspection, testing (including testing for chemical analysis and physical properties) shall be carried out by the contractor and certificates submitted to the engineer's representative who will have the right to witness or inspect the above mentioned testing/inspection at any stage desired by him. Calibration certificates or test instruments shall be produced for the engineer's consent in advance of testing and if necessary instruments shall be recalibrated or substituted before the commencement of the test. Items of plant or control systems not covered by standards shall be tested in accordance with the details and programme agreed between the engineer and contractor.

If during or after testing, any item of the plant fails to achieve its intended duty or otherwise prove defective it shall be modified or altered as necessary, retested and re-inspected as required by the engineer.

At least 21 days notice shall be given to the engineer before the specified tests are carried out.

No material is to be delivered to site without the above described inspection having been carried out or officially waived in writing by the engineer's representative.

3.0 TESTS AT MANUFACTURER'S PREMISES

3.1 Pump Sets

Pump testing and inspection shall confirm to latest standard

(a) Hydrostatic testing

A standard hydrostatic test shall be conducted on all the pressure parts of the pumps at 1.5 times the shut-off head of the pump or twice the rated head whichever is higher. The hydrostatic test shall be conducted for a minimum duration of 30 minutes.

(b) Balancing Test

Impeller and pump rotating assembly shall be dynamically balanced.

(c) Performance Test

Each pump shall be tested for full operating range individually. Test shall be carried out for performance at rated speed with minimum NPSH as available at site.

3.2 Motors

Motors shall be offered for routine and type tests in accordance with IS: 325-1978 or latest applicable standard at the manufacturer's works. Test certificates shall be endorsed to the effect that the motors are properly balanced and free from vibration. In addition, a test shall be required to establish the maximum transient starting current.

4.0 ERECTION -

GENERAL

4.1 The contractor's staff shall include at least one competent erection engineer with proven suitable, previous experience on similar contract to supervise the erection of the works and sufficient skilled, semiskilled and unskilled labour to ensure

completion of the works in time. The contractor shall not remove any representative, erector or skilled labour from the site without the prior approval of the engineer's representative.

- 4.2 One erection engineer who shall be deemed to be the contractor's representative shall be conversant with the erection and commissioning of the complete works. Should there be more than one erector, one shall be in charge and the contractor shall inform the engineer's representative in writing which erector is designated as his representative and is in charge. Erection engineer is to report to Project Manager.
- 4.3 The contractor's erection staff shall arrive at the site on date to be agreed by the engineer's representative before they proceed to the site, however, the contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his sub-contractor's) supply has arrived on site so that there will be no delay on this account.
- 4.4 The contractor shall be responsible for setting up and erecting the plant to the line and levels of reference given by the engineer in writing, and for the correctness (subject as above mentioned) of the positions, levels dimensions and alignment of all parts of the works and for provision of all necessary instruments, appliances and labour in connection therewith. The checking of setting out of any line or level by the engineer or engineer's representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.
- 4.5 Erection of plant shall be phased in such a manner so as to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection work, the contractor shall check the dimensions of structures where the various items of plant are to be installed and shall bring any deviations from the required positions, lines or dimensions to the notice of the engineer. Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the engineer, the contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the contractor during the course of erection to new or existing plant or buildings or any part thereof, the contractor shall, at no additional cost to the employer, make good, repair or replace the damage, promptly and effectively as directed by the engineer and to the engineer's satisfaction.
- 4.6 During erection of the plant the engineer will inspect the installation from time to time in the presence of the contractor's site representative to establish conformity with the

requirements of the specification. Any deviations and deficiencies found or evidence of unsatisfactory workmanship shall be corrected as instructed by the engineer.

4.7 LEVELLING AND GROUTING OF MACHINERY

The pumps and motors shall be properly and accurately leveled and aligned on the concrete plinths by means of tapered metal wedges and metal packing pieces before any grout is poured. After correct alignment and leveling the foundation bolts shall be nipped up to hold the machine firmly in position and it shall be the contractor's responsibility to check that the position is maintain an approved expanding agent will be mixed and poured by the contractor. ACC Shrink 200 grout mix or equivalent is to be used for grouting.

The horizontality of base plate top shall be within 0.05 mm / meter. The base plate top surface and pump motor base are to be blue matched to bet a contact area of at least 80%.

After the grouting mixture has set hard the foundation bolts shall be pulled up hard and the alignment and level rechecked. The engineer shall be informed at all times of the progress of this work and when any checks on alignment and level are to be carried out so that he may witness the checks if he so requires. The approval of the engineer or his intimation that the alignment or level of the machines is to his satisfaction shall in no way relieve the contractor of his obligation under contract to properly install and align the machines and pipe work and shall in no way prejudice the engineer's rights to order rectification of any installation work later found to be improperly carried out.

5.0 RECORD, PROCEDURES AND REPORTS

The contractor shall maintain records pertaining to the quality of installation/erection work and inspection, testing, compliance with all technical requirements in respect of all his works as described in the previous paragraphs. The reporting formats shall be in the approved formats. The contractor shall submit such records to the engineer after the completion of any particular work before submitting the bill of supply/progress of work. Such report shall comprise of shop inspection reports, shop testing reports, material test reports, based on which dispatch clearances are provided, all the quality control reports of welding, erection and alignment records.

All the above mentioned records shall be submitted in the final form duly countersigned by the engineer's representative attesting conformity to specifications and is approval of installation and duly incorporating all the additions, alternations

and information as required by the engineer, on the basis of preliminary reports giving the progress of the work. Such records notwithstanding any records submitted earlier with bill of supply/progress etc. shall be duly bound and submitted to the engineer in six copies by the contractor on his notification of the mechanical completion of erection.

6.0 COMPLETION OF ERECTION

The completion of plant under erection by the contractor shall be deemed to occur, if all the units of the plant are structurally and mechanically complete and will include among other such responsibilities the following:

- (a) Plant in the scope of the contractor has been erected, installed and grouted as per specifications.
- (b) Installation checks are completed and approved by the engineer.
- (c) The erected plant is totally ready for commissioning checks.

At the stage of completion of erection, the contractor shall ensure that all the physical, aesthetic and workmanship aspects are totally complete and the plant is fit and bound to undergo commissioning checks/tests on completion.

Upon achieving the completion as described above, the contractor shall notify the engineer by a written notice intimating such mechanical completion of units and notify the engineer for inspection and acceptance of mechanical completion. The engineer/engineer's representative shall proceed with the inspection of such units within 14 days of such a notice. Thereafter:

- (a) The engineer shall certify completion when there are no defaults in the works and the plant is acceptable or
- (b) The engineer shall inform the contractor list of deficiencies for rectification hereinafter referred as Punch List and the contractor shall complete the rectification work within a jointly agreed period before tests on or approval of the same before proceeding with the Tests on Completion or
- (c) The engineer may inform the contractor that the works are accepted with the 'punch' list (Items which do not hamper operability, safety or maintainability) and allow the contractors to proceed with the pre-commissioning checks followed by Test on Completion when the contractor undertakes to complete such outstanding works within an agreed during Defects Liability Period.

Taking over shall be based on rectification of all deficiencies as advised by punch lists.

The erection period indicated by the contractor would be deemed to cover all the activities up to completion as stipulated in previous paragraphs, notice of completion by the contractor, inspection by the engineer for completion, and contractor rectification of all deficiencies as noticed by the deficiency/punch list, and acceptance by the engineer of such rectification, prior to Test on Completion.

Minor defects, which in the opinion of engineer which do not hamper operability and maintainability will not be taken in to account for deciding mechanical completion. Such defects shall be rectified concurrent to commissioning checks before Test on Completion. However, the engineer's decision in this regard is final.

The commissioning period as notified by the contractor shall be deemed to occur beyond the date of completion and shall include all period of pre-commissioning, trials and Test on Completion.

It is in the contractor's interest to offer the sections/units/systems, progressively under identified milestones within overall erection period, duly completed for inspection by the engineer's representative, obtain his 'punch' list, for rectification of any deficiencies pointed out by the engineer and to achieve mechanical completion before undertaking the Test on Completion within the specified erection period. The engineer also reserves a right to withhold the cost is estimated to be equivalent to the rectification of deficiencies pointed out to the contractor until such a time such deficiencies are rectified to the satisfaction of the engineer.

Erection work should be completed as per instruction of Engineer-in-charge & Header connection should be fit with rising main line as per instruction of EIC.

7.0 SETTING TO WORK

On completion of erection, the contractor shall request the engineer's representative to carry out the installation inspection. After the plant has been set to work, the contractor shall continue to operate the plant for a period of one week.

8.0 INSTALLATION INSPECTION

In addition to the progressive supervision and inspection by the purchaser the contractor shall offer for inspection to engineer, the completely erected plant/part of plant on which tests are to be carried out. After such inspection by engineer, each equipment/sub-system shall be tested by the contractor in accordance with the

applicable standards in the presence of engineer. Such tests shall include but not be limited to the tests specified in following clauses.

PUMPS

- (a) The erected pipe work shall be subjected to a hydraulic test at 1.5 times the maximum pressure or twice the working pressure whichever is higher to test the soundness of the joints. Provision of the necessary pumps, gauges, blank flanges, tapings etc. for carrying out these tests shall be included in the contract.
- (b) Leakage tests shall be carried out on all erected work immediately after erection and where possible before being built in.
- (c) The pump set shall be tested for satisfactory operation. The vibration and noise level shall be checked to be within the specified limits.

PUMP MOTORS

Condition of winding insulation be tested and insulation values shall be restored to required level by suitable heating arrangements locally.

INSTRUMENTATION

Performance of the instrumentation shall be checked as per the design requirements.

9.0 COMMISSIONING

9.1 SCOPE

At the time of commissioning, the engineer will appoint his representative as commissioning engineer. The contractor shall carry out commissioning tests in the presence of the commissioning engineer. Though the mechanical completion may have been checked and clarified by the site engineers, the commissioning engineer may verify any mechanical completion checks to satisfy himself that the plant is fit and sound, if such checks had not been witnessed by him. It will be the responsibility of the contractor to make all arrangements for carrying out these tests. The evaluation of test results and decision passed by the commissioning engineer regarding the test results will be final and binding on the contractor. Any additional tests or repetition of tests to establish satisfactory operation of any equipment shall be carried out by the contractor at no extra cost.

9.2 MISCELLANEOUS

Completion checks and commissioning tests on items not covered under above shall be carried out by the contractor as per the instructions of the engineer's representative.

10.0 TAKING OVER

No item of plant will be certified for taking over by the purchaser unless it has successfully passed all the tests called for under the contract. If nevertheless the

employer uses any part of the works, that part which is used shall be deemed to have been taken over at the date of such use.

A Taking-Over Certificate for plant shall not be issued unless the following documentation are duly compiled and submitted in final formats in duly bound volumes.

- (a) A compilation of all shop inspection results/reports of the plant/machinery with due attestation that the plants have been manufactured to specified standards (5 copies).
- (b) All erection/construction quality control checks in appropriate approved formats for all installation works with attestation that installation has been carried out as per acceptable/stipulated standards (6 copies).

11.0 TENDER / CONTRACT DRAWINGS

Sr. No.	Description	Preliminary drawings to be submitted	Drawings to be submitted after award of work
1.0	Outline dimensional drawing		
(a)			
2.0	Cross Sectional Drawing with Materials of Construction		
(a)	Pump		
(b)	Expansion Bellows		
3.0	Pump performance Curves		
(a)	Pump (Q vs H, P, η & NPSH)		
4.0	Motor Curves		
(a)	Starting Current vs time		
(b)	Characteristic under cold and hot conditions		
5.0	GA drawing of the pumping plants with all dimensions		
6.0	'As built' GA drawing		
7.0	Instrumentation Diagrams		
(a)	Dimensional drawings and installation sketches of instrument		
(b)	Catalogues for all the instruments		

Note: * Indicates the document required to be submitted.

SCHEDULE B1
GRAVITY MAIN

Item No. 1

Vertical cast

Providing and supplying ISI Standard and marked R.C.C. pipes(of Sulphate Resisting Cement) in standard lengths of following class and diameter spigot socket or Tongue and grove joint or Rebated Rubber Ring jointed flushing from inside suitable for rubber ring joints including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. (IS - 458/ 1989)

Note : One rubber ring should be supplied with each full length socketed pipe, cost included in rates below.

1400 mm Dia pipe

Item No. 2

RCC precast M.H. Frame & Cover Manufacture, supply & Delivery at store or at site of work precast RCC M.200 Frame & cover suitable to drainage M.H. and as per type design & Drawing including cost of reinforcement M.S. Angles or Flate, curring mold work etc.

Heavy Duty Mark HD35 or EHD35

2.0 Frame

2.1 Cover

Item No. 3

Scraper Manhole Frame And Cover

Item No. 4

Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified.

Depth (0 to 1.5 m depth)

Sr. No.	Size
4.0	In all sorts of soil & soft murrum

4.1	In hard murrum,boulders
4.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
4.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 5

Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified.

Depth (1.5 to 3.0 m depth)

Sr. No.	Size
5.0	In all sorts of soil & soft murrum
5.1	In hard murrum,boulders
5.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
5.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 6

Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified.

Depth (3.0 to 4.50 m depth)

Sr. No.	Size
6.0	In all sorts of soil & soft murrum
6.1	In hard murrum,boulders
6.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
6.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 7

Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified.

Depth (3.0 to 4.5 m depth)

Sr. No.	Size
7.0	In all sorts of soil & soft murrum
7.1	In hard murrum,boulders
7.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
7.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 8

In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth.

Sr. No.	Size
8.0	In all sorts of soil & soft murrum
8.1	In hard murrum,boulders
8.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
8.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 9

In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth.

Depth (3.00 m to 4.50 m depth)

Sr. No.	Size
9.0	In all sorts of soil & soft murrum
9.1	In hard murrum,boulders
9.2	In soft rock and/or masonry in CM or L M or Lime Concrete.

9.3	In hard rock with blasting and chiseling or by chieilling only for finishing.
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Item No. 10

In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth.

Depth (4.50 m to 6.00 m depth)

Sr. No.	Size
10.0	In all sorts of soil & soft murrum
10.1	In hard murrum,boulders
10.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
10.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 11

Add for restoration of infrastructures like Soak well, Electrical line, Water Supply line, Telephone cables all type, Gas line, Septic Tank etc.

Depth 0 to 1.5 m Depth

Item No. 11.1

Add for restoration of infrastructures like Soak well.

Depth 1.50 to 3.0 m Depth

Item No. 12

In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L.

Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth.

Depth 1.50 m to 3.0 m

Sr. No.	Size
12.0	In all sorts of soil & soft murrum

12.1	In hard murrum,boulders
12.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
12.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 13

In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L.

Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth.

Depth 3.0 m to 4.50 m

Sr. No.	Size
13.0	In all sorts of soil & soft murrum
13.1	In hard murrum,boulders
13.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
13.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 14

In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L.

Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth.

Depth 4.5 m to 6.0 m

Sr. No.	Size
14.0	In all sorts of soil & soft murrum
14.1	In hard murrum,boulders
14.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
14.3	In hard rock with blasting and chiseling or by chieilling only for finishing.

Item No. 15

Shoring or timbering for trench with 50 mm thick planks and suitable size truts etc. complete.

Sr. No.	Size
16.0	Pipe Trench
16.1	MH Pit

Item No. 16

Lowering, Laying & Jointing R.C.C. pipes(Horizontal-Vertical) in C. M. 1:1 1/2 of following diameters in proper position, grade and alignment as directed by Engineer-in-charge including conveyance from stores to site of work, labour, giving hydraulic testing as per ISI code. Class NP3 Test Pressure, 0.7 Kg / Sq.m.

1400 mm Dia

Item No. 17

Refilling the pipeline trenches incl. ramming, watering, consolidating disposal of surplus stuff as directed within a radius of 3 km

Item No. 18

Extra lead for transportation of Surplus stuff spreading or stacking as directed (removal of excavated stuff from site of U/G sump sewage pumping station, filter Plant etc.)

Item No. 19

Providing bedding incl. ramming, watering, levelling, consolidating etc. Complete As above with required quality Sand brought from outside including all lead as per standard and instruction of engineer incharge

For Pipe Bedding

Item No. 20

Supplying of graded stone aggregate of following sizes (for W.B.M. Road)(1) Hand broken stone aggregate 25mm to 90mm size.

Spreading the stone aggregate for rolling and W.B.M. including filling the interstices to required camber and gradient (excluding spreading of Blindage)(iii) 25mm to 50mm size crushed stone

Stone Aggregate for bedding

Item No. 21

Providing C.C.M.:100 for encasing pipes using trap metal size 12 mm to 50 mm incl. form work curing consolidation etc. complete for various location on pipe line. using trap metal 20 mm nominal size

Using trap metal 20 mm nominal size

Item No. 22

Supplying cutting, bending, binding and placing in position steel as per plan and design and as per ISS 2502 including cost of steel and binding wire for reservoirs/structures only including lift up to 6 meter height or depth below G.L. for all diameters

Do – deformed (TMT) bars confirming to relevant IS Fe – 500 grade for all Diameters

Item No. 23

Demolition including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift. (i) R.C.C. work

Item No. 24

Dismantling Item: Scarifying gravelled macadam or bitumen macadam surface 6 cm to 10 cm.depth including stacking useful materials on road side and disposing off remaining stuff.

Item No. 25

Supply, testing & commissioning portable diesel driven self priming horizontal mono dewatering pump set with four wheel trolley, GI medium duty delivery pipes, specials, suction strainer etc. complete set Material of Constructions: Impeller: Bronze, Casing: CI, Shaft: Carbon Steel

Item No. 26

Providing and erecting C. I. and MS ventilating columns 15 cms. dia. with C.I. ornamental cap and Min 6.00 Mtr. Height (Height may be varying as per site) base fixed firmly with necessary foundation with one coat of red lead oxide paint and one coat of any approved colour with 15 cms, dia.10 Mt.in length with 0.35mt*0.35mt* M100 Encasing, stoneware or R.C.C. pipe connection with M.H. including excavation and jointing as required etc. complete. as per drawing.

Item No. 27

Drilling of 1900mm dia Horizontal borehole for watermain pipeline under the railway tracks incl all strata with required length incl fixing of 1200mm dia M.S.casing pipe of minimum 16mm thick Or IRS Casing Pipe with welding pushing etc complete Providing & fixing various size of pipe for 1259mm/1310mm/1360mm/1411mm dia watermain of G.I/M.S pipe of minimum 6.3mm thick for railway permises as per instruction & regulations of Railway authority & under supervision of Railway authority incl Provinding, supplying & fixing of spacer at specified interval if required between Casing pipe and water main,ISI make sluice valve of required size at both side of railway boundry with construction of brickedge pavement incl C:C encasing 1:3:6 in 10mtr length of pipe at both side. Incl Provinding & fixing of M.S/Iron Manhole frame with cover for valve chamber with loacking arregment etc. complete with all material labour fabrication,hydraulic testing of pipe & valve etc complete for 45mtr Length.

ITEM WISE SPECIFICATION

Item No.1

Providing and laying wet mix macadam base course 125 mm thick in two layers using machine crushed B.T. chips as per required gradation mixing with required optimum quantity of water, conveying the mix to site of work, spreading in to grade and camber with mechanical paver and consolidation each layer with vibratory roller including cost of material labour plant and equipment etc. complete.

Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub- base/ base or existing pavement as the case may be in accordance with the requirements of these Specifications.

The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be up to 200 mm with the approval of the Engineer.

Physical Requirements

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-12.

If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

Table : Physical Requirements of Coarse Aggregates for Wet Mix Macadam for Sub-base/Base Courses

S. No.	Test	Test Method	Requirements
1)	Los Angeles Abrasion value or Aggregate Impact value	IS:2386 (Part-4) IS:2386 (Part-4) or IS:5640	40 percent (Max.) 30 percent (Max.)
2)	Combined Flakiness and Elongation indices (Total)	IS:2386 (Part-1)	35 percent (Max.)*

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

Grading Requirements

The aggregates shall conform to the grading given in Table.

Table: Grading Requirements of Aggregates for Wet Mix Macadam

IS Sieve Designation	Percent by weight passing the IS Sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-5

Material finer than 425 microns shall have Plasticity Index (PI) not exceeding 6. The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

Provision of Lateral Confinement of Aggregates

While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described.

Preparation of Mix

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/ positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. The plant shall have following features:

- i) For feeding aggregates– three/ four bin feeders with variable speed motor.
- ii) Vibrating screen for removal of oversize aggregates.
- iii) Conveyor Belt.
- iv) Controlled system for addition of water.
- v) Forced/positive mixing arrangement like pug-mill or pan type mixer.
- vi) Centralized control panel for sequential operation of various devices and precise process control
- vii) Safety devices

Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

Spreading of Mix

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-grade/sub-base/base in required quantities. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread by a paver finisher. The paver finisher shall be self-propelled of adequate capacity with following features:

- i) Loading hoppers and suitable distribution system, so as to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.
- ii) Hydraulically operated telescopic screed for paving width up to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.
- iii) Automatic levelling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used with the prior approval of the Engineer. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual mixing and /or laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual mixing/laying in inaccessible/ remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual mixing/laying is intended to be used, the same shall be done with the approval of the Engineer.

Compaction

After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with an arrangement for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/superelevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or sub-grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case shall the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material as determined by the method outlined in IS:2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

Setting and Drying

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

Opening to Traffic

No vehicular traffic shall be allowed on the finished wet mix macadam surface. Construction equipment may be allowed with the approval of the Engineer.

Surface Finish and Quality Control of Work

Surface Evenness

The surface finish of construction shall conform to the requirements of Clause 902.

Quality Control

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub-grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompacted in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

Arrangement for Traffic

During the period of construction, arrangements for traffic shall be done as per Clause 112.

Measurements for Payment

Wet mix macadam shall be measured as finished work in position in cubic meters.

ITEM NO: 2

Providing and applying priming coat with emulsion grade SS1 at the rate of 7.50 kg/ 10 Sq.mt. including cost of asphalt and preparing the surface heating, and applying etc. complete.

1. The relevant specifications given in Section -502 of MORT&H fifth revision specification shall apply to this item.
2. The measurement shall be per square meter basis.

ITEM NO: 3

Construction of granular sub-base 150 mm thick by providing coarse graded machine crushed B.T. material satisfying MOST specification of grading I (B.T. stone aggregate 53 mm to 26.5 mm 35 %, 26.5 to 4.75 mm - 45 % and 2.36 mm below - 20 %) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.

GRANULAR SUB-BASE

Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or

more layers as sub-base or lower sub-base and upper sub-base (termed as sub- base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base.

The material shall be free from organic or other deleterious constituents and shall conform to the gradings given in Table 400-1 and physical requirements given in Table 400-2. Gradings III and IV shall preferably be used in lower sub-base. Gradings V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract.

Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

Table : Grading for Granular Sub-base Materials

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55 -90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25 - 55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20- 40	30-50	-	-	10-20	10-25
0.85 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10- 15	-	-	0-5	0-8
0.075 mm	<5	< 5	< 5	< 5	-	0-3

Table : Physical Requirements for Materials for Granular

Sub-base

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

Construction Operations

Preparation of Sub-grade

Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter,lightly sprinkled with water, if necessary and rolled with two passes of 80–100 kN smooth wheeled roller.

Spreading and Compacting

The Granular sub-base material of the grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread onthe prepared subgrade with the help of a motor grader of adequate capacity, its blade havinghydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to100 kN weight may be used. For a compacted single layer up to 200 mm the compaction shallbe done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction.

Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super-elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Arrangements for Traffic

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

ITEM NO.: -4

Providing and laying 37.5 mm thick compacted built up spray grout base course in single layer with bitumen grade 80/100 at rate of 15 Kg. per 10 Sqmt with 0.50 Cum stone aggregate and using 0.13 Cum of key aggregate per 10 Sqmt including consolidation with vibratory roller and tack coat using asphalt 80/100 at rate of 2.50 Kg/10 Sqmt etc. complete including the cost of asphalt and stone aggregate.

1. The relevant specifications given in General Technical Specifications for Road Works Item No.38 shall apply to this item.

ITEM NO.: -5

Providing and applying tack coat with mechanical sprayer using Emulsion grade RS1 at the rate of 2.50 Kg/10 Sq.mt. including preparing the surface etc. complete.

1. The relevant specifications given in Section-503 of MORT&H fifth revision specification shall apply to this item.
2. The measurement shall be per Square meter basis.

ITEM NO.: -6

Providing and applying asphalt painting on B.T. surface with mechanical sprayer using bitumen 60/70 (VG-30) at the rate of 5.00 Kg/10 Sq.mt. & spreading stone dust on painting surface at the rate of 0.03 Cu.m./10 Sq.mt. and rolling with smooth wheeled and pneumatic roller and brushing etc. complete.

1. The relevant specifications given in tender as per clause 504 of MORT&H fifth revision specification shall apply to this item.
2. The measurement shall be in Square meter basis.

ITEM NO.: -7

Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide liminance coefficinet on cemend road shall be min 130 mcd/m²/lux and Asphalt road shall be min 100 mcd/m²/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.

1. The relevant specifications given in Section – 803.4 of MORT&H fifth revision specification shall apply to this item.
2. The measurement shall be per square meter basis.

PUMPING MACHINERY

SCHEDULE: B5

Item No. 1

Mechanical Work

SUBMERSIBLE SEWAGE NON-CLOG VERTICAL PUMP : Supply, installation, testing & commissioning of sewage submersible, non clog type suitable for working on three phase, 50 Hz \pm 3%, 415 V \pm 10%, AC supply, 1450 RPM synchronous speed with 3 core flat copper cable from pump to starter panel with cable end terminations, all supports, clamps, pipe fittings along with mechanical seal, bearing bush, strainer etc. complete set & following M.O.C: Casing: CI, Impeller: SS CF8M, Wearing ring & Bearing bush: Bronze, TC mechanical seal, CS / SS bearing, SS shaft with sleeve, SS strainer & MS motor body.

75 HP x 5 set (For 2 DWF)

A. GENERAL

The Pump shall be submersible, non-clog, single stage, centrifugal, wear resistance with vertical shaft suitable for permanent installation in wet-pit / sump along with Submersible motor and submersible cable of specified length. The pump and motor shall be as one unit together with impeller mounted on extended shaft of motor.

The pump shall be designed to pump storm water and operate satisfactorily without detrimental surges, vibration, noise or dynamic imbalance over the required Head-Capacity range. The head-capacity curve of the pump shall have continuously rising head characteristics with decreasing capacity over the whole performance range of pump. The shut off head of the pump shall be at least 120% of the total head.

Each pump must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation's or overload under all operating conditions within the system resistance indicated. All pumps shall have identical performance.

The pump shall be designed to start with delivery valve fully open.

The pump shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to liquid returning through the pump at times when the power supply to the motor is interrupted and the discharge valve fails to close.

Pumps' rotating parts & assembly shall be statically and dynamically balanced as per ISO standards and shall run smooth without undue noise and vibration. The velocity of vibration shall be within the 4.5 mm/sec. Noise level shall be limited to 80 dB at a distance of 1.0 m.

The Sole plates / auto coupling unit with foundation plate shall be grouted with the RCC foundation with the help of "J" type foundation bolts of manufacturer's recommended / approved size.

The power rating of motor to drive pump shall be min. 110 % of power required to meet max. requirement of power for the rated impeller throughout its' performance range considering specific gravity of the liquid rounded up to next standard higher kw rating as per IS.

B. FEATURES OF CONSTRUCTION PUMP

Pump shall be Vertical Submersible centrifugal, single stage, Non Clog suitable for permanent installation in wet-pit / sump. The pump shall have bottom suction and side discharge nozzle. The pump and motor shall be as one unit together with impeller mounted on extended shaft of motor. The pump having delivery

size up to 100 mm shall be designed to handle solids of min. 35 mm to 80 mm size and pump having delivery size up to 100 mm. shall be capable of handling solids of maximum 100 mm size.

CASING

Pump casing shall be volute type of robust construction and designed for high efficiency. Liquid passages shall be designed to allow free passage and finished smooth. The tongue shall be straight across and filed to a smooth rounded edge. Casing shall be provided with wearing rings / wear plates.

Casing shall have inspection hole with cover so as to facilitate removal of clogged material from impeller vanes without dismantling the whole pump.

IMPELLER

Impeller shall be enclosed/semi-open, single suction with smooth and large ways so as to allow free passage to the fluid being pumped. Impeller shall have two / three vanes max. and be capable to handle solids of specified size. It shall be free from sharp corners and projections likely to catch and hold rags and stringy materials. Typical storm water has high content of sand, silt & clay. Hence the pump design shall be of wear resistant type.

Impeller shall be statically and dynamically balanced at rated speed as per applicable standard so as to avoid vibration. The Impeller shall have back vanes or suitable features to balance axial thrust.

Pump having semi open impeller shall be provided with suitable wear plate fixed in casing with adjusting bolts & nuts.

IMPELLER NUT

Impeller shall be fixed on rotating shaft with the help of SS 316 impeller screw or cap top type impeller nut with helicoil insert and washer in such a way that impeller doesn't get loose during rotation of pump in either direction.

SHAFT SLEEVE

Replaceable shaft sleeves shall be provided and shall be securely locked or keyed to the shaft to prevent loosening. Necessary rubber 'O' ring or CAF / Teflon gaskets shall be provided between impeller and shaft sleeve to prevent liquid passage between shaft and sleeve. In no case shaft shall be in the contact with liquid.

MECHANICAL SEALS

Double mechanical seals shall be provided to protect the motor from ingress of Storm water along the shaft. The preliminary and secondary seals shall be oil-lubricated. The seal faces of the preliminary seal shall be of either tungsten carbide or silicon-carbide faces while the secondary seal can be of carbon versus chrome steel or tungsten carbide. Pumps shall be equipped with an electrical monitoring system for seal failure detection. Use of Lip seals or back to back seals is not allowed. The mechanical seals shall be bi-directional.

BEARINGS

Pump set shall have double anti friction grease lubricated bearings. The bearings life shall be minimum 40,000 hrs of operation. Bearings shall be greased for life –i.e. shall not require any re-greasing. Bearings shall be of SKF / FAG make only.

AUTO COUPLING / GUIDE PIPE / LIFTING CHAIN

Each pump shall be supplied with pump connector unit in order to connect connector unit to pump support bracket with rubber diaphragm to make leak proof joint and fixing it to the concrete floor of the suction well. The design of the automatic coupling system shall be such that the joint between the pump discharge flange and the delivery piping shall be made by merely lowering the pump into double guide pipes / wire rope from access level. The pedestal of the automatic coupling system shall be integrally cast with the delivery bend thereby obviating the need of separately bolted CI Duck Foot Bend. It shall be provided with all necessary fixtures like guide wire / double guide pipe for guiding the pumps during lifting/lowering.

Each pump shall be provided with a stainless steel lifting chain conforming to BS 1663 and BS 4942 and stainless steel guide pipe / wire rope of required length.

LIFTING HOOK

To “fish out” a vertical submerged pump set from the wet well (even if a chain has not been attached to the lifting hook prior to the pump set being lowered) the pump shall have a self-centering lifting hook. Its design shall be such that the lifting chain’s hook can be engaged to the pump’s lifting hook without the need for man to enter the wet well. This hook shall be of corrosion resistant stainless steel.

Item No. 2

Pressure Gauge: Design, Supply, Installation, Testing, Commissioning of Bourdon Type Pressure Gauge $\pm 1\%$ accuracy, Direct bottom 1/2" NPT (M) process connection, IP 67, Glycerine filled, SS304 case with Bayonet Type Bezel, SS316 L Bourdon Tube, SS 316, Movement materials, Aluminium dial with black graduation on white background, Micro Zero, adjustable pointer, neoprene gasket, Blow out disc. shatter proof glass, SS tag plate etc as per IS 3624.

100 mm dial size 0 to 6 kg/cm² (For Suction, Discharge + Common Header)

The material should be as per relevant IS specification & the work shall be carried out as per strict instruction of Engineer – in – charge.

Item No. 3

Full Bore Electro-magnetic Flow meter (for Common Header)

Design, Supply, Installation, Testing, Commissioning of Full Bore Electromagnetic flow meter with factory calibration, Inbuilt Battery Power Operated, flanged connection, Flow sensor, Indicator, transmitter and totaliser with all accessories viz. surge arrester, associated cables, cabinets, hardwares, etc complete as per following specifications: Flow meter/ Sensor: DC pulsed type, IP 68 Protection, Flanged process connection as per IS 1538 or equivalent standard, SS304/ Metallic Alloy Flow Tube, SS316/ SS 316 L/ Hastelloy Sensor, SS316/ Hastelloy Grounding Ring/ Inbuilt Grounding

Electrode, Neoprene/Polyurethane/ Hard Rubber/ Rilsan lining, SS304/ Die Cast Aluminium/ Carbon steel with Anticorrosive Paint Coil Housing with Junction Box, CS flanges.. Flow Transmitter/ Converter (remote Field Mounted): Microprocessor based, Modular design, 2 line LCD for indication of actual flow rate, forward, reverse, sum totaliser display,

±0.5% accuracy at 0.3 to 4 m/sec velocity, one scalable pulse/ one status, one Modbus output, one GPRS/ GSM output, IP 67 protection, Die cast aluminium/ polycarbonate/ SS316 with Anticorrosive Paint/ PU finish with glass window enclosure, Inbuilt EEPROM and Data Logger, 20 meters cable length for sensor to transmitter communication, Minimum 5 years battery lifetime, 3.6 VDC Non Rechargeable Lithium-thionyl chloride/ Ni-Cd high power batteries, Hourly Basis Worldwide transmission of measured data and events via e-mail and SMS by integrated GSM/GPRS modem, Reliable data storage facility through integrated SD card etc alongwith wall mounted/ stand mounted cabinet..

Full Bore Electromagnetic Flow Meter (Battery Power Operated)- PN 10-size 800 mm

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 4

Expansion Bellow: Supply, installation, testing & commissioning of flange ends Expansion Bellow as per EJMA standards of overall length of minimum 300 mm, designed for 15 mm axial compression and 5 mm axial extension with tie rods etc. of following MOC & pressure ratings. MOC: Bellows: SA 240 Gr. 304; Internal Sleeve: SA 240 Gr. 304; Weldends: IS 2062 Gr. B; Flanges: IS 2062 Gr. B (Drilling as per IS 1538 / IS 6392) & Limit Rods & Nuts: CS - IS 1367., PN 1.0

600 mm dia (Delivery line)

Stainless steel AISI 304 single expansion bellows which can take radial and axial misalignment of minimum 1 percent of valve nominal size with tie rods shall be included only in delivery pipe work of all pumps for easy dismantling. (No expansion bellows are to be provided on suction side of individual pump as well as on common delivery header).

Single expansion bellows shall be manufactured as per EJMA standards. Bellow element shall be manufactured from Stainless Steel (SA 240 TP 304) & shall have adequate numbers of convolution as per required nominal size. Flanges shall be as per IS 7322. It shall be with PN 1.6 pressure nomenclature & shall be hydraulically pressure tested to 24 kg. cm².

All loose flanges shall be secured to fixed flanges by suitable tie-bolts. All pipe work shall be adequately supported with purpose made fittings. When passing through walls, pipe work shall incorporate a puddle flange. Flange adapters and unions shall be fitted in pipe work runs, wherever necessary, to permit the simple disconnection of flanges, valves and equipment.

The final outlet connection of the pipe work shall match the connecting point of the transmission main.

Item No. 5

LEVEL MEASURING SYSTEM:: Ultrasonic Type Level Transmitter with Integral Display : Design, Supply, Installation, Testing and Commissioning of Non Contact Ultrasonic Type Level Transmitter with Integral Display. Sensor with Head Mounted Transmitter: The sensor should be non contact type, field mounting type, housing shall have minimum IP65 protection, PP/ PVC Sensor MOC, Microprocessor based indicator with LED / LCD digital display, panel/ wall mounting type, power supply shall be 110- 240 Vac or 15 to 36 Vdc, 50 Hz \pm 10 %. Accessories: Mounting bracket, nut, bolts etc as per system requirement and Hook up diagram of the Instruments. Level Transmitter shall be suitable for following Range.

0 to 15 Meter

Item No. 6

Sluice Valve: Providing and supplying ISI mark CID/F Sluice Valves as per IS:14846 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. including Lowering, laying and jointing in position following C. I. / D/F Reflux valves, Butterfly valves, Sluice valves and Air valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete.

PN 1.6 with hand/wheel cap operated ALT-1 type long body.

600 mm dia (Delivery line)

800 mm dia (Header Line)

General

The contractor shall be covering manufacturing, supplying and delivery of: Sluice valve conforming to IS: 2906-1984 & IS: 780-1984 or its latest revision (Specification for sluice valves (50 to 900 mm size) with ISI certification. Flanges shall be machined on faces and edges to ISO 7005, IS 6392 or BS 4504.

- a) They shall be non-rising spindle type. The valve shall be furnished with bushing arrangement for replacement of packing without leakage. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5 mm.
- b) The gate face rings shall be securely pegged over the full circumference.
- c) Valve of 450mm and above shall be provided with thrust bearing arrangement for ease of operation.
- d) Valve of diameter 450 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man-

against an unbalanced head 15 % in excess of the maximum specified ratio. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N.

- e) All valves, spindle and hand wheels shall be positioned to give good access for operational personnel.
- f) All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.
- g) Valves shall be double flanged type and the face shall be parallel to each other and flange face should be at right angles to the valve centerline. Backside of valve flanges shall be machined or spot faced for proper seating of the head and nuts.
- h) Valves buried or installed in underground chamber, where access to a hand wheel would be impracticable, shall be operated by means of extension spindle and/ or keys.
- i) Valves shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.
- j) The valve stem, thrust washer, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel.
- k) Valves shall be free from sharp projections.
- l) Butterfly, Non return valves and rising spindle sluice valves shall be provided with bypass arrangement. This may be integral with valve or connected between pipes. SUITABLE SPECIALS LIKE TAPER/ DISMANTLING JOINTS FOR VALVE SIZE EQUAL TO 500 MM OR MORE SHALL BE PROVIDED.

2 Standards

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below with ISI certification mark on each sluice valves.

3 Temperature Variation

All sluice valves manufactured, supplied and delivered shall be subjected to drinking water under variable temperature condition ranging from 40 to 450 C

4 Marking

The legible and in deniable marking upon each valve shall indicate the following:

- (1) ISI certification mark on each sluice valve.
- (2) Manufacture's brand name and/or trade mark.

- (3) Size of valve and nominal pressure of valve.
- (4) Serial number of cast.
- (5) Serial number in punch
- (6) Where a valve has been tested for only open end test, it should be marked '0' distinctly and permanently.
- (7) Any other important matter that the manufacturer deems fit to be inscribed embossed.

5 Test Certificate

5.1 The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.

5.2 The contractor shall also produce; in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by Engineer/owner for the same purpose. The inspection charges of the authorized person/agency as fixed by the owner shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of the owner.

6 Nominal Pressure

6.1 Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-I" (Mpa= 10 kgf/m² approx)

Class of Valve	Working pressure of body	Working pressure for seat
PN 0.6	5 kg/sq.cm	9 kg/sq.cm
PN 1.0	10 kg/sq.cm	15 kg/sq.cm
PN 1.6	16 kg/sq.cm	24 kg/sq.cm

6.2 The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

7 Material:

7.1 The materials for the different component parts of the sluice valve shall confirm to requirements given in Table.

Materials for components parts of sluice valve

Sr.No	Component	Material	Ref. to Grade or designation
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1	Body, bonnet dome, wedge, stool cover, stuffing box, gland thrust plate, cap, hand wheel. Grey cast iron	210 1978(1)	FG-250		
2	Stem	High tensile brass	320-1980(2)	HT - 2	
3	Wedge nut	Leaded tin bronze	318-1981 (5)	LTB-2	
4	Body seat ring, wedge facing ring	Leaded tin bronze	318-1981 (5)	LTB-2	
5	Bolts	Carbon steel	1363-1967(7)	Class 4.6	
6	Nuts	Carbon steel	1367-1967(7)	Class 4	
7	Bonnet gasket	Compressed fiber Board	2712-1979(8)	C	
8	Gland packing	A) Jute & hemp			
	B) Asbestos	5414-1969(10)			
		4687-1980(11)	--		

- (1) Specification for grey iron castings (third revision).
- (2) Specification for high tensile brass rods and sections (revised).
- (3) Specification for leaded tin bronze ingots and casting (revised).
- (4) Specification for technical supply condition threaded fasteners (first revision)
- (5) Specification for compressed asbestos fiber jointing (first revision)
- (6) Specification for gland packing, jute and hemp.

7.2 Cast Steel double-flanged sluice valve/butterfly valves with two tailpieces suitable to pipe shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.

7.3 The sluice valve/butterfly valves and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect.

7.4 The sluice valves/butterfly valves shall be operated before laying.

7.5 All grits and foreign materials shall be removed from the inside of the valves before placing.

7.6 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.

7.7 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

8 **Manufacture:**

Sluice valve bodies for 80 mm to 900 mm size valves shall be provided with double flanged ends for connection.

9 **Flanges:**

The flanges and their dimensions of drilling shall be in accordance with the requirements given in I.S. 1538 (Part I to XXII) 1976 (Specification for cast Iron fittings for pressure pipes for water, gas and sewage) or its latest revision.

10 **Testing:**

10.1 **Hydraulic test:**

Each valve shall be subjected to hydraulic tests as described in Appendix – B of IS: 2906-1984 to the test pressure for a duration as specified in table – 7 of IS: 2906 and shall show no sign of leakage under these tests.

10.2 **Liquid Penetration Test:**

The forged steel stems shall not show any sign of flaw when subjected to liquid penetration flaw detection test in accordance with IS: 3658-1981

The payment shall be as per payment schedule.

Item No. 7

Dual Plate Check Valve (Reflex valve)

(a) Providing and supplying ISI mark CI D/F Reflex Valves as per IS:5312 (latest edition) of following class and diameters including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete.

(b) Lowering, laying and jointing in position including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete as per Tender Specifications and instructions of Engineer in charge.

PN 1.6 IS 5312 with ISI mark.

600 mm dia (Delivery line)

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 8

AIR VALVE:: Providing and supplying C. I. Temper proof Air valves with SS 304 Float gun metal-nozzle of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete including Lowering, laying and jointing in position

following C. I. / D/F Reflux valves, Butterfly valves, Sluice valves and Air valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete.

With Isolating Sluice Valve PN 1.0

Size: 150 mm NB - PN 1.0

1.0 GENERAL

1.1 The excavation for trenches will generally, refer to open excavation for trenches in wet / dry conditions for pipe laying work.

2.0 CLEARING OF SITES:

2.1 The site on which the pipelines are to be laid and shown on plan and the area required for setting out and other operations shall be cleared and all obstruction loose stones and materials, rubbish of all kinds, stumps, brushwood as trees shall be removed as directed the roots shall be entirely grubbed up.

2.2 The products of the clearing to restocked in such a place and in such a manner, as directed by the engineer in charge.

2.3 In jungle clearings, all trees not specially marked for preservation, bamboo's jungle wood and brushwood shall be cut down their roots grubbed up. All wood and materials from the clearing shall be the property of the local body shall be arranged as directed by the Engineer-in-charge or his authorized agent, the material pronounced as useful by the Engineer will be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.

2.4 All holes or hollows whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well earth, well rammed leveled off, as may be directed.

3.0 SETTING OUT:

The center lines of all pipe trenches etc. shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required true to line, level curve and slopes. The contractor shall assure full responsibility for alignment, and dimension of trench.

The labor materials etc. required for setting out and establishing benchmarks and other reference marks shall be arranged by the contractor at his own cost.

4 EXCAVATION

4.1 The excavation incl. Bailing out of water for the pipe trenches shall also incl. Removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipelines exactly in accordance with alignment, levels grades and curves shown on the plans or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as far as possible or according to the angle of repose various soils. Unless there is a

specific extra provision in the contract for shoring and strutting or for cutting side slopes the contractor shall at his own cost do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or slopped as directed by the Engineer. The contractor shall at his own cost to remove such portions of boulders or rocks, as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer the extra depth shall have to be made with selected excavated stuff only with watering, remedying etc. as directed, by the Engineer and at the cost of the contractor. Other hard excavation shall be cleared of all sorts and loose materials and cut to firm surface, either level, stepped as directed by the Engineer. The Engineer may order such charges in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The contractor shall, at his own expense, make provision for bailing out of draining water and the trenches shall be kept free of water, during laying work.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no laying of pipeline will be allowed to laid until Engineer has approved the depth and dimensions of trenches level and measurements.

5.0 SHORING AND STRUTTING:

5.1 Shoring & strutting and dewatering if required shall have to be carried out by the contractor, for which any extra charge will not be paid

5.2 During excavation if water connections, sewage connections, telephone lines khalkuva (soak pits) etc. are damaged by the contractor, the same shall have to be restored by the contractor without any extra payment.

6.0 PROTECTION

6.1 The trenches shall be strongly fenced and red light signal shall be kept at night and arrangement of watchman to prevent accidents should be done, sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution boards etc. shall be provided by the contractor.

7.0 The excavation in all sorts of soil, hard murrum, soft rock or hard rock or any type of soil shall have to be carried out up to the required depth by the agency

8 DISPOSAL OF EXCAVATED STUFF

8.1 No excavated stuff from trench are to be placed even temporarily nearer than 1.5 meter or greater distance up to 90 meter or as prescribed by the Engineer from the outer edge of trench. All excavated material will be the property of the board. The rate of excavated includes sorting out of useful materials and stacking then separately as directed within specified lead. The excavated stuff suitable and useful for

refilling or for other use shall be stacked at convenient places. The materials not useful in any wet shall be disposal off as directed by the Engineer from the outer edge of trench.

8.2 The site should be cleared off on completion of work.

9.0 ADDITIONAL REQUIREMENTS

9.1

At the joints of pipes, the trench shall be excavated to an additional depth of 15 cm. and width of 30 cm. And length of 15 cm. beyond the edge of collar on both the sides or as directed. The rate include for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of the trench shall be kept as per invert level or as directed. To maintain the proper slop the usual method of site rails and boning rods shall be adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

If the contractor fails or makes delay to give hydraulic test of the pipe line laid in any of the section, without any genuine reason, he shall be responsible to get any part of the length trenches refill in such case i.e. before tasting for safety of pedestrian and/or vehicular traffic as found necessary by the engineer-in-charge without any extra cost. If found necessary any directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during hydraulic test without any extra cost.

At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipeline is done so as to make it suitable for the traffic. The contractor shall provide direction when the pipeline is to be laid along the road as required and shall maintain the diversion or any part of it, without any extra cost. At all road crossings, the pipe shall be laid below the crest of read.

9.2 The contractor shall break the road surface by excavation chiseling to the exact width and length as shown on the drawing or as directed by the Engineer-in-charge.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at non-objectionable place or as directed by the Engineer-in-charge.

10.0 MEASUREMENT AND PAYMENT

10.1 The payment of excavation shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer in charge limited to dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured not paid for and if an ordered by the Engineer the contractor shall have to fill up the excess depth with excavated stuff with watering ramming etc. (Completed as specified) for trench without any extra payment to the contractor.

10.2 Dimension shall be correct to two places of decimals of a meter and individual quantity shall of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.

10.3 The rate for the item of excavation shall include unless and otherwise mentioned.

- (a) Clearing of site
- (b) Setting out work including all materials and labour.
- (c) Providing and subsequently removing, shoring and strutting outing slopes etc.
- (d) Excavation and removal and staking of all excavated stuff as directed.
- (e) Necessary protection including labour materials equipment etc. to ensure safety and protection against risk or accident.
- (f) Providing facilities for inspection and damage to property if caused during progress of work.
- (g) Compensation for injury to life and damage to property if caused during progress of work.
- (h) Restoring of water supply connections, sewer connections, telephone lines, khalkuva soapiest etc. if damaged by contractor without extra payment.
- (i) Dewatering of excavated pit trench during the progress of work.
- (j) Clearing the site on completion of works directed by the Engineer.

Item No. 9

M.S.Pipe: Manufacture, Supply & Delivery of Electric Resistance Welded (Up to 400mm)/Submerged Arc Welded(Above 400mm) M.S.Pipe having beveled ends plate or coil conforming to IS-3589-2001 or its latest revision/ ammendment for following thickness outside diameter at GWSSB store or site anywhere in Gujarat State including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading conveyance to Departmental stores, stacking etc. all complete. including Lowering, laying, jointing & welding in position to correct line & level M.S. Pipe with outside 3 LPE coating & inside solvent free liquid epoxy lining on pedestal or chairs upon prepared formation or prepared bedding in trenches the rates include conveyance from store to site of work loading, unloading, heat shrink sleev jointing hydrotesting etc.complete.

610 mm dia mini 6.3 mm thick(Delivery line)

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 10

MISCELLANEOUS:

Providing, S.I.T.C of Structure Steel at site of work with freight, loading, unloading carting, etc. including all taxes and duties complete such as joints, channels, angles, Iron Rails, ISA/ISMC/ISMB/MS flat, Plates, Chequered plates (below 10mm thickness) etc. required for support structure of Elecrtio- Mechanical equipments etc. for support on floor / wall / beam / brackets etc. as per tender and IS.

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 11

Auto transformer starter suitable for local & remote pump control application consisting of Auto Transformer (vacuum impregnated, air cooled having three (3) tappings at 50%, 65% and 80%), incomer MCCB / MPCB, overload relay and contactors as per Type II coordination including digital MFM with RS 485 communication port, analogue type ammeter with selector switch, run hour meter, required protective relays & control accessories.

T. S. from 71 to 80 HP

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 12

Above 80A, upto & including 250A, 3 & 4 Pole, Air Break Fixed MCCB conforms to IS/ IEC 60947-2 with trip free mechanism, current limiting type with Thermal Magnetic/ Microprocessor release (O / C, S / C & E / F) with adjustable settings & having minimum 2NO+2NC potential free auxiliary contacts with all necessary Electro-Mechanical protections & interlocks etc. MCCB module, when used as Outgoing(s), shall have enclosure dimensions- 400 (H) x 600 (W) x 600 (D) & following technical features::

3 Pole, MCCB with Breaking Capacity of Icu=25 KA at 415V (Ics =100% of Icu), TM release

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 13

Above 50 KVAR capacity: APFC panel consisting following items..a) 125 A, 50 kA for 1sec. TP, TM based MCCB with spreader terminals & rotary handle b) 0-125 A range analogue ammeter of 96 x 96 mm size with selector switch c) 3 nos. 125 / 5A, 10 VA CL-1.0 cast resin type current transformer d) Suitable rating MCCB / MCB & Contactors for each capacitor bank e) Suitable rating APP type

capacitor banks (vacuum impregnated with non-PCB / non toxic oil, internally delta connected with built in internal fuses complete with discharge resistances & terminal cover) of approved make in required steps with well suited detuned reactor is placed in series with each capacitor step. (e.g. 50 KVAR capacity will be provided in steps of 2 nos x 5 KVAR, 2 nos x 7.5KVAR & 2 nos x12.5 KVAR).

f)Enclosure dimensions: 1600 (H) x 1150 (W) x 600 (D)

The capacitor and control panel conform to the latest applicable standards specified below. In case of conflict between standards and this specification, this specification shall govern.

Shunt capacitors for power systems IS : 2834

Internal fuses and internal IS : 12672

Overpressure disconnections for shunt capacitors

Code of practice for phosphate IS : 6005/BS : 3189 iron and steel

Specification for copper rods and IS : 613 bars for electrical purpose

Design Features

- a) The capacitor banks shall be complete with all parts that are necessary or essential for efficient operation. Such parts shall be deemed to be within the scope of supply whether specifically mentioned or not.
- b) The capacitor bank shall be complete with the required capacitors along with the supporting post insulators, steel rack assembly, copper bus bars, copper connecting strips, foundation channels, fuses, fuse clips, etc. The steel rack assembly shall be hot dip galvanized.
- c) The capacitor bank may comprise of suitable number of single-phase units in series parallel combination. However, the number of parallel units in each of the series racks shall be such that failure of one unit shall not create an over voltage on the units in parallel with it, which will result in the failure of the parallel units.
- d) The complete capacitor banks with its accessories shall be metal enclosed (in sheet steel cubicle), indoor floor mounting and free-standing type.
- e) All sheet steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and scarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate and then painted with two coats of zinc rich primer paint. After application of primer, two coats of finishing synthetic enamel paint oven baked/ stoves shall be applied.
- f) The assembly of the banks shall be such that it provides sufficient ventilation for each unit. Necessary louvers may be provided in the cubicle to ensure proper ventilation.

g) Each capacitor unit/bank shall be fitted with directly connected continuously rated, low loss discharge device to discharge the capacitors to reduce the voltage to 50 volts within one minute in accordance with the provisions of the latest edition of IS: 2834.

h) Capacitors shall be of All poly propylene (APP) film of single layer; minimum thickness shall be 12 microns with internal element fuses completely impregnated type non-PCB and nontoxic oil.

i) Each unit shall satisfactorily operate at 135% of rated KVAR including factors of over voltage, harmonic currents and manufacturing tolerance. The units shall be capable of continuously withstanding satisfactorily any over voltage up to a maximum of 10% above the rated voltage, excluding transients.

a) Power capacitor and capacitor control panel shall be housed in metal enclosed cubicle. Power capacitor shall be housed in the lower compartment and capacitor control panel at top compartment. It should be of approved makes given here in with required test certificate to be obtained from GEB.

b) The control equipment including capacitors shall be mounted in a panel of cold rolled sheet steel. The panel shall be of indoor type and shall consist of following.

- 1) Bus bars shall be of copper conductor of hard drawn (HD) and high conductivity
- 2) Isolating switch
- 3) Contactor with overload element
- 4) Relays responsive to current/voltage/KVAR/PF as specified for automatic switching
- 5) Sequencing devices, timers and auxiliary relays for automatic sequential switching of the capacitors in and out of the circuit.
- 6) Auto /manual selector switches
- 7) Push button for opening and closing the power circuit.
- 8) Red and green lamps for capacitors ON/OFF indication
- 9) Protective relays to protect the healthy capacitor units when one unit fails in a series connection
- 10) Space heater and cubicle lighting as per the requirements

Drawings and Data

The following shall be furnished as part of the tender.

a) General arrangement showing plan, elevation and typical sectional views. On award of contract, before commencement of manufacture, the following drawings shall be submitted for the approval.

- b) Fully dimensioned general arrangement drawings of capacitor and capacitor control panel with elevation, side view, and sectional view and foundation details.
- c) Complete schematic and wiring diagrams for capacitor control panel.

Applicable Standards

a) The capacitor banks and panel shall conform to the latest applicable standards specified below. In case of conflict between standards and this specification, this specification shall govern.

Metal enclosed switchgear	:IS:3427/BSEN:60298/IEC:298
Current transformers	: IS:2705/BS:7
Arrangement for switchgear	: IS:5578/IS: 11353
bus bars, main connections and auxiliary wiring	
Bus bar support insulators	: IS: 2544/BS:3297/IEC:273
Degree of protection	: IS: 13947-Part (I)/IEC:947-1
High voltage fuses	: IS:9385/BS:2692
Specification for copper rods	: Bars for electrical purposes
Code of practice for phosphate	: iron and steel
Load break switches	: IS:9920, IEC:129, 265,298
Shunt capacitors for power systems	:IS: 2834
Series reactor	:IS5553
Internal fuses and internal	: IS12672
Overpressure disconnections for shunt capacitors	

Porcelain post insulators : IS2544

Main Bus bars

- a) Bus bars shall be fully insulated by encapsulation in epoxy resin, with Moulded caps protecting all joints.
- b) Bus bars shall be supported on insulators capable of withstanding dynamic stresses due to short circuit.
- c) Bus bars shall be of copper conductor of hard drawn (HD) and high conductivity.

Disconnection Switches

- a) Disconnect switches shall be load break, type. Push button with indicating lamps shall be provided for the opening of the load break switch.

Earthing

- a) An earthing bus shall be provided at the bottom and extended throughout the length of the cubicle. It shall be bolted/welded to the frame work.
- b) All non-current carrying metal work of the cubicle shall be effectively bonded to the earth bus. Hinged doors shall be earthed through flexible earthing braid.

Panel Accessories and Wiring

- a) Panel shall be supplied completely wired internally up to equipment and terminal blocks and ready for the external cable connections at the terminal blocks.
- b) All auxiliary wiring shall be carried out with 650 volts grade, single core, stranded copper conductor with HDPE insulation. The sizes of wire shall be not less than 1.5 mm².
- c) Terminal blocks shall be of stud type, 650 volts grade 10 amps, rated complete with insulated barriers. Terminal blocks for CTs shall be provided with test links and isolating facilities.
- d) All spare contacts and terminals of cubicle mounted equipment and devices shall be wired to terminal blocks.
- e) Push buttons shall be provided wherever specified. They shall be provided with inscription plates engraved with their functions.
- f) Indicating lamps shall be panel mounting type with series resistors. The wattage of lamps shall be 5 to 10 watts.

g) Each panel shall be provided with 240 volts, 1 phase, 50 Hz, 5 amps, 3 pin receptacle with switch located in a convenient position.

h) An interior illuminating lamp together with operating door switch and protective fuse shall be provided.

Cable Termination

a) Necessary number of cable glands shall be supplied for terminating auxiliary power and control cables. Glands shall be of heavy-duty brass castings, machine finished and complete with check nut, washers, neoprene compression ring etc.

b) Cable lugs for all power and control cable connections shall be supplied. The lugs shall be tinned copper/aluminum depending on cable conductor and of solder less crimping type

c) All necessary materials required for terminating the power cables such as tapes, fillers, binding wires, armor clamps, brass glands etc. shall be supplied. Equipment.

Drawings and Data

The following shall be furnished as part of the tender:

a) General arrangement showing plan, elevation and typical section views.

b) Technical literature on the equipment offered.

The following shall be furnished after award of contract for Purchaser's approval.

a) Full dimensional general arrangement drawings of capacitor banks with panel showing elevation, side view, sectional view and foundation details.

b) Foundation plan showing location of fixing channels, floor openings etc.

c) Schematic diagram for the capacitor bank and switching

The '*' marked thus shall be decided by the Contractor.

Item No. 14

Supply, laying, testing & commissioning 1.1 kV grade, XLPE insulated, stranded Aluminium conductor, galvanised steel flat strip / round wire armoured, extruded PVC type ST2 sheathed, heavy duty cable (to be laid on wall surface with necessary clamps / in existing cable trench / cable trays / conduit / pipe sleeves at road crossing or floor as per site requirement) conforming to IS:7098 (Part-1) & IEC:60502 (Part-1) of following sizes:

3 Core x 16 Sqmm

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 15

Pipe type earthing with 40 mm dia 2.5 mtr long 'B' grade G.I. pipe with necessary coupling buch buried in specially prepared earth pit & G.I. earth wire of 8 SWG erected & connected as directed (For panel)

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 16

CABLE TRAY

Supply & laying GI ladder type cable trays with side channels of size - 75 x 15 x 15 mm / 100 x 15 x 15 mm & rungs of size - 35 x15 x 15 mm spaced at 250 mm apart, fabricated from 2 mm thick sheet steel in standard length of 2.5 meter, duly hot dipped galvanized after fabrication as per IS 2629-1989/ IS 4759-1984 including accessories such as coupler plates/ fish plates, bends, tees, reducers, elbows, covers and electro-galvanized hardware etc, erected on existing support as per specification and instruction of Engineer-in-charge.

150(W) x 35(H) x 2.0 mm Thick

- Cable tray should be fabricated from the steel sheets conforming to IS1079:1973 and IS 513:1994
- Cable tray must be laid 1 feet above ground hold by supports inside the pump/panel room.

Work shall be executed as directed by engineer in-charge

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 17

Float type Level Switch:

Design, Supply, Installation, Testing and Commissioning of Top mounted Displacer Type level switches with 2 nos SPDT contacts of Micro switch rated 5 A, potential free power supply, Material of wetted parts shall be SS 316 and the material of accessories shall be SS. IP 65 or equivalent degree of protection for enclosure, suitable for sump, ESR, tank, vessels and underground reservoirs. The top mounted level switches shall be supplied with still tubes to suit the requirement. . Accessories like name plate, mating flange, gaskets, fasteners, bolts & nuts, etc. shall be supplied with the Level Switch of following Range.

0 to 5 Meter

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 18

INTERNAL WIRING:-

SITC of Main & Outlet points wiring with 1.1KV Grade FRLS PVC insulated ISI marked flexible stranded copper conductor wires with medium class min. 25mm dia. Rigid PVC Pipe and accessories to be erected concealed in/to be run on surface /wall/ ceiling with following sizes as mentioned below. The unit rate wiring shall be with connector, PVC junction box, wire holder, ceiling rose, Angle holder, switch, switchboard brass chromium/cadmium plated machine screws, phase and neutral wires, green earth continuity wires etc. as required to complete wiring from LDB panel to the final outlet termination points. The wiring shall be as per IS :732, IS : 4648 and as per tender specification / IS

SITC of Main wiring with 3wire 1.5 Sq.mm

SITC of Main wiring with 3 wire 2.5 Sq.mm

SITC of Main wiring with 4 wire 1.5 Sq.mm

SITC of Main wiring with 4 wire 2.5 Sq.mm

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 19

Point wiring: Point wiring for Light/ Bell with 2-1.5 sq mm & earthwire of 1.5 sq mm (Green) both are of ISI marked 1.1kV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected concealed in/on surface on wall/ceiling complete with 6A Modular type switch/ bell push & accessories and earth continuity of following type, erected on PVC/ Metallic box, single mounting base frame covered With textured/ metallic front plate modules erected on/ in wall/ ceiling as per pipe erected, with necessary Lamp holder/ ceiling rose/ H D.Connector as directed.

(a) with Medium class Rigid PVC pipe and accessories erected flushed on Wall/ceiling complete.

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 20

Supply,Installation,Testing and Commissioning of 5/15A Point wiring for Individual Plug with & earthwire of 1.5 sq.mm (Green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of to be erected concealed in / on surface of wall / ceiling complete with Modular type switch & 5 pin Plug erected on PVC / Metallic box covered with appropriate front plate modules erected on / in wall / ceiling as per pipe erected with following type of accessories.

[III] for 16A Plug and 16 amp switch with 2.-2.5 sq.mm Cu. Wire from mcb db board.

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 21

Supplying and erecting LED street light / Flood light fittings with High power White LEDs wattage of 3 Watt and above assembled on single MCPCB, efficiency more than 130 lm/w and corrosion free High pressure die cast aluminium housing with smooth finish powder coated and heat sink extruded aluminium with diffuser and Polycarbonate optics/ lenses with company mark/name engraved or embossed 160 to 270 V,Power Factor more than 0.95, THD < 10 %, CCT 3000 K to 5700K,Uniformity ratio >0.45, Luminaire efficacy > 100 lumens/watt . LED driver efficiency > 85 %.(fittings required LM-79 & LM-80 certificates)(NOTE: Below description have shown ranges of Wattage capacity of LED fittings.The Engineer incharge may select any wattage capacity between the ranges shown.)

(A) Street Light (IP-65), Surge protection -4KV integral and ,Light must have 440VAC line supply with over-voltage protection.

(ii) 15 to 24 Watts Cat-III

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 22

Supplying and erecting approved make suitable panel indicator LED type lamp, lens cover, complete erected with necessary connections

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

Item No. 23

Supplying & erecting carbon dioxide (CO2) fire extinguisher user of following capacity with necessary clamps made from 50 x 6 mm M.S. Flat with nut & bolts grouted in wall complete.

for 4.5 kg capacity

As Per Details Description and Specification As Per Relevant General Technical Specification of Tender and As directed by Engineer In Charge

Item No. 24

Providing and fixing printed instruction chart both in English and Gujarati and duly framed with front glasses, for treatment of person suffering from Electric shock with minimum 50" diagonally size.

As Per Details Description and Specification As Per Relevant General Technical Specification of Tender and As directed by Engineer In Charge

Item No. 25

Supplying stand first AID box with antiseptic cream, medicine for use on wounds due burn, crepe bandage, gauge bandage, medicated ready to use bandage (Band-aid) adhesive tape for medicinal user, Scissors, anti-septic solution (savlon or similar) etc. (All above contents shall be of standard makes)

As Per Details Description and Specification As Per Relevant General Technical Specification of Tender and As directed by Engineer In Charge

Item No. 26

Supplying FIRE bucket round bottom of 9 litres capacity made out of 24 gauge G.I. sheet with extra handle at bottom duly painted white inside and Red out side with FIRE mark, filled with dry-sand and kept on existing stand provided or hung on wall hook.

As Per Details Description and Specification As Per Relevant General Technical Specification of Tender and As directed by Engineer In Charge

Item No. 27

Supplying rubber matting of following thickness as per IS:15652/IEC 61111

(a) 3 mm

As Per Details Description and Specification As Per Relevant General Technical pecification of Tender and As directed by Engineer In Charge

Item No. 28

Providing pair of rubber hand gloves suitable for working on 11 KV/22 KV supply.

As Per Details Description and Specification As Per Relevant General Technical pecification of Tender and As directed by Engineer In Charge

ITEMWISE SPECIFICATIONS

: SCHEDULE: B-6

RISING MAIN

Item No. 1

Providing and supplying D. I. K-7 grade pipes for following nominal bore diameter with internal cement mortar lining including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. (IS.8329-2000).

For sewerage Project cement mortar lining shall be with sulphate resistance cement.

Sr. No.	Size
1.0	900 mm DI

GENERAL TECHNICAL Specifications:

A] DUCTILE IRON PIPES:

Note: Wherever International Standards or Indian standards / specifications are mentioned, their equivalent or higher standards / specifications are also acceptable

Supply and Delivery of Ductile Iron Pipe K-7 / K9 as per IS:8329-2000 or its latest revision or amendments if any including jointing material as EPDM ring as per IS 5382-1985 and ISO: 4633-1996 or its latest revision or amendments if any

Standards

The following standards, specifications and codes are part of this specification. In all cases, the latest revision of the including all applicable official amendments and revisions shall be referred to. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

ISO: 10803-1997 Design method for ductile iron pipes

IS:8329-2000 Centrifugally Cast (spun) ductile iron pressure pipes for water, gas and sewage

ISO:2531-1991 Ductile iron pipes, fittings and accessories for pressure pipelines.

ISO:4179-1985 Ductile iron pipes for pressure and non pressure-Centrifugal cement mortar lining – General requirements.

IS:8112 Specification for 43 Grade ordinary Portland cement.

BS:3416 Bitumen based coatings for cold application, suitable for use in contact with potable water.

ISO:8179-1995 Ductile iron pipes-External coating-Part-1 Metallic Zinc with finishing layer.

IS:638 Sheet rubber jointing and rubber insertion jointing.

ISO:4633-1996 Rubber seals-Joint rings.

IS:5382-1985 Specification for Rubber sealing rings for gas mains, water mains and sewers.

AWWA C600 Installation of ductile iron water mains and their appurtenances.

1.0 Internal Diameter:

The nominal values of the internal diameters of pipe, expressed in millimeters are approximately equal to the number indicating their nominal sizes DN.

2.0 Length:

The working length of socket and spigot pipes shall be 5 m ,5.5 m, or 6metres.

3.0 Thickness:

The wall thickness of pipe 'e' in mm shall be calculated as a function of the nominal diameter by the following equation with minimum of 5 mm

$$e = K(0.5 + 0.001 DN)$$

where : e = wall thickness in mm, DN = the nominal diameter, K = the whole number coefficient

EPDM Rubber Gasket:

Rubber Gasket shall be suitably for Push-on-Joint.

The spigot ends shall be suitably chamfered or rounded off to facilitate smooth entry of pipe in the socket fitted with the rubber gasket

Rubber Gasket shall confirm to IS 5382-1985 and ISO : 4633-1996 its latest revision or amendments if any

5.0 Sampling Criteria:

Sampling criteria for various tests, unless specified in IS 8329-2000, shall be as laid down in IS 11606. Mechanical test, Brinell Hardness test, Hydrostatic test etc are shall be as per IS 8329-2000

6.0 Tolerances on External Diameter:

The nominal external diameter (DE) of the spigot end of socket and spigot pipes and when measured circumferentially using a diameter tape shall confirm to the requirements specified as follow. The positive tolerance is +1 mm and applies to all thickness classes of pipes. The maximum negative tolerance of the external diameter are specified as follow:

DN	Nominal	Positive Tolerance	Negative Tolerance
80	98	+1	-2.2
100	118	+1	-2.8
125	144	+1	-2.8
150	170	+1	-2.9

200	222	+1	-3.0
250	274	+1	-3.1
300	326	+1	-3.3
350	378	+1	-3.4
400	429	+1	-3.5
450	480	+1	-3.6
500	532	+1	-3.8
600	635	+1	-4.0

7.0 Tolerance on Ovality:

Pipes shall be as far as possible circular internally and externally. The tolerance for out-of-roundness of the socket and spigot ends is given below:

Nominal Diameter in mm	Allowable Difference Between Minor Axis and DE in mm
80 to 300	1.0
350 to 600	1.75
700	2.0
750 to 800	2.4
900 to 1000	3.5

8.0 Tolerance in thickness

The tolerance on wall thickness (e) and the flange thickness (b) of the pipes shall be as below:

Dimensions	Tolerance in mm
Wall thickness (e)	$-(1.3 + 0.001 \text{ DN})1$
Flange thickness (b)	$+(2+0.05b) \& -(2+0.05b)$

9.0 Coating

Pipe shall be delivered internally and externally coated.

External Coating: Pipe shall be metallic zinc coated and after that it shall be given a finishing layer of bituminous paint as per IS - 8329-2000

Zinc coating shall comply with IS:8329/EN 545/ ISO 8179. Only molten zinc spray coating shall be acceptable. The average mass of sprayed metal shall not be less than 130 g/sqm with a local minimum of 110 g/sqm.

Bitumen overcoat shall be of normal thickness of 70 microns unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II suitable for tropical climates factory applied preferably through an automatic process.

Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

Internal lining: Internally pipe shall be Portland Cement mortar lined (as per IS - 8329-2000). The mortar shall contain by mass at least one part of cement to 3.5 part of sand.

All pipes and fittings shall be internally lined with cement mortar using high speed centrifugal process in accordance with IWO 4179/IS 8329. Cement mortar lining shall be applied at the pipe manufacturing shop in conformity with the aforesaid standards. No admixtures in the mortar shall be used without the approval of the Engineer. The sand to cement proportion of sand if justified by the sieve analysis.

Pipe lining shall be inspected on site and any damage or defective areas shall be made good to the satisfaction of the Engineer.

Lining shall be uniform in thickness all along the pipe. The minimum thickness of factory applied cement mortar lining shall be as per IS: 8329 Annex-B or ISO 4179. This is given below.

Nominal Pipe Size (mm)	Nominal lining thickness (mm)
Up to 300	3
350-600	5
700-1200	6
1400-2000	9

10.0 Joint

Jointing of DI pipes and fittings shall be push-on type

Push-on-joints

The Contractor shall source the push-on-joint gaskets only from the pipe manufactures. In turn the pipe manufacturer shall supply at least 10% additional quantity of gaskets over and above the requirement to the Contractor at no extra cost.

The gasket used for joints shall be suitable for natural and purified water conveyance. In jointing DI pipes and fittings, the Contractor shall take into account the manufacturer's recommendations as to the methods and equipments to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that once the rubber ring is correctly positioned before the joint is made, does not get damaged by friction or sharp edges of the spigot Chamfer. The rubber rings and the recommend lubricant shall be obtained only through the pipe manufacturer.

Rubber ring bundles from every lot shall carry with them manufacturers test certificate for the following mechanical properties.

Hardness

Tensile strength

Compression set

Accelerated aging test

Water absorption test

Stress relaxation test

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint, the size of the pipe with which they are to be used, the manufacturer's name and trade mark, the month and year of manufacture and the shelf life.

11.0 Testing of Pipe:

The main test among others to be conducted shall be as per IS:8329-2000 or with its latest revision/amendments.

[a] Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes as specified in the Standards. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS 11606-1986. The test results so obtained for all the pipes and fittings of different sizes shall be submitted to Engineer. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS:8329/EN 545 for pipes and IS:9523/EN 545 for fittings.

[b] Brinell Hardness Test

For checking the Brinell hardness the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS:1500. The test shall comply with the requirements specified in IS:1500/ISO 6506.

[c] Re-tests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

[d] For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in the standard for a period of minimum 15 seconds during which the pipes shall be struck moderately with a 700 g hammer for conformation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

12.0 Quality Assurance

The manufacturer shall have a laid down Quality Assurance Plan for the manufacture of the products offered which shall be submitted along with the tenders.

13.0 DI specials shall be conforming to IS 9523-2000 and flanges shall be of PN-10 class. The rates includes providing DI specials suitable to DI K-9 pipes in all categories as per requirement.

Mode of Payment : As per schedule B.

Item No. 2

Manufacture, supply & delivery of Ductile Iron Flange socket spigot bends, reducers or any other specials as per BS-EN-545/1995 Class-A series K12 suitable for use with D.I. Pipes manufactured as per IS: 8329/1994 delivery of specials is to be made to GWSSB store or site of works any where in Gujarat including all taxes, loading, unloading, carting, stacking, insurance, octroi etc. complete.

With external bitumen & zinc coating & internal cement mortar lining.

Socket & Spigot Type

350 & Above

GENERAL:

1.0 **Materials :**

1.1 Galvanized mild steel tubes of specified dia nominal bore shall be supplied by departments as shown in schedule 'B' The galvanized dia. Bore pipes shall be carted by the contractor on work site at his own cost.

2.0 **Workmanship**

Cutting, laying and jointing.

2.1.1 When the tubes are to be cut or rethreaded, one shall be carefully filed out so, that no construction to bore in offered. The ends of the tubes shall then be threaded conforming to the requirements of I.S. 554-1955 with pipe and taps carefully in joints when the two pieces are screwed together.

2.1.2 The taps and dies shall be used only for straightening screw threads which have become bent or damaged and dies shall not be used for turning of the threads so as to make them slacks as the latter procedure may not result in a watertight shall be protected from edges until they are fitted.

2.1.3 In jointing the tube, end of the tubes shall be oiled and smeared with white or red lead and wrapping around the screws end of the tube. The end shall then be tightly screwed in the socket, tees, etc. with a pipe wrench. Care shall be taken that all pipes and fittings are properly jointed to make the joints watertight and pipes are kept at all times free from dust and dirt during fixing. Butt joints shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

2.1.4 Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anti-corrosive paint to prevent corrosion.

2.1.5 Fixing of the tube fitting to wall coiling and floors,

2.2.1 IN case of fixing of tubes and fitting to the walls or ceilings, these shall run on the surface of the wall or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern, holder clamps keeping the pipes about 15mm clear of the walls and when specified so, chasing may be adopted or pipe fixed in ducts or recesses etc. provided that there is sufficient space to work on the ordinary be buried in walls on solid floors, where unavoidable, pipes may be buried for short distances provided that adequate protection is given against damage and where so required M.S. tube sleeve shall be fixed at a place a pipe is passing through a wall or floor for expansion and contraction and other movements in case the pipe is embedded in walls or floors, it should be painted with anti-corrosive bit mastic paint of approved quality. The pipe is affected by lime. Under the floors, the pipe shall be laid in layer of sand filling.

2.2.2 All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern clamps of size and shape, one end of which shall be properly plugged or cemented into walls with cement mortar 1:3 (1 cement : 3 coarse sand) and the other tightened round the pipes to hold it secretly. These clamps shall be spaced at regular intervals in straight length at 2 MC/C interval in horizontal run and 2.5 M interval in horizontal run . For pipe of 15 mm dia up to 25 mm dia the holes in the walls and floors shall be made by drilling with chisel or concrete. However for bigger diameter pipes, the holes shall be carefully made of the holes shall be made good with cement mortar 1:3 (1 cement : 3 coarse sand) and properly finished to match the adjacent surface.

2.3 Testing of Joints :

2.3.1 after laying and jointing the pipes and fitting shall be inspected under working conditions of pressure and all leaking pipes removed and replaced without extra cost.

2.3.2 The pipes and fitting as they are laid shall be tested to hydraulic pressure of 6 Kg/Sq.cm. The pipe shall be slowly and carefully charged with water hammer. The pressure gauge must be accurate. The pipe and fitting shall be tested in sections as the work of laying proceeds keeping the joints exposed for inspection during the testing.

Mode of measurement and Payment

2.1 As per payment schedule

Item No. 3

Providing and supplying ISI mark CI D/F Butterfly Valves as per IS:13095 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete.

Butterfly Valve IS 13095 with ISI PN-1.6

900 mm Dia

Sr. No.	Size
3.0	900 mm

Butterfly valves as per **IS - 13095 / 1991**

1.0 SCOPE – Fabricated valve will not be considered.

1.1 This standard cover double flanged and wafer type of metal seated, resilient seated cast iron, ductile iron, and carbon steel and lined butterfly valves for general purpose. Valves covered under this standard are manually, pneumatically, hydraulically or electrically operated.

1.2 It covers valves of nominal pressure designations up to and including 4 Mpa. and class 300 with ends flanged in accordance with appropriate table of I.S 6418 : 1971 ‘Cast iron and malleable cast iron flanges for general engineering purpose’ or wafer type valves with bodies designed to be accommodate between pipe work flanges in accordance with appropriate table of IS 6418 : 1971 or IS 6392 : 1971 ‘steel pipe flanges’ in nominal size DN 40 to DN 2000. It also covers valves up to class 300 and flanges as per the pressure/temperature ratings given in IS 13159 (Part 1) : 1991 ‘steel pipe flanges and flanged fittings : part I dimensions’ and IS 6418 : 1971 ‘cast iron and malleable cast iron flanges for general engineering purposes’.

2.0 REFERENCE

The Indian standards listed in Annex A are necessary adjuncts to this standard.

3.0 TERMINOLOGY AND DEFINITIONS

Terminology and definition covered in IS 4854 (Part3) : 1974 are generally applicable.

4.0 VALVE END CONNECTIONS

4.1 Double flanged valves

A valve having flanged ends for connection to pipe flanges by individual bolting as shown in Fig. 1

4.2 WATER VALVE

A valve for clamping between two pipe flanges using through bolting this may be single flange, lug type, U- section or flangeless type as shown in Fig 2,3,4,5 & 6.

5.0 SERVICE APPLICATIONS

5.1 Valves shall be suitable for one or more of the following applications.

- (a) Tight shut off - A valve having no visible leakage past the disc in closed position under test conditions.
- (b) Regulating - A valve intended for regulating purpose and which may have a clearance between the disc and the body in close position.

- (c) Low leakage - A valve which has specified maximum leakage rate past the disc in the closed position.

5.2 VACUUM CONDITION

Where valve are to be used under vacuum conditions, purchaser shall mention specifically and the detailed design provision shall be mutually agreed between the purchaser and the manufacturer.

6.0 NOMINAL SIZES

The range of nominal valve size (DN) in mm shall be as follows:

40,50,65,80,100,150,200,250,300,350,400,450,500,600,700,800,900,1000,1200,1400,1600,1800 and 2000

7.0 NOMINAL PRESSURES

- 7.1 Valve shall be designated by nominal pressure (PN) defined as the maximum permissible working pressure (Mpa) at 20⁰ C temperature as follows:

PN 0.25, PN0.6, PN1.0, PN1.25 and PN4.0

- 7.2 The class designation for valves specified by nominal pipe size shall be class 125, class 150 and class 300.

8.0 PRESSURE/TEMPERATURE RATINGS

Maximum permissible gauge working pressure and operating temperatures shall be in accordance with IS 6418 : 1971 and IS 13159 (Part I) : 1991 except that restriction on temperature may be placed by the manufacturer on valves in accordance with this standard by reason of valve type, trim materials or other factors. However, all valves shall be suitable for continuous use at their PN designation within the temperature range of -10⁰ c to 65⁰ c.

9.0 BODY ENDS

9.1 DOUBLE FLANGED BODY ENDS

The dimensions of flanged body ends and drillings shall be in accordance with the requirement given in Annex B. Flanges as per any other specific requirements of the purchaser may also be given as agreed to between the manufacturer and the purchaser or as per I.S. 13159 (part I) : 1991.

- 9.1.1 Flanges shall be at right angles to the axis of the bore and concentric with the bore. Flanges shall be drilled unless otherwise specified and bolt holes shall be off centers. Tapped by the design of the valve

9.2 WAFER BODY ENDS

- 9.2.1 Body ends shall be capable of being fitted between the pipe flanges complying with the requirements of annex B flange drilling.

- 9.2.2 The joint faces shall be at right angles to the axis of the bore and concentric with the bore.

- 9.2.3 Holes may be provided, where required by the design, for the passage of the bolts securing the flanges and the valve. Where through bolting is not practicable due to the presence of valve shaft, bearing housing, tapped holes may be provided for individual bolting of each flange.

10.0 FACE TO FACE DIMENSIONS

- 10.1 Face to face dimensions of double flanged and wafer types of valve shall be as per Table 1.

- 10.2 Face to face dimensions given in Table 1 are exclusive of the sealing gaskets at both ends.

10.3 The manufacturer shall ensure that adequate space will be available between valve flanges for bolting when flanged valve with short body face to face to face or wafer long face to face are manufactured.

10.4 Tolerance on face to face dimension in Table 1 shall be as follow

Face to face dimension of Unlined valve		Tolerance
MM		MM
Over	Up to and Including	
0	250	<u>+2</u>
250	500	<u>+3</u>
500	800	<u>+4</u>
800	1000	<u>+5</u>
1000	2400	<u>+6</u>

11.0 BODIES

Bodies end ports shall be circular and the numerical valves of the diameter shall be as close as possible to the valve of DN.

12.0 DISC AND SHAFT

The disc and shaft shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The shaft may be of one piece design or in two pieces separately attached to the disc. Any means of attachment between the shaft and the disc shall be such as to preclude components becoming loose in service.

13.0 SEATING AND LININGS

Non-integral seating, and lining where used, and their means of attachment shall be such as to preclude their becoming loose in service.

14.0 BEARINGS

14.1 The bearings shall be suitable for the maximum loads imposed by the shaft during testing and in service.

14.2 For valves DN 350 and above, a bearing shall be provided to take the axial thrust, spring retaining clips (circlips) shall not be used as thrust bearing.

14.3 Suitable sealing shall be provided for the shaft where it passes outside the pressure containing enclosure.

15.0 MATERIALS

This standard is based on materials specified in Table 2. Unless otherwise agreed, the materials shall be of a grade equivalent to those given in Table 2 or superior. Other material may be used as per agreement between the manufacturer and the purchaser.

16.0 OPERATION

16.1 MANUAL OPERATION

All valves shall be capable of operated at a differential pressure across the disc as marked on the valve. Lever, worms gear/traveling nut type or any other suitable type of operator can be used.

16.1.1 DIRECTION

Unless otherwise, specified manually operated valves shall be closed by turning hand wheel or lever in a clockwise direction when facing the hand wheel or lever. The design of lever when fitted shall be such that the lever may only be assembled to the valve so that it is parallel to the direction of flow when the valve is open.

- 16.1.2 All gear traveling nut operators shall be provided with suitable stops to prevent movement of the shaft beyond the limit corresponding to the fully closed position of the disc.
- 16.1.3 All gear traveling nut operators shall be packed with grease for life time operation. Gear/traveling nut operators shall be totally enclosed and weather proof for general application. For special applications such as marine, submerged service etc. the purchaser may specify special en-closer.
- 16.1.4 All gear/traveling nut operators shall be self locking type. All lever operated valve shall be capable of being locked at least three intermediate position.
- 16.2 The operating hand-wheels shall be marked 'CLOSE' or 'SHUT' to indicate the direction of closer.
- 16.3 The operator shall be provided with arrangement to indicate the disc position.

17.0 TESTING

All valves shall hydrostatically tested by the manufacturer before dispatch. The pressure shall be obtained without any significant hydraulic shock. Testing shall be carried on before application of paint or other similar treatment unless otherwise agreed between the purchaser and the manufacturer. There shall be no air entrapped within the part of the valves subjected to test pressure.

17.1 PERFORMANCE TESTING

Each valve shall be shop operated from fully closed to fully open position and reverse, under no pressure and no flow condition to demonstrate that the complete assembly is workable.

17.2 BODY TEST

Completely assembled valve shall be tested as follows:

'The body ends shall be blanked so that the valve is subjected to the full pressure in all directions include by the test pressure wafer valves may be tested in any suitable manner agreed between the purchaser and the manufacturer. The valve disc shall be in slightly open position and pressure equivalent to 1.5 times the maximum permissible working pressure shall be applied with water. The duration of this test shall be as in Table 3.'

17.3 SEAT TEST

The seating surface of the valve shall be cleaned unless a surface treatment forms an integral part of the design or the use of a temporary surface treatment has been agreed between the manufacturer and the purchaser to avoid the possibility of damage under the condition of the test.

TABLE-3

NOMINAL DIA MM	MINIMUM TEST DURATION IN MINUTES	
	BODY TEST	SEAT TEST WHEN APPLICABLE
Up to and including 50	0.25	0.25
65 to 150	1.00	1.00
200 to 300	2.00	2.00
350 to 1000	5.00	2.00
1200 to 2000	5.00	3.00

- 17.3.1 Each valve shall be shop tested for leaks in close position. The test shall be conducted with the body flanges in a horizontal position. Pressure shall be applied to the upstream end of the valve, the downstream being open to atmosphere. The duration of test shall be as per Table 3. There shall be no indication of leakage past the valve disc during test and valves shall be drop tight. Seat test

shall be carried out in both the direction of valve if agreed between the manufacturer and the purchaser. The seat pressure applied on upstream side shall be equivalent to 1.1 times the maximum permissible working pressure at 20 °C and shall be applied with water.

17.3.2 For regulating type valves seat test shall not be applicable.

17.4 DISC STRENGTH TEST

The test shall be conducted with the body flanges in horizontal position. The test pressure shall be 1.5 times the maximum permissible pressure at 20 °C. With disc in closed position, hydro test pressure shall be applied to the lower face of the disc for duration as per table-3. There shall be no damage to the valve disc nor shall any part of valve or disc be permanently deformed by the test. The purpose of this test is to provide evidence of the adequacy and structural integrity of disc and body. Any leakage past the seat shall not be the criteria for rejection of the valve (Sampling test sample as per IS 2500). For regulating type valves, disc strength shall not be applicable.

17.5 Maximum permissible leakage shall be as given in Table-4

18.0 TEST CERTIFICATES

When specified by the purchaser, the manufacturer shall issue a test certificate confirming that the valves have been tested in accordance with this standard and stating the actual pressures and medium used in the test.

VALVE TYPE	LEAKAGE RATE
Tight shut-off	No visible leakage for duration of test
Low leakage	0.1 mm ³ /s X DN (sec 5)
Regulating	Not specified. Outside the scope of this standard.

19.0 INSPECTION

If inspection is required, this shall be stated in the enquiry/order. The purchaser or his authorized representative shall have access to the manufacturer's works at all reasonable times to inspect assembled valve to his order.

20.0 WITNESSING OF TESTS

When the purchaser desires to witness the tests, this shall be specifically agreed in advance.

21.0 MARKING

Marking shall be cast integral on the body or on a plate securely attached to the body. The markings shall be in accordance with I.S. 9866: 1981.

22.0 PREPARATION FOR DESPATCH

- (a) Valve shall be complete in all respect when shipped. Each valve shall be drained, cleaned, prepared and suitably protected with 2 coats of red oxide on un-machined surfaces and rust preventive coats on machined and flanged surfaces for dispatch in such a way as to minimize the possibility of damage and deterioration during transit and storage. Painting other than specified on the finished valve shall be as per the agreement between the manufacturer and the purchaser.
- (b) Disc shall be unseated when dispatched, but care shall be taken to ensure that there is no risk of damage to the disc.

(c) When specified, the body ends shall be suitably sealed to exclude foreign matter during transit and storage.

(d) Components shipped unattached shall be adequately protected and identified to permit correct field assembly.

23 MODE OF MEASUREMENT AND PAYMENT

Measurement shall be paid on number basis as per relevant dia of the item in schedule 'B' of the tender and as per payment schedule.

Item No. 4

Providing and supplying ISI mark CI D/F Sluice Valves as per IS:14846 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete.

Sluice Valve PN-1 with Hand/Wheel Cap Operated (Alt-1 Type Long Body)

Sr. No.	Size
4.0	900 mm
4.1	250 mm

SLUICE VALVE

Sluice valve as per I.S: 780 & 2906/1984

1.0 GENERAL

The contractor shall be covering manufacturing, supplying and delivery of:

Sluice valve conforming to IS: 2906-1984 & IS: 780-1984 or its latest revision (Specification for sluice valves (50 to 900 mm size) with ISI certification

2.0 STANDARDS

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below: with ISI certification mark on each sluice valves.

3.0 TEMPERATURE VARIATION

All sluice valves manufactured, supplied and delivered shall be subjected to drinking water under variable temperature condition ranging from 40 to 450 C.

4.0 MARKING

The legible and in deniable marking upon each valve shall indicate the following:

(1) ISI certification mark on each sluice valve only.

- (2) Manufacture's brand name and/or trade mark.
- (3) Size of valve and nominal pressure of valve.
- (4) Serial number of cast.
- (5) Serial number in punch
- (6) Where a valve has been tested for only open and test, it should be marked '0' distinctly and permanently.
- (7) Any other important matter that the manufacturer deems fit to be inscribed embossed.

5.0 TEST CERTIFICATE

5.1 The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.

5.2 The contractor shall also produce, in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by localbody for the same purpose.

6.0 NOMINAL PRESSURE

6.1 Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-II" (Mpa= 10 kgf/m² approx)

6.2 The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

7.0 MATERIAL:

7.1 The materials for the different component parts of the sluice valve shall confirm to requirements given in Table

Materials for components parts of sluice valve

Sr. No	Component	Material	Ref.to	Grade of designation
1	Body, bonnet wedge stuffing box, gland thrust plate, cap.	Grey cast iron	210-FG	1978(1)
2	Steam	High tensile brass	320-1962(2)	Ally 1 of 2
3	Wedge nut	Leaded tin bronze	318-1962(3)	2
4	Body seat ring, wedge facing ring	Leaded tin bronze	318-1962(3)	2
5	Bolts	Carbon steel	1367-1967(4)	Class 4.6
6	Nuts	Carbon steel	1367-1967(4)	Class 4
7	Bonnet gasket	Compressed fiber Board	2712-1971(5)	C

8 Gland packing Jute & hemp 5414-1969(6) --

- (1) Specification for grey iron castings (third revision).
- (2) Specification for high tensile brass rods and sections (revised).
- (3) Specification for leaded tin bronze ingots and casting (revised).
- (4) Specification for technical supply condition threaded fasteners (first revision)
- (5) Specification for compressed asbestos fiber jointing (first revision)
- (6) Specification for gland packing, jute and hemp.

8.0 MANUFACTURE

Sluice valve bodies for 80 mm to 900 mm size valves shall be provided with double flanged ends connection.

9.0 FLANGES

The flanges and their dimensions of drilling shall be in accordance with part IV and VI of I.S. 1538 (Part I to XXII) 1976 (Specification for cast Iron fittings for pressure pipes for water gas and sewage) or its latest revision.

10.0 MODE OF MEASUREMENT AND PAYMENT

Measurement shall be paid on number basis as per relevant dia of the item in schedule '1' of the tender and as per payment schedule

Item No. 5

Providing and supplying C. I. Temper proof Air valves with SS 304 Float gun metal Nozzle of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc.comp.

(With isolating Sluice valve PN 1.6)

Sr. No.	Size
5.0	150 mm

1.0 GENERAL

1.1 The excavation for trenches will generally, refer to open excavation for trenches in wet / dry conditions for pipe laying work.

2.0 CLEARING OF SITES:

2.1 The site on which the pipelines are to be laid and shown on plan and the area required for setting out and other operations shall be cleared and all obstruction loose stones and materials, rubbish of all kinds, stumps, brushwood as trees shall be removed as directed the roots shall be entirely grubbed up.

2.2 The products of the clearing to restocked in such a place and in such a manner, as directed by the engineer in charge.

2.3 In jungle clearings, all trees not specially marked for preservation, bamboo's jungle wood and brushwood shall be cut down their roots grubbed up. All wood and materials from the clearing shall be the property of the local body shall be arranged as directed by the Engineer-in-charge or his authorized agent, the material pronounced as useful by the Engineer will be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.

2.4 All holes or hollows whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well earth, well rammed leveled off, as may be directed.

3.0 SETTING OUT:

The center lines of all pipe trenches etc. shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required true to line, level curve and slopes. The contractor shall assure full responsibility for alignment, and dimension of trench.

The labor materials etc. required for setting out and establishing benchmarks and other reference marks shall be arranged by the contractor at his own cost.

4 EXCAVATION

4.1 The excavation incl. Bailing out of water for the pipe trenches shall also incl. Removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipelines exactly in accordance with alignment, levels grades and curves shown on the plans or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as far as possible or according to the angle of repose various soils. Unless there is a specific extra provision in the contract for shoring and strutting or for cutting side slopes the contractor shall at his own cost do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or slopped as directed by the Engineer. The contractor shall at his own cost to remove such portions of boulders or rocks, as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer the extra depth shall have to be made with selected excavated stuff only with watering, remedying etc. as directed, by the Engineer and at the cost of the contractor. Other hard excavation shall be cleared of all sorts and loose materials and cut to firm surface, either level, stepped as directed by the Engineer. The Engineer may order such changes in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The contractor shall, at his own expense, make provision for bailing out of draining water and the trenches shall be kept free of water, during laying work.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no laying of pipeline will be allowed to laid until Engineer has approved the depth and dimensions of trenches level and measurements.

5.0 SHORING AND STRUTTING:

5.1 Shoring & strutting and dewatering if required shall have to be carried out by the contractor, for which any extra charge will not be paid

5.2 During excavation if water connections, sewage connections, telephone lines khalkuva (soak pits) etc. are damaged by the contractor, the same shall have to be restored by the contractor without any extra payment.

6.0 PROTECTION

6.1 The trenches shall be strongly fenced and red light signal shall be kept at night and arrangement of watchman to prevent accidents should be done, sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution boards etc. shall be provided by the contractor.

7.0 The excavation in all sorts of soil, hard murrum, soft rock or hard rock or any type of soil shall have to be carried out up to the required depth by the agency

8 DISPOSAL OF EXCAVATED STUFF

8.1 No excavated stuff from trench are to be placed even temporarily nearer than 1.5 meter or greater distance up to 90 meter or as prescribed by the Engineer from the outer edge of trench. All excavated material will be the property of the board. The rate of excavated includes sorting out of useful materials and stacking then separately as directed within specified lead. The excavated stuff suitable and useful for refilling or for other use shall be stacked at convenient places. The materials not useful in any wet shall be disposal off as directed by the Engineer from the outer edge of trench.

8.2 The site should be cleared off on completion of work.

9.0 ADDITIONAL REQUIREMENTS

9.1

At the joints of pipes, the trench shall be excavated to an additional depth of 15 cm. and width of 30 cm. And length of 15 cm. beyond the edge of collar on both the sides or as directed. The rate include for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of the trench shall be kept as per invert level or as directed. To maintain the proper slop the usual method of site rails and boning rods shall be adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

If the contractor fails or makes delay to give hydraulic test of the pipe line laid in any of the section, without any genuine reason, he shall be responsible to get any part of the length trenches refill in such case i.e.

before testing for safety of pedestrian and/or vehicular traffic as found necessary by the engineer-in-charge without any extra cost. If found necessary any directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during hydraulic test without any extra cost.

At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipeline is done so as to make it suitable for the traffic. The contractor shall provide direction when the pipeline is to be laid along the road as required and shall maintain the diversion or any part of it, without any extra cost. At all road crossings, the pipe shall be laid below the crest of road.

9.2 The contractor shall break the road surface by excavation chiseling to the exact width and length as shown on the drawing or as directed by the Engineer-in-charge.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at non-objectionable place or as directed by the Engineer-in-charge.

10.0 MEASUREMENT AND PAYMENT

10.1 The payment of excavation shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer in charge limited to dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured not paid for and if an ordered by the Engineer the contractor shall have to fill up the excess depth with excavated stuff with watering ramming etc. (Completed as specified) for trench without any extra payment to the contractor.

10.2 Dimension shall be correct to two places of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.

10.3 The rate for the item of excavation shall include unless and otherwise mentioned.

- (a) Clearing of site
- (b) Setting out work including all materials and labour.
- (c) Providing and subsequently removing, shoring and strutting cutting slopes etc.
- (d) Excavation and removal and staking of all excavated stuff as directed.
- (e) Necessary protection including labour materials equipment etc. to ensure safety and protection against risk or accident.
- (f) Providing facilities for inspection and damage to property if caused during progress of work.
- (g) Compensation for injury to life and damage to property if caused during progress of work.
- (h) Restoring of water supply connections, sewer connections, telephone lines, khalkuva soapiest etc. if damaged by contractor without extra payment.
- (i) Dewatering of excavated pit trench during the progress of work.

- (j) Clearing the site on completion of works directed by the Engineer.

Item No. 6

Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 0 to 1.5 m. depth

Sr. No.	Size
6.0	In all sorts of soil and soft murrum
6.1	In hard murrum, boulders, incl. Macadam road

1.0 GENERAL

1.1 The excavation for trenches will generally, refer to open excavation for trenches in wet / dry conditions for pipe laying work.

2.0 CLEARING OF SITES:

2.1 The site on which the pipelines are to be laid and shown on plan and the area required for setting out and other operations shall be cleared and all obstruction loose stones and materials, rubbish of all kinds, stumps, brushwood as trees shall be removed as directed the roots shall be entirely grubbed up.

2.2 The products of the clearing to restocked in such a place and in such a manner, as directed by the engineer in charge.

2.3 In jungle clearings, all trees not specially marked for preservation, bamboo's jungle wood and brushwood shall be cut down their roots grubbed up. All wood and materials from the clearing shall be the property of the local body shall be arranged as directed by the Engineer-in-charge or his authorized agent, the material pronounced as useful by the Engineer will be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.

2.4 All holes or hollows whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well earth, well rammed leveled off, as may be directed.

3.0 SETTING OUT:

The center lines of all pipe trenches etc. shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required true to line, level curve and slopes. The contractor shall assure full responsibility for alignment, and dimension of trench.

The labor materials etc. required for setting out and establishing benchmarks and other reference marks shall be arranged by the contractor at his own cost.

4 EXCAVATION

4.1 The excavation incl. Bailing out of water for the pipe trenches shall also incl. Removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipelines exactly in

accordance with alignment, levels grades and curves shown on the plans or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as far as possible or according to the angle of repose various soils. Unless there is a specific extra provision in the contract for shoring and strutting or for cutting side slopes the contractor shall at his own cost do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or slopped as directed by the Engineer. The contractor shall at his own cost to remove such portions of boulders or rocks, as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer the extra depth shall have to be made with selected excavated stuff only with watering, remedying etc. as directed, by the Engineer and at the cost of the contractor. Other hard excavation shall be cleared of all sorts and loose materials and cut to firm surface, either level, stepped as directed by the Engineer. The Engineer may order such changes in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The contractor shall, at his own expense, make provision for bailing out of draining water and the trenches shall be kept free of water, during laying work.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no laying of pipeline will be allowed to laid until Engineer has approved the depth and dimensions of trenches level and measurements.

5.0 SHORING AND STRUTTING:

5.1 Shoring & strutting and dewatering if required shall have to be carried out by the contractor, for which any extra charge will not be paid

5.2 During excavation if water connections, sewage connections, telephone lines khalkuva (soak pits) etc. are damaged by the contractor, the same shall have to be restored by the contractor without any extra payment.

6.0 PROTECTION

6.1 The trenches shall be strongly fenced and red light signal shall be kept at night and arrangement of watchman to prevent accidents should be done, sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution boards etc. shall be provided by the contractor.

7.0 The excavation in all sorts of soil, hard murrum, soft rock or hard rock or any type of soil shall have to be carried out up to the required depth by the agency

8 DISPOSAL OF EXCAVATED STUFF

8.1 No excavated stuff from trench are to be placed even temporarily nearer than 1.5 meter or greater distance up to 90 meter or as prescribed by the Engineer from the outer edge of trench. All excavated material will be the property of the board. The rate of excavated includes sorting out of useful materials and stacking then separately as directed within specified lead. The excavated stuff suitable and useful for refilling or for other use shall be stacked at convenient places. The materials not useful in any wet shall be disposal off as directed by the Engineer from the outer edge of trench.

8.2 The site should be cleared off on completion of work.

9.0 ADDITIONAL REQUIREMENTS

9.1

At the joints of pipes, the trench shall be excavated to an additional depth of 15 cm. and width of 30 cm. And length of 15 cm. beyond the edge of collar on both the sides or as directed. The rate include for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of the trench shall be kept as per invert level or as directed. To maintain the proper slop the usual method of site rails and boning rods shall be adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

If the contractor fails or makes delay to give hydraulic test of the pipe line laid in any of the section, without any genuine reason, he shall be responsible to get any part of the length trenches refill in such case i.e. before tasting for safety of pedestrian and/or vehicular traffic as found necessary by the engineer-in-charge without any extra cost. If found necessary any directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during hydraulic test without any extra cost.

At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipeline is done so as to make it suitable for the traffic. The contractor shall provide direction when the pipeline is to be laid along the road as required and shall maintain the diversion or any part of it, without any extra cost. At all road crossings, the pipe shall be laid below the crest of read.

9.2 The contractor shall break the road surface by excavation chiseling to the exact width and length as shown on the drawing or as directed by the Engineer-in-charge.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at non-objectionable place or as directed by the Engineer-in-charge.

10.0 MEASUREMENT AND PAYMENT

10.1 The payment of excavation shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer in charge limited to dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured not paid for and if an ordered by the Engineer the contractor shall have to fill up the excess depth with excavated stuff with watering ramming etc. (Completed as specified) for trench without any extra payment to the contractor.

10.2 Dimension shall be correct to two places of decimals of a meter and individual quantity shall of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.

10.3 The rate for the item of excavation shall include unless and otherwise mentioned.

- (a)** Clearing of site
- (b)** Setting out work including all materials and labour.
- (c)** Providing and subsequently removing, shoring and strutting outing slopes etc.
- (d)** Excavation and removal and staking of all excavated stuff as directed.
- (e)** Necessary protection including labour materials equipment etc. to ensure safety and protection against risk or accident.
- (f)** Providing facilities for inspection and damage to property if caused during progress of work.
- (g)** Compensation for injury to life and damage to property if caused during progress of work.
- (h)** Restoring of water supply connections, sewer connections, telephone lines, khalkuva soapiest etc. if damaged by contractor without extra payment.
- (i)** Dewatering of excavated pit trench during the progress of work.
- (j)** Clearing the site on completion of works directed by the Engineer.

Item No. 7

Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 1.5 to 3.0 m. depth

Sr. No.	Size
7.0	In all sorts of soil and soft murrum
7.1	In hard murrum, boulders, incl. Macadam road
7.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
7.3	In hard rock and / or in C. C. 1:2:4 or RCC with blasting, breaking, chiseling, or by chiseling/breaking only.

2.0 GENERAL

2.1 The excavation for trenches will generally, refer to open excavation for trenches in wet / dry conditions for pipe laying work.

2.0 CLEARING OF SITES:

2.1 The site on which the pipelines are to be laid and shown on plan and the area required for setting out and other operations shall be cleared and all obstruction loose stones and materials, rubbish of all kinds, stumps, brushwood as trees shall be removed as directed the roots shall be entirely grubbed up.

2.2 The products of the clearing to restocked in such a place and in such a manner, as directed by the engineer in charge.

2.3 In jungle clearings, all trees not specially marked for preservation, bamboo's jungle wood and brushwood shall be cut down their roots grubbed up. All wood and materials from the clearing shall be the property of the local body shall be arranged as directed by the Engineer-in-charge or his authorized agent, the material pronounced as useful by the Engineer will be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.

2.4 All holes or hollows whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well earth, well rammed leveled off, as may be directed.

3.0 SETTING OUT:

The center lines of all pipe trenches etc. shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required true to line, level curve and slopes. The contractor shall assure full responsibility for alignment, and dimension of trench.

The labor materials etc. required for setting out and establishing benchmarks and other reference marks shall be arranged by the contractor at his own cost.

4 EXCAVATION

4.1 The excavation incl. Bailing out of water for the pipe trenches shall also incl. Removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipelines exactly in accordance with alignment, levels grades and curves shown on the plans or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as far as possible or according to the angle of repose various soils. Unless there is a specific extra provision in the contract for shoring and strutting or for cutting side slopes the contractor shall at his own cost do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or slopped as directed by the Engineer. The contractor shall at his own cost to remove such portions of boulders or rocks, as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer the extra depth shall have to be made with selected excavated stuff only with watering, remedying etc. as directed, by the Engineer and at the cost of the contractor. Other hard excavation shall be cleared of all sorts and loose materials and cut to firm surface, either level, stepped as directed by the Engineer. The Engineer may order such changes in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The contractor shall, at his own expense, make provision for bailing out of draining water and the trenches shall be kept free of water, during laying work.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no laying of pipeline will be allowed to laid until Engineer has approved the depth and dimensions of trenches level and measurements.

5.0 SHORING AND STRUTTING:

5.3 Shoring & strutting and dewatering if required shall have to be carried out by the contractor, for which any extra charge will not be paid

5.4 During excavation if water connections, sewage connections, telephone lines khalkuva (soak pits) etc. are damaged by the contractor, the same shall have to be restored by the contractor without any extra payment.

6.0 PROTECTION

6.1 The trenches shall be strongly fenced and red light signal shall be kept at night and arrangement of watchman to prevent accidents should be done, sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution boards etc. shall be provided by the contractor.

7.0 The excavation in all sorts of soil, hard murrum, soft rock or hard rock or any type of soil shall have to be carried out up to the required depth by the agency

8 DISPOSAL OF EXCAVATED STUFF

8.1 No excavated stuff from trench are to be placed even temporarily nearer than 1.5 meter or greater distance up to 90 meter or as prescribed by the Engineer from the outer edge of trench. All excavated material will be the property of the board. The rate of excavated includes sorting out of useful materials and stacking then separately as directed within specified lead. The excavated stuff suitable and useful for refilling or for other use shall be stacked at convenient places. The materials not useful in any wet shall be disposal off as directed by the Engineer from the outer edge of trench.

8.2 The site should be cleared off on completion of work.

10.0 ADDITIONAL REQUIREMENTS

9.1

At the joints of pipes, the trench shall be excavated to an additional depth of 15 cm. and width of 30 cm. And length of 15 cm. beyond the edge of collar on both the sides or as directed. The rate include for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of the trench shall be kept as per invert level or as directed. To maintain the proper slop the usual method of site rails and boning rods shall be adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

If the contractor fails or makes delay to give hydraulic test of the pipe line laid in any of the section, without any genuine reason, he shall be responsible to get any part of the length trenches refill in such case i.e. before tasting for safety of pedestrian and/or vehicular traffic as found necessary by the engineer-in-charge without any extra cost. If found necessary any directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during hydraulic test without any extra cost.

At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipeline is done so as to make it suitable for the traffic. The contractor shall provide direction when the pipeline is to be laid along the road as required and shall maintain the diversion or any part of it, without any extra cost. At all road crossings, the pipe shall be laid below the crest of read.

9.2 The contractor shall break the road surface by excavation chiseling to the exact width and length as shown on the drawing or as directed by the Engineer-in-charge.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at non-objectionable place or as directed by the Engineer-in-charge.

10.0 MEASUREMENT AND PAYMENT

10.1 The payment of excavation shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer in charge limited to dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured not paid for and if an ordered by the Engineer the contractor shall have to fill up the excess depth with excavated stuff with watering ramming etc. (Completed as specified) for trench without any extra payment to the contractor.

10.2 Dimension shall be correct to two places of decimals of a meter and individual quantity shall of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.

10.3 The rate for the item of excavation shall include unless and otherwise mentioned.

- (a) Clearing of site
- (b) Setting out work including all materials and labour.
- (c) Providing and subsequently removing, shoring and strutting outing slopes etc.
- (d) Excavation and removal and staking of all excavated stuff as directed.
- (e) Necessary protection including labour materials equipment etc. to ensure safety and protection against risk or accident.
- (f) Providing facilities for inspection and damage to property if caused during progress of work.
- (g) Compensation for injury to life and damage to property if caused during progress of work.
- (h) Restoring of water supply connections, sewer connections, telephone lines, khalkuva soapiest etc. if damaged by contractor without extra payment.
- (i) Dewatering of excavated pit trench during the progress of work.
- (j) Clearing the site on completion of works directed by the Engineer.

Item No. 8

Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 3.0 to 4.5 m. depth

Sr. No.	Size
8.0	In all sorts of soil and soft murrum
8.1	In hard murrum, boulders, incl. Macadam road
8.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
8.3	In hard rock and / or in C. C. 1:2:4 or RCC with blasting, breaking, chiseling, or by chiseling/breaking only.

3.0 GENERAL

3.1 The excavation for trenches will generally, refer to open excavation for trenches in wet / dry conditions for pipe laying work.

2.0 CLEARING OF SITES:

2.1 The site on which the pipelines are to be laid and shown on plan and the area required for setting out and other operations shall be cleared and all obstruction loose stones and materials, rubbish of all kinds, stumps, brushwood as trees shall be removed as directed the roots shall be entirely grubbed up.

2.2 The products of the clearing to restocked in such a place and in such a manner, as directed by the engineer in charge.

2.3 In jungle clearings, all trees not specially marked for preservation, bamboo's jungle wood and brushwood shall be cut down their roots grubbed up. All wood and materials from the clearing shall be the property of the local body shall be arranged as directed by the Engineer-in-charge or his authorized agent, the material pronounced as useful by the Engineer will be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.

2.4 All holes or hollows whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well earth, well rammed leveled off, as may be directed.

3.0 SETTING OUT:

The center lines of all pipe trenches etc. shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required true to line, level curve and slopes. The contractor shall assure full responsibility for alignment, and dimension of trench.

The labor materials etc. required for setting out and establishing benchmarks and other reference marks shall be arranged by the contractor at his own cost.

4 EXCAVATION

4.1 The excavation incl. Bailing out of water for the pipe trenches shall also incl. Removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipelines exactly in accordance with alignment, levels grades and curves shown on the plans or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as far as possible or according to the angle of repose various soils. Unless there is a specific extra provision in the contract for shoring and strutting or for cutting side slopes the contractor shall at his own cost do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or slopped as directed by the Engineer. The contractor shall at his own cost to remove such portions of boulders or rocks, as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer the extra depth shall have to be made with selected excavated stuff only with watering, remedying etc. as directed, by the Engineer and at the cost of the contractor. Other hard excavation shall be cleared of all sorts and loose materials and cut to firm surface, either level, stepped as directed by the Engineer. The Engineer may order such changes in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The contractor shall, at his own expense, make provision for bailing out of draining water and the trenches shall be kept free of water, during laying work.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no laying of pipeline will be allowed to laid until Engineer has approved the depth and dimensions of trenches level and measurements.

5.0 SHORING AND STRUTTING:

5.5 Shoring & strutting and dewatering if required shall have to be carried out by the contractor, for which any extra charge will not be paid

5.6 During excavation if water connections, sewage connections, telephone lines khalkuva (soak pits) etc. are damaged by the contractor, the same shall have to be restored by the contractor without any extra payment.

6.0 PROTECTION

6.1 The trenches shall be strongly fenced and red light signal shall be kept at night and arrangement of watchman to prevent accidents should be done, sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution boards etc. shall be provided by the contractor.

7.0 The excavation in all sorts of soil, hard murrum, soft rock or hard rock or any type of soil shall have to be carried out up to the required depth by the agency

8 DISPOSAL OF EXCAVATED STUFF

8.1 No excavated stuff from trench are to be placed even temporarily nearer than 1.5 meter or greater distance up to 90 meter or as prescribed by the Engineer from the outer edge of trench. All excavated material will be the property of the board. The rate of excavated includes sorting out of useful materials and stacking then separately as directed within specified lead. The excavated stuff suitable and useful for refilling or for other use shall be stacked at convenient places. The materials not useful in any wet shall be disposal off as directed by the Engineer from the outer edge of trench.

8.2 The site should be cleared off on completion of work.

11.0 ADDITIONAL REQUIREMENTS

9.1

At the joints of pipes, the trench shall be excavated to an additional depth of 15 cm. and width of 30 cm. And length of 15 cm. beyond the edge of collar on both the sides or as directed. The rate include for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of the trench shall be kept as per invert level or as directed. To maintain the proper slop the usual method of site rails and boning rods shall be adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

If the contractor fails or makes delay to give hydraulic test of the pipe line laid in any of the section, without any genuine reason, he shall be responsible to get any part of the length trenches refill in such case i.e. before tasting for safety of pedestrian and/or vehicular traffic as found necessary by the engineer-in-charge without any extra cost. If found necessary any directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during hydraulic test without any extra cost.

At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipeline is done so as to make it suitable for the traffic. The contractor shall provide direction when the pipeline is to be laid along the road as required and shall maintain the diversion or any part of it, without any extra cost. At all road crossings, the pipe shall be laid below the crest of read.

9.2 The contractor shall break the road surface by excavation chiseling to the exact width and length as shown on the drawing or as directed by the Engineer-in-charge.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at non-objectionable place or as directed by the Engineer-in-charge.

10.0 MEASUREMENT AND PAYMENT

10.1 The payment of excavation shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer in charge limited to dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured not paid for and if an ordered by the Engineer the contractor shall have to fill up the excess depth with excavated stuff with watering ramming etc. (Completed as specified) for trench without any extra payment to the contractor.

10.2 Dimension shall be correct to two places of decimals of a meter and individual quantity shall of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.

10.3 The rate for the item of excavation shall include unless and otherwise mentioned.

- (a) Clearing of site
- (b) Setting out work including all materials and labour.
- (c) Providing and subsequently removing, shoring and strutting outing slopes etc.
- (d) Excavation and removal and staking of all excavated stuff as directed.
- (e) Necessary protection including labour materials equipment etc. to ensure safety and protection against risk or accident.
- (f) Providing facilities for inspection and damage to property if caused during progress of work.
- (g) Compensation for injury to life and damage to property if caused during progress of work.
- (h) Restoring of water supply connections, sewer connections, telephone lines, khalkuva soapiest etc. if damaged by contractor without extra payment.
- (i) Dewatering of excavated pit trench during the progress of work.
- (j) Clearing the site on completion of works directed by the Engineer.

Item No. 9

Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 4.5 to 6.0 m. depth

Sr. No.	Size
9.0	In all sorts of soil and soft murrum
9.1	In hard murrum, boulders, incl. Macadam road
9.2	In soft rock and/or masonry in CM or L M or Lime Concrete.
9.3	In hard rock and / or in C. C. 1:2:4 or RCC with blasting, breaking, chiseling, or by chiseling/breaking only.

4.0 GENERAL

4.1 The excavation for trenches will generally, refer to open excavation for trenches in wet / dry conditions for pipe laying work.

2.0 CLEARING OF SITES:

2.1 The site on which the pipelines are to be laid and shown on plan and the area required for setting out and other operations shall be cleared and all obstruction loose stones and materials, rubbish of all kinds, stumps, brushwood as trees shall be removed as directed the roots shall be entirely grubbed up.

2.2 The products of the clearing to restocked in such a place and in such a manner, as directed by the engineer in charge.

2.3 In jungle clearings, all trees not specially marked for preservation, bamboo's jungle wood and brushwood shall be cut down their roots grubbed up. All wood and materials from the clearing shall be the property of the local body shall be arranged as directed by the Engineer-in-charge or his authorized agent, the material pronounced as useful by the Engineer will be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.

2.4 All holes or hollows whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well earth, well rammed leveled off, as may be directed.

3.0 SETTING OUT:

The center lines of all pipe trenches etc. shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required true to line, level curve and slopes. The contractor shall assure full responsibility for alignment, and dimension of trench.

The labor materials etc. required for setting out and establishing benchmarks and other reference marks shall be arranged by the contractor at his own cost.

4 EXCAVATION

4.1 The excavation incl. Bailing out of water for the pipe trenches shall also incl. Removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipelines exactly in accordance with alignment, levels grades and curves shown on the plans or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as far as possible or according to the angle of repose various soils. Unless there is a specific extra provision in the contract for shoring and strutting or for cutting side slopes the contractor shall at his own cost do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or slopped as directed by the Engineer. The contractor shall at his own cost to remove such portions of boulders or rocks, as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer the extra depth shall have to be made with selected excavated stuff only with watering, remedying etc. as directed, by the Engineer and at the cost of the contractor. Other hard excavation shall be cleared of all sorts and loose materials and cut to firm surface, either level, stepped as directed by the Engineer. The Engineer may order such changes in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The contractor shall, at his own expense, make provision for bailing out of draining water and the trenches shall be kept free of water, during laying work.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no laying of pipeline will be allowed to laid until Engineer has approved the depth and dimensions of trenches level and measurements.

5.0 SHORING AND STRUTTING:

5.7 Shoring & strutting and dewatering if required shall have to be carried out by the contractor, for which any extra charge will not be paid

5.8 During excavation if water connections, sewage connections, telephone lines khalkuva (soak pits) etc. are damaged by the contractor, the same shall have to be restored by the contractor without any extra payment.

6.0 PROTECTION

6.1 The trenches shall be strongly fenced and red light signal shall be kept at night and arrangement of watchman to prevent accidents should be done, sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution boards etc. shall be provided by the contractor.

7.0 The excavation in all sorts of soil, hard murrum, soft rock or hard rock or any type of soil shall have to be carried out up to the required depth by the agency

8 DISPOSAL OF EXCAVATED STUFF

8.1 No excavated stuff from trench are to be placed even temporarily nearer than 1.5 meter or greater distance up to 90 meter or as prescribed by the Engineer from the outer edge of trench. All excavated material will be the property of the board. The rate of excavated includes sorting out of useful materials and stacking then separately as directed within specified lead. The excavated stuff suitable and useful for refilling or for other use shall be stacked at convenient places. The materials not useful in any wet shall be disposal off as directed by the Engineer from the outer edge of trench.

8.2 The site should be cleared off on completion of work.

12.0 ADDITIONAL REQUIREMENTS

9.1

At the joints of pipes, the trench shall be excavated to an additional depth of 15 cm. and width of 30 cm. And length of 15 cm. beyond the edge of collar on both the sides or as directed. The rate include for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of the trench shall be kept as per invert level or as directed. To maintain the proper slop the usual method of site rails and boning rods shall be adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

If the contractor fails or makes delay to give hydraulic test of the pipe line laid in any of the section, without any genuine reason, he shall be responsible to get any part of the length trenches refill in such case i.e. before tasting for safety of pedestrian and/or vehicular traffic as found necessary by the engineer-in-charge without any extra cost. If found necessary any directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during hydraulic test without any extra cost.

At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipeline is done so as to make it suitable for the traffic. The contractor shall provide direction when the pipeline is to be laid along the road as required and shall maintain the diversion or any part of it, without any extra cost. At all road crossings, the pipe shall be laid below the crest of read.

9.2 The contractor shall break the road surface by excavation chiseling to the exact width and length as shown on the drawing or as directed by the Engineer-in-charge.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at non-objectionable place or as directed by the Engineer-in-charge.

10.0 MEASUREMENT AND PAYMENT

10.1 The payment of excavation shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer in charge limited to dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured not paid for and if an ordered by the Engineer the contractor shall have to fill up the excess depth with excavated stuff with watering ramming etc. (Completed as specified) for trench without any extra payment to the contractor.

10.2 Dimension shall be correct to two places of decimals of a meter and individual quantity shall of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.

10.3 The rate for the item of excavation shall include unless and otherwise mentioned.

- (a) Clearing of site
- (b) Setting out work including all materials and labour.
- (c) Providing and subsequently removing, shoring and strutting outing slopes etc.
- (d) Excavation and removal and staking of all excavated stuff as directed.
- (e) Necessary protection including labour materials equipment etc. to ensure safety and protection against risk or accident.
- (f) Providing facilities for inspection and damage to property if caused during progress of work.
- (g) Compensation for injury to life and damage to property if caused during progress of work.
- (h) Restoring of water supply connections, sewer connections, telephone lines, khalkuva soapiest etc. if damaged by contractor without extra payment.
- (i) Dewatering of excavated pit trench during the progress of work.
- (j) Clearing the site on completion of works directed by the Engineer.

Item No. 10**Extra for Dewatering for Excavation in wet condition in all streta.**

Sr. No.	Size
10.0	Depth up to 0. to 1.5 m depth
10.1	Depth up to 1.5 to 3.0 m depth
10.2	Depth up to 3.0 to 4.5 m depth
10.3	Depth up to 4.5 to 6.0 m depth

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programmed. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Employer's Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for adequate time so that concrete, Brick work of M.H. & cement mortar used for sewer line jointing shall attain adequate strength. The Contractor shall, however, ensure that no damage to the sewer, M.H. results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer's Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Employer's Representative. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a buildup of water in the opinion of the Employer's Representative obstructs the progress of the work, leads to unsanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

Measurement and Payment

Payment shall be made on cubic meter basis of excavation for single time only.

Item No. 11

Lowering, laying and jointing C. I. S & S Spun pipes suitable for Tyton joints / Mortar lined D. I. Pipes of various classes with CI / MS specials of following diameters in proper position, grade and alignment as directed by Engineer-in-charge including hydraulic testing etc. comp. DI K-7/9 pipe.

Sr. No.	Size
11.0	900 mm DI

GENERAL:

1. Materials :

1.1. Ductile mild steel tubes of specified dia nominal bore shall be supplied by departments as shown in schedule 'B' The galvanized dia. Bore pipes shall be carted by the contractor on work site at his own cost.

2. Workmanship

2.1. Cutting, laying and jointing.

2.1.1. When the tubes are to be cut or rethreaded, tge one shall be carefully filed out so, that no construction to bore in offered. The ends of the tubes shall then be threaded confirming to the requirements of I.S. 554-1955 with pipe dies and taps carefully in joints when the two pieces are screwed together.

2.1.2. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and dies shall not be used for turning of the treads so as to make them slacks as the latter procedure may not result in a watertight shall be protected from edges unit they are fitted.

2.1.3. In jointing the tube, end of the tubes shell be oiled and smeared with white of red load and wrapping around the screws end of the tube. The end shall then be tightly screwed in the socket, tees, etc. with a pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust, and dirt during fixing. Butt joints shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

2.1.4. Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anti-corrosive paint to prevent corrosion.

2.1.5. Fixing of the tube fitting to wall coiling and floors,

2.1.6. IN case of fixing of tubes and fitting to the walls or ceilings, these shall run on the surface of the or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern, holder clamps keepings the pipes about 15mm clear of the pipes and when specified so, chasing may be adopted or pipe fixed in ducts or recesses etc. provided that there is sufficient space to work on the ordinary be buried in walls on solid floors, where unavoidable, pipes may be buried for short distances provided that adequate protection is given against damage and where so required M.S. tube sleeve shall be fixed at a place a pipe is passing through a wall or floor for expansion and contraction and other movements in case the pipe is embedded in walls or floors, it should be painted with anti-corrosive bitumastic paint of approved quality. The pipe is affected by lime. Under the floors, the pipe shall be laid in layer of send filling.

2.1.7. All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern clamps of size and shape, one end of which shall be properly plugged or cemented into walls with cement mortar 1:3 (1 cement : 3 coarse sand) and the other tightened round the pipes to hold it secretly. These clamps shall be spaced at regular intervals in straight length at 2 MC/C interval in horizontal run and 2.5 M interval in horizontal run . For pipe of 15 mm dia up to 25 mm dia the holes in the walls and floors shall be made by drilling with chisel or concrete. However for bigger diameter pipes, the holes shall be carefully made of the holes shall be made good with cement mortar 1:3 (1 cement : 3 coarse sand) and properly finished to match the adjacent surface.

2.2. Testing of Joints :

2.2.1. after laying and jointing the pipes and fitting shall be inspected under working conditions of pressure and all leaking pipes removed and replaced without extra cost.

2.2.2. The pipes and fitting as they are laid shall be tested to hydraulic pressure of 6 Kg/Sq.cm. The pipe shall be slowly and carefully charged with water hammer. The pressure gauge must be accurate. The pipe and fitting shall be tested in sections as the work of laying proceeds keeping the joints exposed for inspection during the testing.

3. Mode of measurement and Payment

3.1. As per payment schedule

Item No. 12

Lowering, laying and jointing in position following C. I. / D/F Reflux valves, Butterfly valves, Sluice valves and Air valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete.(Sluice valve/BF valve)

Sr. No.	Size
12.0	800 mm DI
12.1	250 mm dia Scour Valve

[A] SLUICE VALVES, BUTTERFLY VALVES, REFLUX VALVE, SCOUR VALVE

1.0 SUPPLY OF MATERIAL

1.1 Cast iron double-flanged sluice valve/butterfly valves with two tailpieces suitable to pipe shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.

1.2 The sluice valve/butterfly valves and tailpieces shall be examined before laying for cracks and other flows. They shall be undamaged in all respect.

1.3 The sluice valves/butterfly valves shall be operated before laying.

1.4 All grits and foreign materials shall be removed from the inside of the valves before placing.

1.5 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.

1.6 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

2.0 JOINTING MATERIAL

2.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool etc.

2.2 All tools and plant required for installation of sluice valve shall be provided by the contractor.

2.3 All jointing materials shall be not approved from the engineer-in-charge before use

2.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.

2.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials

3.0 INSTALLATION

3.1 The sluice valve/butterfly valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.

3.2 If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.

3.3 The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice/butterfly valve bore. It shall be even at both the inner and outer edges.

3.4 The flange faces thoroughly greased.

3.5 If flange faces are not free, the contractor shall use thin fibers of lead wool.

3.6 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.

3.7 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.

3.8 Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.

3.9 The sluice valve/butterfly valve shall be installed in such a way that its Spindle shall remain in truly vertical position.

3.10 The other end of tailpiece shall be fitted with pipes so that continuous lines can work.

3.11 Extra excavation required for facility of lowering and fixing sluice valve shall not be paid for.

Item No. 13

Labour charges for installation of air riser(flange pipe) on the pipe line at suitable place as per design & directed by Engineer-in charge including M.S. flange pipe R.C.C. foundation block & column in C.C. M-150 etc. complete. including fixing of DAV with suice valve. The length of pipe is 3.00 mt. above G.L.

Air valves double ball flanged

Sr. No.	Size
13.0	150 mm

4.0 TESTING

- 4.1 After installation of sluice valve/butterfly valve the same is tested to 1 1/2 times of its test pressure.
- 4.2 The joints sluice valve/butterfly valve shall withstand the test pressure of pipelines.
- 4.3 Defects noticed during test and operation of sluice valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge

AIR VALVES, SLUICE VALVES, BUTTERFLY VALVES, REFLUX VALVE, SCOUR VALVE

1.0 SUPPLY OF MATERIAL

- 1.1 Cast iron double-flanged sluice valve/butterfly valves with two tailpieces suitable to pipe shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.
- 1.2 The sluice valve/butterfly valves and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect.
- 1.3 The sluice valves/butterfly valves shall be operated before laying.
- 1.4 All grits and foreign materials shall be removed from the inside of the valves before placing.
- 1.5 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.
- 1.6 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

2.0 JOINTING MATERIAL

- 2.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool etc.
- 2.2 All tools and plant required for installation of sluice valve shall be provided by the contractor.
- 2.3 All jointing materials shall be not approved from the engineer-in-charge before use
- 2.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.
- 2.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials.

3.0 INSTALLATION

- 3.1 The sluice valve/butterfly valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.
- 3.2 If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.

- 3.3 The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice/butterfly valve bore. It shall be even at both the inner and outer edges.
- 3.4 The flange faces thoroughly greased.
- 3.5 If flange faces are not free, the contractor shall use thin fibers of lead wool.
- 3.6 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.
- 3.7 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.
- 3.8 Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.
- 3.9 The sluice valve/butterfly valve shall be installed in such a way that its Spindle shall remain in truly vertical position.
- 3.10 The other end of tailpiece shall be fitted with pipes so that continuous lines can work.
- 3.11 Extra excavation required for facility of lowering and fixing sluice valve shall not be paid for.

4.0 TESTING

- 4.1 After installation of sluice valve/butterfly valve the same is tested to 1 1/2 times of its test pressure.
- 4.2 The joints sluice valve/butterfly valve shall withstand the test pressure of pipelines.
- 4.3 Defects noticed during test and operation of sluice valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

Item No. 14

Construction of RCC valve chambers of required size for sluice valves, butterfly valves etc. as per detailed drawing and specification and as per instruction of Engineer -in-charge. Walls of the chambers should constructed in C.C. 1:2:4 and P.C.C. should be done in 1:3:6 Rate also includes RCC top cover in C.C. 1:2:4 incl.CI/MS Steps. For sluice valve and water meter.

Sr. No.	Size
14.0	2.50 x 2.50 x 3.0

1.0 Inside size of chamber shall be as above.

- 1.1 Additional excavation required to be done shall be carried out as per instruction of Engineer-in-charge. For foundation chamber 15 cm. thick 1:4:8 PCC shall be provided and 23 cm. up to 1.5 m. depth and beyond 1.5 m. depth 35 cm thick BB masonry walls in CM 1:6 shall be constructed.
- 1.2 Second Class bricks of Standard size shall be brought by the Contractor & shall got approval before use in the work from the Engineer-in-charge.
- 1.3 20mm thick cement plaster in CM 1:3 shall be provided on inside and outside of walls upto 20 cm below from G.L. Cement pointing in CM 1:3 shall be provided for outside below G.L. from 20 cm.
- 1.4 20 mm dia MS bar steps shall be provided and fixed in wall at 30 cm c/c for facilitating access into the chamber. First step should be at a depth of 0.5 m from top and last step should be 0.5 m above bottom.

1.5 Chamber shall be covered with cast in situ RCC slab in one single piece with providing and fixing of CI MH frame and cover with 20 cm. thick BM wall in C.M.1:6

1.6 Reinforcement for the cover slab shall be provided considering heavy traffic load.

Curing of concrete, BB masonry, RCC etc. shall be done using chemical or water for 14 days.

1.7 20mm dia MS bar handles minimum two nos. shall be provided to each piece of slab during the time of casting of slab.

1.8 Sides of chamber shall be refilled properly with selected excavated earth.

1.9 All the above items shall be carried out in workman like manner as per prevalent sound engineering practice and instruction of Engineer-in-charge.

2.0 PAYMENT:

2.1 Payment shall be made at the rate quoted in schedule '1' per number of chamber constructed as above and rate covers cost of supply of all materials and labours. The rates includes manhole frame and cover.

Item No. 15

Refilling the pipeline trenches incl. ramming, watering, consolidating disposal of surplus stuff as directed within a radius of 3 km

- Refilling materials shall be from excavated stuff.
- Excavated stuff to be used shall be cleared off all rubbish, large size stone bricks bats etc. big clods shall 50 mm or less. The selected soil sand or any other materials shall be got approved before filling, Refilling shall be done in a systematic manner in layers by the contract. Before refilling the trenches the contractor shall got checked the trenches, ready for refilling.
- All space between pipe line and the sides of excavation shall be refilled to the original surface with earth or selected material in layers of 15 cms to 10 cms, well-watered and rammed. Each layers shall be watered and compacted with heavy manner, before the upper layer is laid till the final level is reached to the thoroughly compacted base.
- Refilling on top of pipe shall be carried out carefully with selected soft stuff out of the excavated stuff. The filling shall be raised about 15 cms. to take care of subsequent settlement.
- The contractor shall be responsible for any settlement. The contractor shall be responsible for any settlement during passage of time during monsoon and the same shall be refilled with stuff brought from the outside if necessary at his cost.
- The process of refilling trenches, watering, ramming shall be carried out in such a way that no damage is done to the pipe line already laid.
- Disposal of the Excavated Stuff:

The excavated stuff of the selected type shall be used for filling the trenches and plinth or leveling the ground in layers including ramming and watering etc. complete. The Contractor shall remove the balance of the excavated from the site of work to a place as directed within a lead up to 3 km.

Item No. 16

Providing and casting in situ mass C.C. in grade M-10 (approx corresp. to prop. 1:3:6) using granite, quartzite trap metal of size 12mm to 25mm for RCC work, incl. consolidation, curing etc. comp. (without form work)

The work shall be carried out with Ready Mix system in M-100 grade maintaining cement level @ 380.00 Kg./Cum. for Foundations, Footing, Base of Columns and the like and Mass Concrete as per detailed drawing 1.1 Ready Mix concrete

1.1 Mixing Thorough mixing is essential for production of uniform concrete. Equipment and methods used shall be capable of effectively mixing concrete materials to produce in form mixes of the lowest slump practical for the work.

Charging of mixer:-

Mixers both stationary and truck mounted shall be so charged that there is a pre blending of the ingredients as the stream flows into the mixer.

Water shall enter the mixer first, but must continue to flow while other ingredients are entering the mixer. Water charging pipes shall be of proper design and of adequate size so that water enters at a point well inside the mixer. Water charging shall be complete within the first 25% of the mixing

Cement shall be charged along with other materials, but it shall be ensured that cement enters the stream after approximately 10% of the aggregate is in the mixer. When it is necessary to charge cement into truck mixers separately, additional mixing time shall be allowed to obtain desired uniformity to mix.

Admixtures shall be charged to the mixer at the same time in the mixing sequence for every batch. Liquid admixtures shall be charged with the water, powdered admixtures shall be sprinkled in to the mixer with other dry ingredients. When more than one admixture is used. They shall be batched separately and they shall not be premixed before entering the mixer. 1

Mixer performance:-

Mixer performance checks shall be made at regular intervals to ensure uniformity of the concrete. Visual examination of the concrete shall be one of the aids for maintaining and checking mixer performance.

Results of tests on air content, slump unit weight of air free mortar shall be guide lines on mixer performance.

Mixing Time.

Mixing time shall be measured from the time all ingredients are in the mixer.

Mixing time shall be established from mixer performance tests conducted at frequent intervals throughout the period of the work. However, as an initial guide, mixer manufacturer's recommendation may be followed. Other guide line being 1.33 mins. For 1 cum capacity of mixer and 0.33 min for every additional 1 cum of mixer capacity.

Mixer shall be designed to have audible indicators and combination inter locks which prevent mixer discharge prior to completion of a preset mixing time. Mixer shall also be designed to start and stop operation with full load.

Re-Tempering

Provided that design water cement ratio is not exceeded, small increments of remembering water may be added to mixed batches to obtain the desired. Slump

Addition of water in excess of designed water cement ratio to compensate for slump loss resulting from delays in delivery or placing of concrete shall be permitted

Mix Temperature

Batch to batch uniformity of concrete regard to slump, water requirement and air content is dependent on temperature of concrete. It shall therefore, be ensured that the maximum and minimum temperatures of concrete throughout all seasons of the year donot vary beyond the limits given below.

Necessary measures shall be taken to lower or raise the temperature of water to maintainthe mixed concrete between the specified temperature limits

Discharging of mixer.

Mixer shall be capable of and handled properly so that concrete of lowest desired slumpcan be effective) discharged without causing segregation.

Ready- Mix concrete may be:

Mixed in a central plant and transported to the job in agitating or no agitating truck bodies.Mixed entirely in transit. Mixed entirely after reaching the job site. Mixed partially in a central plant and completed in transit or after reaching the job site (Shrink mixing)

In ready mix concrete special at tension shall be given the addition of mixing waterquantity, which if incorrect, shall result in reduction of concrete quality.

Concrete consistency (Slump) is also affected by : Amount and rate of mixing. Length ofhaul Time period for unloading Temperature conditions.

In cool weather or short haul and with prompt delivery concrete quality may not be significantly affected. But with reverse conditions, quality of concrete may be significantlyaffected. Addition of water to compensate for slump loss shall not exceed that quantity necessary to compensate for a maximum 25mm slump loss However, by this additional quantity of water, the design water cement ratio shall not be exceeded.

Loss in workability in warm weather shall be minimized by expediting delivery andplacement, and by controlling the concrete temperature

If it becomes necessary to use readers to prolong the time the concrete will respond tovibration

In hot weather conditions or delays in deliveryl placement, use may be made of the procedure of withholding some of the mixing water till the mixer arrives at the job site, in such cases after addition of the balance (Withheld) quantity. of water an additional 30 revolutions of mixer at mixing speed shall be given to adequately incorporate the additionswater into the mix.

When loss of slump or workability cannot be controlled by measures stated above. complete mixing shall be done at the job site using centrally dry batched ingredients.

Supply and placing of ready-mix concrete.

Responsibility of in-place quality of ready-mix concrete shall be shared by the manufacturer¹ supplier of ready mix concrete and the placing contractor.

They shall work in close coordination. The placing crew shall be in direct radio 1 telecommunication contract with the batch plant to ensure. Avoidance of delay in dispatching concrete from batch plant. Inform batching plant delays in formwork, reinforcement work, handling or placing The placement contractor shall give in writing his requirement of a particular batch of concrete to the supplier.

The ready - mix concrete manufacturer / supplier shall along with each batch of concrete delivered to the placement contractor give him a concrete delivery ticket. The supplier shall give copies of all such delivery tickets to the Engineer- in Charge for his record and also shall get duplicate Copies of all such delivery tickets duly received and signed from the placement contractor.

Ready mixed concrete as supplied by the manufacturer and as placed by the contractor shall in no way be different from the specifications of concrete as approved by the Engineer-in - Charge.

Transportation.

Fresh concrete can be transported to the placement area by a variety of methods common among them are: -Mixer trucks. -Stationary truck bodies with or without agitators. -Buckets hauled by trucks. - Conveyor belts. -House or pipe line by pumping. Each type of transportation has specific advantages and limitations depending on the condition of use, mix , accessibility and location of placing.

Transportation by mixer trucks.

These are essentially revolving drums mounted on truck chassis. Truck mixers used in the job shall be labeled permanently to indicate the manufacture specifications. for mixing like. .Capacity of drum. .Total number of drum revolutions required for complete mixing.c. Mixing speed. d. Maximum time limit before completion of discharge and after cement e. has entered the drum. f. Reduction in time period of discharge. g. Due to warm weather or other variables. All above information shall only form guidelines for the manufacture/ producer of concrete. Fulfillment of the stipulated number of revolutions or elapsed time shall not be acceptable criterion. As long as the mixing water limit not exceeded and the concrete has satisfactory plastic physical properties and is of satisfactory consistency and homogeneity for satisfactory placement and consolidation and is without initial se the concrete shall be acceptable.

When the concrete is totally mixed in transporting trucks or in case of shrink- mix concrete, cede 63% of the rated capacity of the drum. In case the concrete is totally mixed in the central batching plant, the transporting truck may be loaded up to 80% of the rated capacity of the drum. In this case the drum shall be rotated at charging speed during loading and reduced to agitating speed after loading is complete.

When transporting concrete by truck mixers, delivery time shall be restricted to 1.50 hours from the time cement has entered the mixer to completion of discharge.

Transporting by Agitating.

Transporting ready mix concrete by this method shall consist of truck chassis mounted with open top bodies. The metal body shall be smooth and streamlined for easy discharge. Discharge may be from the rear when the body is mechanically tilted. Body of the truck shall have a provision of discharge gate. Mechanical vibrators shall be installed at the discharge gate for control of discharge flow. Agitators, if mounted, also aid in the discharging of concrete from the truck in addition to keeping the concrete alive.

Water shall not be added to concrete in transport through this system. Bodies of trucks shall be provided with protective covers during period of inclement weather

Delivery period when adopting this system of transporting, concrete shall be restricted to 30 minutes from the moment all ingredients including cement and water enters in mixer to completion of discharge.

Transporting by buckets.

This method of transportation is very common for transportation of centrally mixed concrete. Buckets of suitable capacities may be fitted with concrete which is totally mixed in central plant and hauled to the job site. Buckets then may be conveyed to the actual point of placement either with the help of crane / hoist or they may be carted.

As in the case of open truck transportation water shall not be added to concrete transported in buckets. Concrete shall be protected from inclement weather by necessary covering arrangements. Also, maximum delivery period for this system of transportation from the time cement is introduced into the mixer to completion of discharge shall not exceed 30 minutes.

Cleaning

Before loading concrete in either truck mixer open bodied trucks or buckets, the containers shall be thoroughly cleaned, washed and dried so that there is no water or moisture in the container which may affect the designed water content of the concrete.

Other methods of transportation.

Transportation of concrete either by belt conveyors or by pumping is envisaged in this work. If, however, producer, manufacturer, purchaser or ready mix concrete desires to use such methods of transportation, they may do so provided their

Scheme and complete specifications are submitted to the Engineer-in-Charge for his record and approval.

Objective

Method of transportation used shall ensure. -Efficient delivery of concrete -No significant alteration of properties. -with regard to water cement ratio. -slump, air content and homogeneity.

All variables in transportation considering type and accessibility of placement locations. Distance, time interval etc. shall be carefully studied before arriving at the method used.

PLACING CONCRETE BY PUMPING METHODS.

Concrete conveyed by pressure through either rigid pipes or flexible hoses and discharged directly into the desired area is termed as pumped concrete. The method of conveying the concrete through pipe lines is dealt with in these specifications.

Method of applying pressure to concrete is by pumps. Pumps to be used shall be either of the two types as mentioned below. a) Piston type pumps. b) Squeeze pressure type pumps. Compressed air pressure pumps shall not be used in the works.

Pumping Equipment's

Piston pumps Piston pump to be used in the works shall consist of a receiving hopper formixed concrete an inlet valve, an outlet valve, and the pump shall be a twin piston pump. The two pistons shall be so arranged that one piston retracts when the other is moving forwarded and bushing concrete into the pipe line to maintain reasonably steady flow of concrete Single pistol pumps shall not be acceptable. Inlet and outlet valves shall be any one of the following types

-Rotating plug type -Sliding plate type -Guided plunger type -Swing type -Flapper type -or any combination of the above. The pistons shall be mechanically driven using crank or chain or hydraulically driven using oil water. The receiving hopper shall have a minimum capacity of 1.0 cum and the hopper shall be fitted with mixing rotating blades capable of maintaining consistency and uniformity of concrete. The primary power for pumps may besupplied be gasoline, diesel, or electric motors. The primary power unit and the pump unit may truck trailer or skid mounted.

Squeeze pressure pumps Squeeze pressure pumps shall cyclist of a receiving hopper fitted with re-mixing blade re- mixing blades shall be such that these can put the concrete into the flexible hose connected at the bottom of the hopper. The flexible hose shall pass through a metal drum around the inside periphery of the drum and come out through the top part of the drum. The drum shall be maintained under a very high degree of a vacuum during operation The drum shall be so fitted with hydraulically operation metal rollers, which when rotating, create a squeeze pressure on the flexible hose carrying and forces theconcrete out into the pipe line. **Effective Range and Discharge of pumps.**

Effective range of pumps to be used in the work shall be decided by the contractors after studying the site conditions. However, the minimum horizontal range shall not be less than 150 meters and minimum vertical range shall not be less than 50 meters.

Selection of pumps based on discharge capacity shall be decided by the contractors after studying the requirements for the project Discharge capacity shall be worked out by the contractors and approval obtained from the Engineer- in - Charge. As a guide line figure thecontractors may assume a discharge capacity of 15 cubic meter / hour / pump. Pipe Lines. All concrete carrying pipe lines shall generally be rigid pipe lines. flexible pipelines may only be used at bend curves in lines or at discharge ends if required. placements of flexible units shall be done judiciously and connected to the pipe lines only when it meets the approval of the Engineer- in Charge.

Rigid line / Hard Line/ slick line such lines shall be made either of steel or plasticAluminum alloy pipes shall not be used. Minimum pipeline diameter shall be 100

Item No. 17

Providing and casting in situ C.C. in grade M-15 (prop. as per mix design or as per tabel-9 of IS 456-2000 in masses by weight betching) using granite, quartzite trap metal of size 6mm to 20mm for RCC work, incl. scaffolding centering, form work, needle vibrated cosolidation, curing comp. upto 6 metre depth or height (excl. cost of reinforcement and neat finishing) with centering & shuttering etc. complete. for structure other than water retaining. (with form work)

Footing for column or foundation (with form work)

Providing and laying controlled cement concrete M-250 and curing complete excluding the cost of reinforcement for reinforced concrete work in :

(A) Foundations, footings, bases of columns and the like and mass concrete (B) Walls from top of foundation level up to floor two level (C) Slabs, landings shelves, balconies, beams, girders and cantilever up to floor two level. (D) Columns, pillars, struts up to two level.

1.0. Materials & Workmanship: 1.1. The relevant specifications of item No. 5.8.1. shall be followed except that the grading of concrete shall be controlled concrete M-2SO grades for the works as specified in the item.

2.0. Mode of measurement and payment:

2.1 The relevant specifications of item No. 5.8.1. shall be followed.

2.2. The rate shall be for a unit of one cubic meter.

Charging of mixer:-

Mixers both stationary and truck mounted shall be so charged that there is a pre blending of the ingredients as the stream flows into the mixer.

Water shall enter the mixer first, but must continue to flow while other ingredients are entering the mixer. Water charging pipes shall be of proper design and of adequate size so that water enters at a point well inside the mixer. Water charging shall be complete within the first 25% of the mixing time.

Cement shall be charged along with other materials, but it shall be ensured that cement enters the stream after approximately 10% of the aggregate is in the mixer. When it is necessary to charge cement into truck mixers separately, additional mixing time shall be allowed to obtain desired uniformity to mix.

Admixtures shall be charged to the mixer at the same time in the mixing sequence for every batch. Liquid admixtures shall be charged with the water, powdered admixtures shall be sprinkled in to the mixer with other dry ingredients. When more than one admixture is used. They shall be batched separately and they shall not be premixed before entering the mixer. 1

Mixer performance:-

Mixer performance checks shall be made at regular intervals to ensure uniformity of the concrete. Visual examination of the concrete shall be one of the aids for maintaining and checking mixer performance.

Results of tests on air content, slump unit weight of air free mortar shall be guide lines on mixer performance.

Mixing Time.

Mixing time shall be measured from the time all ingredients are in the mixer.

Mixing time shall be established from mixer performance tests conducted at frequent intervals throughout the period of the work. However, as an initial guide, mixer manufacture's recommendation may be followed. Other guide line being 1.33 mins. For 1 cum capacity of mixer and 0.33 min for every additional 1 cum of mixer capacity.

Mixer shall be designed to have audible indicators and combination inter locks which prevent mixer discharge prior to completion of a preset mixing time. Mixer shall also be designed to start and stop operation with full load.

Re-Tempering

Provided that design water cement ratio is not exceeded, small increments of remembering water may be added to mixed batches to obtain the desired. Slump

Addition of water in excess of designed water cement ratio to compensate for slump loss resulting from delays in delivery or placing of concrete shall be permitted

Mix Temperature

Batch to batch uniformity of concrete regard to slump, water requirement and air content is dependent on temperature of concrete. It shall therefore, be ensured that the maximum and minimum temperatures of concrete throughout all seasons of the year donot vary beyond the limits given below.

Minimum: 20 C

Necessary measures shall be taken to lower or raise the temperature of water to maintainthe mixed concrete between the specified temperature limits

Discharging of mixer.

Mixer shall be capable of and handled properly so that concrete of lowest desired slumpcan be effective) discharged without causing segregation.

Ready- Mix concrete may be:

Mixed in a central plant and transported to the job in agitating or no agitating truck bodies.Mixed entirely in transit. Mixed entirely after reaching the job site. Mixed partially in a central plant and completed in transit or after reaching the job site (Shrink mixing)

In ready mix concrete special at tension shall be given the addition of mixing waterquantity, which if incorrect, shall result in reduction of concrete quality.

Concrete consistency (Slump) is also affected by : Amount and rate of mixing. Length ofhaul Time period for unloading Temperature conditions.

In cool weather or short haul and with prompt delivery concrete quality may not be significantly affected. But with reverse conditions, quality of concrete may be significantly affected. Addition of water to compensate for slump loss shall not exceed that quantity necessary to compensate for a maximum 25mm slump loss However, by this additional quantity of water, the design water cement ratio shall not be exceeded.

Loss in workability in warm weather shall be minimized by expediting delivery andplacement, and by controlling the concrete temperature

If it becomes necessary to use readers to prolong the time the concrete will respond tovibration

In hot weather conditions or delays in deliveryl placement, use may be made of the procedure of withholding some of the mixing water till the mixer arrives at the job site, in such cases after addition of the balance (Withheld) quantity. of water an additional 30 revolutions of mixer at mixing speed shall be given to adequately incorporate the additionswater into the mix.

When loss of slump or workability cannot be controlled by measures stated above. complete mixing shall be done at the job site using centrally dry batched ingredients.

Supply and placing of ready-mix concrete.

Responsibility of in-place quality of ready-mix concrete shall be shared by the manufacturer/supplier of ready mix concrete and the placing contractor.

They shall work in close coordination. The placing crew shall be in direct radio / telecommunication contact with the batch plant to ensure. Avoidance of delay in dispatching concrete from batch plant. Inform batching plant delays in formwork, reinforcement work, handling or placing

The placement contractor shall give in writing his requirement of a particular batch of concrete to the supplier.

The ready - mix concrete manufacturer / supplier shall along with each batch of concrete delivered to the placement contractor give him a concrete delivery ticket. The supplier shall give copies of all such delivery tickets to the Engineer- in Charge for his record and also shall get duplicate Copies of all such delivery tickets duly received and signed from the placement contractor.

Ready mixed concrete as supplied by the manufacturer and as placed by the contractor shall in no way be different from the specifications of concrete as approved by the Engineer-in - Charge.

Transportation.

Fresh concrete can be transported to the placement area by a variety of methods common among them are: -Mixer trucks. -Stationary truck bodies with or without agitators. -Bucketshauled by trucks. -Conveyor belts. -House or pipe line by pumping. Each type of transportation has specific advantages and limitations depending on the condition of use, mix , accessibility and location of placing.

Transportation by mixer trucks.

These are essentially revolving drums mounted on truck chassis. Truck mixers used in the job shall be labelled permanently to indicate the manufacture specifications. for mixing like

- a. Capacity of drum.
- b. Total number of drum revolutions required for complete mixing.
- c. Mixing speed.
- d. Maximum time limit before completion of discharge and after cement has entered the drum.
- e. Reduction in time period of discharge.
- f. Due to warm weather or other variables.

All above information shall only form guidelines for the manufacture/ producer of concrete. Fulfilment of the stipulated number of revolutions or elapsed time shall not be acceptable criterion. As long as the mixing water limit not exceeded and the concrete has satisfactory plastic physical properties and is of satisfactory consistency and homogeneity for satisfactory placement and consolidation and is without initial set the concrete shall be acceptable.

When the concrete is totally mixed in transporting trucks or in case of shrink- mix concrete, exceed 63% of the rated capacity of the drum. In case the concrete is totally mixed in the central batching plant, the transporting truck may be loaded up to 80% of the rated capacity of the drum. In this case the drum shall be rotated at charging speed during loading and reduced to agitating speed after loading is complete.

When transporting concrete by truck mixers, delivery time shall be restricted to 1.50 hours from the time cement has entered the mixer to completion of discharge.

Transporting by Agitating.

Transporting ready mix concrete by this method shall consist of truck chassis mounted with open top bodies. The metal body shall be smooth and streamlined for easy discharge. Discharge may be from the rear when the body is mechanically tilted. Body of the truck shall have a provision of discharge gate. Mechanical vibrators shall be installed at the discharge gate for control of discharge flow. Agitators, if mounted, also aid in the discharging of concrete from the truck in addition to keeping the concrete alive.

Water shall not be added to concrete in transport through this system.

Bodies of trucks shall be provided with protective covers during period of inclement weather

Delivery period when adopting this system of transporting, concrete shall be restricted to 30 minutes from the moment all ingredients including cement and water enters in mixer to completion of discharge.

Transporting by buckets.

This method of transportation is very common for transportation of centrally mixed concrete. Buckets of suitable capacities may be fitted with concrete which is totally mixed in central plant and hauled to the job site. Buckets then may be conveyed to the actual point of placement either with the help of crane / hoist or they may be carted.

As in the case of open truck transportation, water shall not be added to concrete transported in buckets. Concrete shall be protected from inclement weather by necessary covering arrangements. Also, maximum delivery period for this system of transportation from the time cement is introduced into the mixer to completion of discharge shall not exceed 30 minutes.

Cleaning

Before loading concrete in either truck mixer open bodied trucks or buckets, the containers shall be thoroughly cleaned, washed and dried so that there is no water or moisture in the container, which may affect the designed water content of the concrete.

Other methods of transportation.

Transportation of concrete either by belt conveyors or by pumping is envisaged in this work. If, however, producer / manufacturer / purchaser or ready mix concrete desires to use such methods of transportation, they may do so provided their

Scheme and complete specifications are submitted to the Engineer-in-Charge for his record and approval.

Item No. 18

Supplying cutting bending binding and placing in position steel as per plan and design and as per ISS 2502 incl. cost of steel and binding wire for reservoirs/ structures only including lift up to 6 meter height or depth below GL for all diameters. -do- Thermo mechanically treated (TMT) bars Fe 415 grade for all diameters.

Workmanship

The work shall consist of furnishing and-placing reinforcement to the shape and dimensions shown as on the drawings or as directed by the engineering - charge

Steel shall be clean and free from rust and loose mill scale at the time of fixing in position and subsequent concreting.

Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown on relevant drawings. Bars shall be bent cold to specified shape and dimensions or as directed, using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport-or handling shall be straightened before being used on the work. They shall not be heated to facilitate bending Unless otherwise specified a "U" type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

All the reinforcement bars shall lie accurately placed in exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size, and conforming to IS : 280 and by using stay blocks or metal chair spacers, metal hangers supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports nor displaced during concreting or any other operations of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports shall not extend to the surface of concrete, except where shown on drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, precast mortar blocks or other approved devices. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed. To prevent reinforcement from corrosion, concrete cover shall be provided as indicated on drawings. All the bars protruding from concrete and to which other bars are to be lapped and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout.

Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm. in such a manner that they do not slip over each other at the time of fixing and concreting.

As far possible, bars of full length shall be used. In case this is not possible. Overlapping of bars shall be done as directed. When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm. Where not feasible, overlapping bars shall be bound with annealed wires not less than 1 mm. thick twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither shear nor bending moment is maximum.

Whenever indicated on the drawings or desired by the Engineer-in-charge, bars shall be jointed by couplings which shall have a cross-section sufficient to transmit the full stresses of bars. The ends of the bars that are jointed by coupling shall be upset for sufficient length so that the effective cross section

at the base of threads is not less than the normal cross-section of the bar. Threads shall be standard threads. Steel for coupling shall conform to I.S. 226.

When permitted or specified on the drawings, joints of reinforcement bars shall be welded so as to transmit their full stresses. Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work shall be accepted. Suitable means shall be provided for holding bars securely in position during welding. It shall be ensured that no voids are left in welding and when welding is done in two or three stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The M.S. electrodes used for welding shall conform to I.S. 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of test shall be as directed.

Mode of Measurement & Payment

For the purpose of calculating consumption, wastage shall not be permitted beyond 5 percent. Excess consumption over 5% will be charged at penal rate.

Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work. Where welding or coupling is resorted to in place lap joints, such joints shall be measured for payment as equivalent length of overlap as per design requirement. From the length so measured, the weight of reinforcement shall be calculated in tones on the same basis of as per M-18 even though steel is supplied to the contractor by the department on actual weight. Length shall include hooks at the ends. Wastage and annealed steel wire for binding shall not be measured and the cost of these items shall be deemed to be included in the rate for reinforcement.

The rate for reinforcement includes cost of steel binding wires, its carting from Department store to work site, cutting, bending, placing, binding and fixing in position as shown on the drawings and as directed. It shall also include all devices for keeping reinforcement in approved position, cost of joining as per approved method and all wastage and spacer bars. The rate shall be for a unit of One kg.

Item No. 19

Providing and filling rubbles including hand packing and filling interstices with quarry spalls below pipeline trenches and between returns as directed.

Specification same as item No.6 except that metal or stone aggregate shall be spread by paver finisher and not manually. Besides all the labour charges, the rate also includes the hire and operating charges of paver. The contractor shall have to make his own arrangement for procuring appropriate paver.

Item-6(B) Spreading quarry spalls in grade & camber complete.

1. The quarry spalls shall only be allowed to be spread after the written permission of the Executive Engineer is obtained.
2. The permission for spreading the metal shall be given by the Executive Engineer if
 - (i) The full quantity of a particular mile (kilometer) is completely collected.
 - (ii) The collection of metal is also completed in the adjoining two miles (Kilometers)
 - (iii) The measurements are recorded in the Measurement book.
3. Q.S. shall, if required, be screened, it containing rubbish, dust, grass etc. it shall then be filled in basket & conveyed where required and spread evenly on the prepared surface by given twisting motion to the basket.

at the time of spreading. The surface shall then (15 m) by means of templates and strings as well as with camber boards and spirit level

4. Between the straight length and curves and at the meeting points of the convex and concave portions of the reverse curves, the change in camber of the road, due to super elevations shall be made as well as with camber boards and spirit level.

5. At the time of spreading Q.S. a small quantity (about 4 to 5 percent) of metal as directed. shall be retained at the first instance. It shall be spread later r. i after partial consolidated as required to rectify the camber and to fill up the hollows if any. No extra amount shall be paid to this.

6. Measurements shall be paid as per the measurements of collection less the quantity remained to be spread and on cubic metre basis.

7. The rate includes the cost of screening the Q.S. if any spreading, sectioning, with template and adding reserved quota of metal, while rolling is in progress for making good hollows and camber.

8. The surface shall be brought to the required camber which shall be checked at every 50 ft.(15 M.) by means off templates of while the necessary of the in between shall tested by strings and corrected as required.

9. The centre line shall first be marked in the subgrade which is properly consolidated and has uniform camber and grade as required.

10. The Q.S shall be laid for a small length on 25 ft. (8 M.) and then the edge stones shall be laid.

11. Pegs shall be driven on either side of the road and joined with strings true and parallel with a distance between they equal to the width be laid with oversize metal Similarly.

12. The Q.S. shall be laid as close as possible so as too leave minimum possible interstices and voids.

13. Before rolling is allowe1 on soling the side berms shall be filled upto the top of the soling and at least 3'-0" (1 m.) on either side so as to prevent metal layer getting disturbed at times during rolling. The rate is inclusive of all the operations as stated above.

Item No. 20

Drilling of 1300 mm dia Horizontal borehole for watermain pipeline crossing under the railway tracks incl all strata with required length incl fixing of 1200 mm dia M.S. casing pipe of minimum 16 mm thick or IRS Casing pipe with welding pushing etc complete providing & fixing various size of pipe for 559 mm/ 610 mm /660 mm / 711 mm dia watermain of G.I / M.S Pipe of minimum 6.3 mm thick for railway permises as per instruction & regulations of Railway authority & under supervision of Railway authority incl providing, supplying & fixing of spacer at specified interval if required between casing pipe and water main ISI make sluice valve of required size at both side of railway boundary with constuction of brickedge pavement incl C:C encasing 1:3:6 in 10mtr length of pipe at both side. Incl providing & fixing of M.S /Iron Manhole frame with cover for valve chamber with loacking arregment etc. complete with all material labour fabrication, hydraulic testing of pipe & valve etc complete for 45 mtr length.

Without Water main & with MS Casing Pipe.

Drilling of various size horizontal bore hole for water main pipe line under Railway / Road in all strata with required length. The work is to be carried out under the supervision of Railway / Road authority after taking necessary permission from Railway / Road department. AS per drawing given by the Railway / Road Department.

The drilling of horizontal bore work is to be carried out by necessary augur and by mechanized method.

Various size (As mentioned in Price bid) M.S. casing pipe shall have to be brought by the agency incl. Necessary pushing, welding etc. complete. The specification of M.S. Pipe are same as per schedule. Cost of M.S. pipe & specials are included in this work.

Necessary Excavation and C.C. M-100 block at the ends of Railway / Road crossing work shall have to be carried out by agency without any extra cost. As per approved drawing & Requirement from B&C Department.

Necessary brick edge pavement in C.M. 1:6 and cement pointing work shall have to carried out for damaged pavement on both side of Highway.

Necessary refilling work shall have to carried out after completion of Railway / Road Crossing Work. The rates are inclusive of considering 20 mt. casing pipe (As mentioned in Price bid), Water main, Sluice valve and Chamber on both side

The rate shall have to paid as per Job basis.

CROSSING

GENERAL SPECIFICATIONS

At Roads, public highways, at such other crossings as are shown in the construction drawings issued by the company the pipeline shall be installed in M.S. casing pipes conforming to the specifications given herein.

The casing pipes shall be installed in accordance with the details given in drawing and the casing, bushing and insulators, etc., shall be installed on the carrier pipe as detailed in drawings. Casing pipe size shall be about 100 mm (Hundred millimeters) larger than the carrier pipe to facilitate the insertion of the later without disturbing the casing pipe and to provide adequate drainage, Casing shall be installed with even bearing throughout its length and shall slope towards one end, as specified or desired by the engineer-in-charge. The ends of the casing shall be sealed to outside of carrier pipe in accordance with the details given in drawing.

Before installation, holes for installing vent pipes shall be cut and burrs if any shall be removed. The welding of both carrier pipe and casing pipe shall be done in accordance with the welding specifications, given herein. Before installing the casing pipe, it should be cleaned of all internal obstructions and during installation care should be taken to keep the inside clean.

The section of carrier pipe to be placed in any casing shall be closed at each end, hydrostatically tested preferably with dead weight tester for at least two hours. Only on successful completion of this test, shall the carried pipe section be inserted in the casing pipe. The installation of casing may open cut as circumstances may permit or require as directed by the engineer-in-charge.

The installation of casing in bended section of the carrier pipe shall be performed by metre bends of the casing pipe provided that the length of each metre cut out of casing pipe shall be such as to provide a clearance of at least 1-1/2" between the inside of the casing pipe and the outside of the coated carrier pipe.

Excavation for casing installation shall be immediately backfilled at the completion of the work with suitable solid matter and packed thoroughly to prevent seepage of water into the excavation.

ROAD, AND IRRIGATION CANAL CROSSINGS :

At road, canal and Road crossings the work shall be performed to the specifications of local authorities or such public bodies as may be in charge (S) of roads, Roads and canals to be crossed.

In case, however the minimum requirements of the governing agencies are less than those set out in the drawing or the specifications given herein, then the requirements given in the drawings and the specifications given for encased line shall be followed.

Where as the casing pipe in the case of encased line to be laid normal by boring, tunnelling, engineer-in-charge may at his discretion permit open-cuts to be made for the installation of casing provided, however, that the TENDERER shall procure the necessary permit / license for the same from competent authority. At locations wherein the open cut methods are permitted, the TENDERER shall pass the carrier pipe through the casing located in the trench after the approval of the engineer-in-charge in writing and care shall be exercised to avoid damage to pipe coating and wrapping during this operation. The TENDERER shall produce a certificate in writing from concerned authorities for its satisfactory restoration and payment therefore.

At all crossings the carrier pipe shall be laid straight without bends so that if necessary the pipe at a later date may be replaced without cutting the casing. The carried pipe shall extend at least 2 meters beyond the end of casing pipe at either end.

At Road crossings the TENDERER shall eliminate unnecessary bending of pipe to conform to the contour of ground by gradually deepening the ditch at such approaches as directed by the engineer-in-charge. Where the installation of the casing has been made by open cut TENDERER shall install suitable temporary bridge work ensuring the safety of the traffic aids and safeguards for protection of the public safety, or he shall provide suitable diversions as desired by the engineer-in-charge.

At all Roads pipeline crossings shall be bored with horizontal boring machine.

The method of carrying out a cased crossing by boring for various crossings on this pipeline route shall be jointly inspected by the representative of the COMPANY and TENDERER for each category of work prior to commencement of actual work.

Pipeline under Road track and irrigation canal an applicable portion of the right-of-way shall be encased in accordance with the specification. This item of work shall include, necessary clearing and grading required therefore, trenching to the depths and widths required, welding of casing and carrier pipes, testing, lowering in, installation of vent assemblies, end seals, insulator and all other fittings that may be required, backfilling, clean up, complete restoration to the original condition and further strengthening and protective works as may be required. The work shall be carried out in accordance with the drawings and as directed by the engineer-in-charge. For various operations mentioned above, the specifications pertaining to these operations shall apply in addition to the specifications given herein.

The TENDERER shall be permitted to use William Sons type Neoprene seals in place of concrete end seals for the crossings. The item shall be procured by the TENDERER himself as per the provisions under the appropriate head of work in case TENDERER so desires. The representative

of the COMPANY may also be associated to determine the quality of the material and its delivery schedule from the open market. However, the particular work defined under the proper head shall not be delayed on account of non-availability of Neoprene end seals. In such case, concrete seals may be provided.

On both ends of pushing concrete supports are to be provided as per direction of engineer-in-charge.

MODE OF PAYMENT:

The payment shall be made on No. of Job basis as shown in relevant schedule, however the increase or decrease in length as suggested by Road/ Highway authority shall be paid extra

Item No. 21

Cutting down trees with Branches and removing and stacking the same to 100 mts. Distance including removing roots, completely with necessary excavation.

24.1 Workmanship:

The site on which the structure is to be built shall be cleared and all obstructions, loose stone, materials and rubbish of all kind, bush, wood and trees shall be removed as directed:

The materials so obtained shall be property of the Government and be conveyed and stacked as directed within 50 M. lead. The rate of site clearance is deemed included in the rate of earthwork for which no extra will be paid.

Setting out: After clearing the site, the centerlines will be given by the Engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the tractor shall assume full responsibility for alignment elevation and dimension of each and all parts of the work.

Contractor shall supply laborers, materials, etc. required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from, the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may-be specified on the drawings or by the Engineer.

It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials.

Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

Road side trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage.

The Contractor shall, provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc.

Methods, Tools and Equipment:

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc.,

Ground level that in no case foil within 500 mm of the sub grade. Also, all vegetation such as roots, undergrowth, grass and other deleterious matter unsuitable for incorporation in the embankment/sub grade shall be removed between fill lines to the satisfaction of the Engineer.

On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the trimmed as directed by the Engineer. All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several meters, shall be suitably treated.

Disposal of Materials

All materials arising from clearing and grubbing operations shall be the property of Government and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also, boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer.

Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lead and lift.

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer.

Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, sub grade and road construction.

24.2 Mode of Measurement

Mode of measurement for clearing and grubbing shall be carried out in Square Meter.

Item No. 22

Full Bore Electromagnetic Flow Meter- Regular Power operated

Design, Supply, Installation, Testing, Commissioning of Full Bore Electromagnetic flow meter with factory calibrated, Regular Power Operated, flanged connection, Flow sensor, Indicator, transmitter and totaliser with all accessories viz. surge arrester, associated cables, cabinets, hardwares, etc complete as per following specifications:

Flow Meter/ Sensor:

DC pulsed type, IP 68 Protection, Flanged process connection as per IS 1538 or equivalent standard, SS304/ Metallic Alloy Flow Tube, SS316/ SS 316 L/ Hastelloy Sensor, SS316/ Hastelloy Grounding Ring/ Inbuilt Grounding Electrode, Neoprene/ Polyurethane/ Hard Rubber/ Rilsan lining, SS304/ Die Cast Aluminium/ Carbon steel with Anticorrosive Paint Coil Housing with Junction Box, CS flanges. alongwith wall mounted/ stand mounted cabinet. Microprocessor based, Modular design, 2 line LCD for indication of actual flow rate, forward, reverse, sum totaliser display,

±0.5% accuracy at 0.3 to 4 m/sec velocity, 4 to 20 mA with HART/Modbus output, one scalable pulse, one status output, IP 67 protection, Die cast aluminium/ polycarbonate/ SS316 with Anticorrosive Paint/ PU finish with glass window enclosure, Inbuilt EEPROM and Data Logger, 20 meters cable length for sensor to transmitter communication etc.

Flow Transmitter/ Converter (Remote Field Mounted):

Full Bore Electromagnetic Flow Meter (Regular Power Operated)- PN 10

Sr. No.	Size
22.0	900mm Nominal Bore

As per detail Item Description and directed by Engineer in Charge and As per relevant General Technical Specification of E & M of Tender

ITEM WISE SPECIFICATION

Item No. 1

Clearing and grubbing road land including uprooting trunk vegetation, grass bushes, shrubs, saplings and tree girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable materials (C) by mechanical means in area of light jungle.

Workmanship:

The site on which the structure is to be built shall be cleared and all obstructions, loose stone, materials and rubbish of all kind, bush, wood and trees shall be removed as directed:

The materials so obtained shall be property of the Government and be conveyed and stacked as directed within 50 M. lead. The rate of site clearance is deemed included in the rate of earthwork for which no extra will be paid.

Setting out: After clearing the site, the centerlines will be given by the Engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the tractor shall assume full responsibility for alignment elevation and dimension of each and all parts of the work.

Contractor shall supply laborers, materials, etc. required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from, the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer.

It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials.

Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

Road side trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not to be disturbed shall be protected from injury or damage.

The Contractor shall, provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc.

Methods, Tools and Equipment:

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc.,

Ground level that in no case foil within 500 mm of the sub grade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/sub grade shall be removed between fill lines to the satisfaction of the Engineer.

On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the trimmed as directed by the Engineer. All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several meters, shall be suitably treated.

Disposal of Materials

All materials arising from clearing and grubbing operations shall be the property of Government and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also, boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer.

Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lead and lift.

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer.

Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, sub grade and road construction.

24.2 Mode of Measurement

Mode of measurement for clearing and grubbing shall be carried out in Square Meter.

Item No. 2

Box cutting the road surface to proper slope & camber for making a base for road work including compacting at O.M.C. and removing the excavated stuff, and depositing on the road side slopes as directed up to 50 Mt. lead.

Box Cutting shall be done in proper grade & camber as per measurements given. Care must be taken the tall slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level in proper grade and the camber. If extra depth of cutting is done due to negligence of contractor the same shall be refilled with approved quality o.f materials duly consolidated to the satisfaction of the Engineer-in-charge (without extra cost) Box cutting for soling and metalling in required width the depth shall be done.

The stuff received from the cutting shall be utilised for filling cuts and correcting side slopes of bank with all lead and lift as directed. Useful stuff shall be carefully stacked separately as directed.

The measurement shall be taken as per cross section measurement of the cutting based on length, breadth, depth measured with tape at every 25 metres interval.

Mode of Payments

The payment shall be made on Cu.mt. basis.

Item No. 3

Construction of granular sub-base 100 mm thick by providing coarse graded machine crushed B.T. material satisfying MOST specification of grading II (B.T. stone aggregate 26.5 to 4.75 mm - 75 % and 2.36 mm below - 25 %) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.

GRANULAR SUB-BASE

Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub- base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base.

The material shall be free from organic or other deleterious constituents and shall conform to the gradings given in Table 400-1 and physical requirements given in Table 400-2. Gradings III and IV shall preferably be used in lower sub-base. Gradings V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract.

Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

Table : Grading for Granular Sub-base Materials

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55 -90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25 - 55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20- 40	30-50	-	-	10-20	10-25
0.85 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10- 15	-	-	0-5	0-8
0.075 mm	<5	< 5	< 5	< 5	-	0-3

Table : Physical Requirements for Materials for Granular Sub-base

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

Construction Operations

Preparation of Sub-grade

Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter,lightly sprinkled with water, if necessary and rolled with two passes of 80–100 kN smooth wheeled roller.

Spreading and Compacting

The Granular sub-base material of the grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction.

Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super-elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Arrangements for Traffic

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

Item No. 4

Construction of granular sub-base 150 mm thick by providing coarse graded machine crushed B.T. material satisfying MOST specification of grading I (B.T. stone aggregate 53 mm to 26.5 mm 35 %, 26.5 to 4.75 mm - 45 % and 2.36 mm below - 20 %) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.

GRANULAR SUB-BASE

Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base.

The material shall be free from organic or other deleterious constituents and shall conform to the gradings given in Table 400-1 and physical requirements given in Table 400-2. Gradings III and IV shall preferably be used in lower sub-base. Gradings V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract.

Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

Table : Grading for Granular Sub-base Materials

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	100	-
53.0 mm	80-100	100	100	100	80-100	100

26.5 mm	55 -90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25 - 55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20- 40	30-50	-	-	10-20	10-25
0.85 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10- 15	-	-	0-5	0-8
0.075 mm	<5	< 5	< 5	< 5	-	0-3

Table : Physical Requirements for Materials for Granular Sub-base

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

Construction Operations

Preparation of Sub-grade

Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter,lightly sprinkled with water, if necessary and rolled with two passes of 80–100 kN smooth wheeled roller.

Spreading and Compacting

The Granular sub-base material of the grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of waterand mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread onthe prepared subgrade with the help of a motor grader of adequate capacity, its blade havinghydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitablyadjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction.

Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super-elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Arrangements for Traffic

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

Item No.5

Providing and laying wet mix macadam base course 125 mm thick in two layers using machine crushed B.T. chips as per required gradation mixing with required optimum quantity of water, conveying the mix to site of work, spreading in to grade and camber with mechanical paver and consolidation each layer with vibratory roller including cost of material labour plant and equipment etc. complete.

Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub- base/ base or existing pavement as the case may be in accordance with the requirements of these Specifications.

The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be up to 200 mm with the approval of the Engineer.

Physical Requirements

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-12.

If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

Table : Physical Requirements of Coarse Aggregates for Wet Mix Macadam for Sub-base/Base Courses

S. No.	Test	Test Method	Requirements
1)	Los Angeles Abrasion value or Aggregate Impact value	IS:2386 (Part-4) IS:2386 (Part-4) or IS:5640	40 percent (Max.) 30 percent (Max.)
2)	Combined Flakiness and Elongation indices (Total)	IS:2386 (Part-1)	35 percent (Max.)*

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

Grading Requirements

The aggregates shall conform to the grading given in Table.

Table: Grading Requirements of Aggregates for Wet Mix Macadam

IS Sieve Designation	Percent by weight passing the IS Sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-5

Material finer than 425 microns shall have Plasticity Index (PI) not exceeding 6. The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

Provision of Lateral Confinement of Aggregates

While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described.

Preparation of Mix

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/ positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. The plant shall have following features:

- i) For feeding aggregates– three/ four bin feeders with variable speed motor.
- ii) Vibrating screen for removal of oversize aggregates.
- iii) Conveyor Belt.
- iv) Controlled system for addition of water.
- v) Forced/positive mixing arrangement like pug-mill or pan type mixer.
- vi) Centralized control panel for sequential operation of various devices and precise process control
- vii) Safety devices

Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding

water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted

.Spreading of Mix

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-grade/sub-base/base in required quantities. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread by a paver finisher. The paver finisher shall be self-propelled of adequate capacity with following features:

- i) Loading hoppers and suitable distribution system, so as to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.
- ii) Hydraulically operated telescopic screed for paving width up to to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.
- iii) Automatic levelling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used with the prior approval of the Engineer. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual mixing and /or laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual mixing/laying in inaccessible/ remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual mixing/laying is intended to be used, the same shall be done with the approval of the Engineer.

Compaction

After the mix has been laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with an arrangement for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/superelevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has

been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the center line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub-grade is soft or yielding or when it causes a wave- like motion in the sub-base/base course or sub-grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case shall the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material as determined by the method outlined in IS:2720 (Part-8).

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

Setting and Drying

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

Opening to Traffic

No vehicular traffic shall be allowed on the finished wet mix macadam surface. Construction equipment may be allowed with the approval of the Engineer.

Surface Finish and Quality Control of Work

Surface Evenness

The surface finish of construction shall conform to the requirements of Clause 902.

Quality Control

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub-grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added premixed material or removed and replaced with fresh premixed material as applicable and recompactd in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

Arrangement for Traffic

During the period of construction, arrangements for traffic shall be done as per Clause 112.

Measurements for Payment

Wet mix macadam shall be measured as finished work in position in cubic meters.

Item No. 6

Rolling and watering of earth work in layers with power roller including filling in depression which occur during the process.

Spreading and Compacting

The Granular sub-base material of the grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction.

Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super-elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Arrangements for Traffic

During the period of construction, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

CONTRACT NO.

Bhavnagar Municipal Corporation
BHAVNAGAR



(A WHOLLY OWNED BHAVNAGAR MUNICIPAL CORPORATION UNDERTAKING)

ESTIMATED COST

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

ESTIMATED COST: RS. 14,70,03,332.00/-

VOLUME – IIIC: DATA SHEET

Employer

EXECUTIVE ENGINEER

(Drainage Dept.)

BHAVNAGAR Municipal Corporation

Sir Mangal Sinhji Road, Near Kalanala,

Bhavnagar,

Bhavnagar,-364001.

Contact Number: 0278 2424801-10

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PREAMBLE TO DATA SHEET

1. The Levels given in the Appendix to Bid and drawings are as per the Data available with authority. As the Working survey is included in scope of the work of contractor, agency shall carry out working survey along the route.
2. The Agency shall have to confirm both the levels and line out of the pipeline network as per the requirement of the inter-related actual pipeline route/any structure and design accordingly. No Extra payment shall be made by the Department to the Agency for the extra excavation or for the raised structure above Ground Level.
3. The levels given in the documents are tentative as per the selected site presently surveyed. In case of change in pipeline route/any structure is to be necessary due to any reason, the Agency shall be bound to carry out all the works as per the new pipeline route/any structure and the design is to be carried out accordingly without any extra claims.
4. The sizes of the panel room given in the Price Bid are as per the Departmental Type Design of authority. The above-mentioned work should be constructed accordingly and any changes in size shall be measured and the payment will be made as per schedule of Payment. Agency shall be bound to carry out the work as per the re-designed structures.
5. All the civil structure like panel room given should be designed in relevant manner with given flow diagram, and the layout shall get approved before the detailed designing from the EIC.
6. For Construction of Civil Structures all the data are to be obtained by the agency and accordingly the structural design shall be prepared & to be got approved by authority.

Signature of Bidder

**Executive Engineer
(Drainage Dept)
BMC BHAVNAGAR**

**SECTION- 1:
BRIEF DESCRIPTION OF WORK**

The main scope of works/ services to be done/ provided by the contractor under this bid shall be as under.

A LAYING/ INSTALLATION OF MATERIAL ISSUED BY DEPARTMENT:

Nil

B-1 PROCUREMENT, SUPPLY & LAYING OF SEWER COLLECTING PIPELINE

Providing, Supplying, Lowering, Laying, Jointing, testing and commissioning of RCC pipes (of Sulphate resisting Cement), NP3 Class pipes for following nominal bore diameter with One collar should be provided with each full length plain ended RCC pipe. One rubber ring should be supplied with each full length socketed pipe.

Sr. No.	Description	Quantity
1	1400 mm dia NP3 class	As per price bid

B-2 CONTRUCTION OF ASPHALT ROAD RESURFACING WORK FROM CHITRA PUMPING STATION TO RAILWAY

Sr. No.	Description	Quantity
1	ROAD RESURFACING WORK FROM CHITRA PUMPING STATION TO RAILWAY	As per price bid

B-3 DESIGN AND CONTRUCTION OF SEWAGE PUMPING STATION

Designing and construction of Sewage Pumping Station as per Contractor's own design complete. The designs shall be as per Design criteria given in tender & as per BMC and required to be approved by authority prior to construction.

Sr. No.	Description	Quantity
1	MAIN PUMPING STATION AT PLOT NO 49-SFC TP-20	As per price bid

B-4 DESIGN AND CONTRUCTION OF SCREEN CHAMBER

Designing and construction of Screen Chamber as per Contractor's own design complete. The designs shall be as per Design criteria given in tender & as per BMC and required to be approved by authority prior to construction.

Sr. No.	Description	Quantity
1	SCREEN CHAMBER AT PLOT NO 49-SFC TP-20	As per price bid

B-5 ELECTRO-MECHANICAL WORKS

Designing, procuring, erection & Commissioning of Pumping machinery & allied works

Sr. No.	Description	Capacity/Rating
1	Designing providing, Installation and commissioning Submersible Non Clog Vertical Pumping Machinery and associated electrical works at Main Pumping Station At Plot No 49-Sfc Tp-20.	As per design

B-6 PROCUREMENT, SUPPLY & LAYING OF RISING MAIN PIPELINE

Providing, Supplying, Lowering, Laying, Jointing, testing and commissioning of D.I. K-7 grade pipes for following nominal bore diameter with internal cement mortar lining from various pumping station to Nearby Man Holes/ SPS/ STP with valves, fixtures, fastening, appurtenances, accessories etc.

Sr. No.	Description	Diameter	Quantity
1	Proposed Pumping station at Plot No 49-SFC Tp-20 To 30 MLD STP at Kumbharvada	900 D.I K7	As per price bid

B-7 CONTRUCTION OF CONSTRUCTION WORK OF WMM ROAD PARALLEL TO RISING MAIN

Sr. No.	Description	Quantity
1	CONSTRUCTION WORK OF WMM ROAD PARALLEL TO RISING MAIN	As per price bid

B-8 Operation & Maintenance

Sr. No.	Particular	Months
1	Operation & Maintenance after Completion of the Project.	60
2	Defect Liability period	36

Signature of Bidder

Executive Engineer (Drainage Dept)
BMC
Bhavnagar

SECTION- 2:

TECHNICAL SCHEDULE: MECHANICAL WORKS.

1.0 SUBMERSIBLE NON-CLOG VERTICAL PUMP

SR. NO.	PARTICULAR	DESCRIPTION	DATA TO FILL BY BIDDER
1.0	LIQUID DATA		
1.1	Liquid handled	Sewage	
1.2	Specific gravity	1.02	
1.3	Temperature	Amb. temp. - 50 Deg. C	
1.4	Suc. Pre.@ rated capacity-m	Atmospheric	
2.0	PUMP DATA		
2.1	Make	Please furnish	
2.2	Pump type	Sub.NC with dry type motor	
2.3	Pump Model	Please furnish	
2.4	Number of pumps	6 nos.	
2.5	Type of duty	Continuous	
2.6	Design capacity-m ³ /hr.	Please furnish	
2.7	Total Rated Head-m	Please furnish	
2.8	Pump Efficiency at duty point-%	Please furnish	
2.9	Motor Effi. at Duty Point-kW	Please furnish	
2.10	Guaranteed Overall efficiency of Pump set-%	Min. 78 % w/o -ve Tolerance	
2.11	Motor input at rated duty-kW	Please furnish	
2.12	Rated Speed of pump-RPM	Please furnish FLS of motor	
2.13	Max. BKW for Rated Impeller-W	Please furnish	
2.14	Recommended motor rating- kW	Please furnish	
2.15	Min. Submergence Required-m	Please furnish	
2.16	Shut off head -m	Please furnish	
2.17	Min. permissible solid size-mm	100	
2.18	Length of pair of cable offered with Pump (Power & Control)-m	Please furnish	
2.19	Location	Submerged	
3.0	CONSTRUCTIONAL FEATURE		
3.1	No. of stage	Single	
3.2	Casing	Volute type	
3.3	Impeller	Single suction Enclosed/Semi-open	
3.4	Impeller dia.-mm	Rated	
		Max. / Min.	
3.5	Shaft / Drive Transmission	Direct Unit-built	
3.6	Shaft sealing	Double Mechanical Seal	

SR. NO.	PARTICULAR	DESCRIPTION	DATA TO FILL BY BIDDER
3.7	-Type & size of Mech. Seal -Faces Pump side Motor Side:	Pl. furnish detail of faces Pl. furnish detail of faces Pl. furnish detail of faces	
3.8	Nozzle orientation & size in mm		
	Suction	Bottom	___ mm / Bottom
	Discharge	Side	___ mm / Side
	Mounting Orientation	Vertical	
	Flange drilling	As per IS 1538, FF with off center bolt holes	
	Direction of rotation	CW when viewed from DE	
	Type of Starter	Soft Starter	
	MOTOR DATA		
	Motor Rating in KW	Pl. furnish	
	Voltage / Phase / Frequency & % variation	Pl. furnish	
	Combined Voltage & Frequency variation	Pl. furnish	
	Amb. Temp. / Temp. Rise °C	Pl. furnish	
	Insulation Class	Pl. furnish	
	Duty	Continuous	
	Full Load Speed-RPM	Pl. furnish	
	Full load Torque(FLT)-kg.m	Pl. furnish	
	Starting torque as % of FLT	Pl. furnish	
	Full load current(FLC)-A	Pl. furnish	
	Locked rotor current-A	Pl. furnish	
	Starting Current as % of FLC	Pl. furnish	
	Break down or POT - % of FLT	Pl. furnish	
	Starting time at 80% V / 100% V (Sec.) with load coupled	Pl. furnish	
	No load starting time	Pl. furnish	
	Locked rotor withstand time Hot/cold (Sec)	Pl. furnish	
	Overload capacity-%	Pl. furnish	
	Permissible cold / hot starts-Nos	Pl. furnish	
	Power factor @ 50% @ 75% @ 100% load	Pl. furnish	
	Efficiency @ 50% @ 75% @ 100% load	Pl. furnish	
Guaranteed efficiency w/o tolerances	Pl. furnish		
Starting Power Factor	Pl. furnish		
Provision of Thermistors	Pl. furnish		
Bearing Type/Number, DE/ NDE	Pl. furnish		
Cable Type / Size	Pl. furnish		

SR. NO.	PARTICULAR	DESCRIPTION	DATA TO FILL BY BIDDER
	Control & Signal Cable:	Pl. furnish	
	Power Cable :	Pl. furnish	
	Protection Class	IP-68	
5.0	MATERIAL OF CONSTRUCTION		
5.1	Pump Casing & Casing cover	CI; IS 210 GR FG 260 with 2 % Ni	
5.2	Impeller & Impeller Nut (M)	CF 8 M	
5.3	Wear Plate / suction Cover (M)	CI; IS 210 GR FG 260 with to 2 % Ni	
5.4	Shaft (M)	AISI 410	
5.5	Shaft Sleeve(M)	AISI 410	
5.6	Motor housing/Oil chamber (M)*	CI: IS 210 Gr FG 260 with 2 % Ni	
5.7	Motor Jacket / Strainer	Not required	Not required
5.8	Motor Rotor	Copper Bar base / Aluminum Die Cast	
5.9	Hardware in contact with liquid	SS 304	
5.10	Guide pipe	SS 304	
5.11	Painting	Pl. furnish	
5.12	Auto Coupling unit with del. Bend	CI/DI epoxy painted	
6.0	ACCESSORIES & SERVICES REQUIRED		
6.1	Auto Coupling unit	YES	
6.2	Strainer	NO	NO
6.3	SS Double Guide pipe with support	YES	
6.4	SS304 Lifting Chain	YES	
6.5	Set of foundation bolts & Nuts	YES	
6.6	Control Panel	NO	NO
6.7	Nonstandard/special maint. tools	YES	
7.0	WEIGHT		
7.1	Weight of pump set-kg	Pl. furnish	
7.2	Reco. crane capacity-Ton	Pl. furnish	
8.0	DRAWINGS		
8.1	ISO Performance curve	Pl furnish	
8.2	GAD drg. of Pump set	Pl furnish	
8.3	C/S drg. of pump set with part list	Pl furnish	
8.4	Catalogue of products	Pl furnish	
8.5	QAP of products	Pl furnish	
9.0	TESTING		
9.1	Hydrostatic test	Certificate required	
9.2	Performance test	Witness	
9.3	Static and dynamic balancing test	Certificate required	
9.4	Visual inspection check	Witness	

Note: 01. Manufacturer / supplier shall submit separate data sheet for each duty.
02. For components (Marked-M) material certificates shall be furnished.

03. (*) Motor housing / Oil chamber not forming a part of casing in can be offered in CI.

2.0 DATA SHEET FOR SLUICE VALVES

SR. NO.	PARTICULARS	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.0	CONSTRUCTIONAL FEATURES		
1.1	Make	Pl. furnish detail	
1.2	Standard	IS 780-1980/2906-1980	
1.3	Size in mm/ Qty.		
1.4	Location	Indoor	
1.5	Fluid	Sewage	
1.6	Sp. Gravity	1.02	
1.7	Pressure Rating	PN 1.0	
1.8	Ends	Flanged, as per IS-1538 T- IV & VI	
1.9	Disc.	Duo eccentric	
1.9.1	Eccentricity-1 in mm	Pl. furnish detail	
1.9.2	Eccentricity-2 in mm	Pl. furnish detail	
1.10	Operation	Manually gear box operated	
1.11	Other requirements	Valves shall be with hand wheel	
1.12	Stem/Shaft Orientation	Horizontal	
2.0	MATERIAL OF CONSTRUCTION		
2.1	Body	C.I. IS 210 GR 260 (M)	
2.2	Disc	C.I. IS 210 GR 260 (M)	
2.3	Stem	S.S. AISI - 410 (M)	
2.4	Body seat (Renewable)	S.S. AISI - 410 (M)	
2.5	Disc seal	EPDM Rubber	
2.6	Clamping ring	S.S AISI -304	
2.7	Bolts, studs & nuts	CS, IS :1367 Class 4.6 / 4 galvanized	
3.0	ACCESSORIES		
3.1	Gear Box	Required (150 mm above)	
3.2	By-Pass Arrangement	Required (600 mm above)	Not required
3.3	Support foot	Required (900 mm above)	Not required
4.0	Details applicable require for Electrically Operated Valve		
4.1	Actuator make / model	Pl. furnish detail	N.A
4.2	Actuator Torque capacity	Pl. furnish detail	N.A
4.3	Power supply	3 Phase, 415 V, AC, 50 Hz.	N.A
4.4	Valve opening/closing time	Vendor to specify	N.A
4.5	Electric Actuator Requirements	Fwd. & reverse integral starter for local & remote mode & cable up to actuator motor with all accessories as per specifications as applicable	N.A
4.6	Actuator make / model	Pl. furnish detail	N.A
4.7	Actuator motor rating-kW	Pl. furnish detail	N.A
5.0	DRAWINGS		
5.1	General outline dimensional drg.	Pl. furnish detail	
5.2	C.S. drawing with parts	Pl. furnish detail	
5.3	QA plan	Pl. furnish detail	

6.0	TESTING	Each valve shall be subjected to hydraulic tests as described in Appendix - B of IS: 2906-1984 to the test pressure for a duration as specified in table - 7 of IS: 2906	
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3.0 DATA SHEET FOR NON-RETURN VALVES

SR. NO.	PARTICULAR	DESCRIPTION	DATA TO BE FILLED BY BIDDER
1.0	CONSTRUCTIONAL FEATURES		
1.1	Make	Pl. furnish detail	
1.2	Mfg. Standard	IS 5312- PART II	
1.3	Size & Quantity	Pl. furnish detail	
1.4	Pressure Rating	PN : 1.0	
1.5	Fluid	Sewage	
1.6	Sp Gravity	1.02	
1.7	Type	Pl. furnish detail	
	No of Doors	Pl. furnish detail	
1.8	Ends	Flanged. Flat faced and conforming to IS 1538-part IV& VI having off center bolt holes	
1.9	Seat	Body: Renewable Disc :Renewable	
2.0	MATERIAL OF CONSTRUCTION		
2.1	Body -Inlet & Outlet shell	C.I. IS 210 GR 260(M)	
2.2	Diaphragm & Hinges	C.I. IS 210 GR 260(M)	
2.3	Doors	C.I. IS 210 GR 260 (M)	
2.4	Seat rings	S.S AISI 316 (M)	
2.5	Hinge Pin	S.S BS 970 Gr 431 S29 (M)	
2.6	Internal Bolts, Studs & Nuts	SS 304	
3.0	ACCESSORIES		
3.1	By-Pass Arrangement	Required	Not Required
3.2	Drain Plug	Required	
3.3	Support foot	Required	
4.0	DRAWINGS		
4.1	General outline dimensional drg.	Pl. furnish detail	
4.2	C.S. drawing with parts	Pl. furnish detail	
4.3	QA plan	Pl. furnish detail	
5.0	TESTING		
5.1	Shell test	Each valve shall be subjected to	

		hydraulic tests as described in Appendix - B of IS: 2906-1984 to the test pressure for a duration as specified in table - 7 of IS: 2906	
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4.0 DATA SHEET FOR AIR VALVE

SR. NO.	PARTICULAR	DESCRIPTION	DATA TO BE FILLED BY BIDDER
1.0	CONSTRUCTIONAL FEATURES		
1.1	Make	Pl. furnish detail	
1.2	Mfg. Standard	IS - 14846	
1.3	Size & Quantity	Pl. furnish detail	
1.4	Pressure Rating	PN : 1.0	
1.5	Fluid	Sewage	
1.6	Sp Gravity	1.02	
1.7	Type	Pl. furnish detail	
	No of Doors	Pl. furnish detail	
1.8	Ends	Flanged. Flat faced and conforming to IS 1538-part IV& VI having off center bolt holes	
1.9	Seat	Body: Renewable Disc :Renewable	
2.0	MATERIAL OF CONSTRUCTION		
2.1	Body -Inlet & Outlet shell	C.I. IS 210 GR 260(M)	
2.2	Diaphragm & Hinges	C.I. IS 210 GR 260(M)	
2.3	Doors	C.I. IS 210 GR 260 (M)	
2.4	Seat rings	S.S AISI 316 (M)	
2.5	Hinge Pin	S.S BS 970 Gr 431 S29 (M)	
2.6	Internal Bolts, Studs & Nuts	SS 304	
3.0	ACCESSORIES		
3.1	By-Pass Arrangement	Required	Not Required
3.2	Drain Plug	Required	
3.3	Support foot	Required	
4.0	DRAWINGS		
4.1	General outline dimensional drg.	Pl. furnish detail	
4.2	C.S. drawing with parts	Pl. furnish detail	
4.3	QA plan	Pl. furnish detail	
5.0	TESTING		
		Each valve shall be subjected to hydraulic tests as described in Appendix - B of IS:2906-1984 to the test pressure for a duration as specified in table - 7 of IS: 2906	

**TECHNICAL DATA SHEET
(ELECTRICAL & INSTRUMENTATION WORKS)**

SECTION- 3:

TECHNICAL SCHEDULE: ELECTRICAL INSTRUMENTATION WORKS

TABLE OF CONTENTS

Sr. No.	Description
1.0	ELECTRICAL EQUIPMENT
1.1	LV Metal Enclosed Switchgear (PCC/ MCC/ PDB/ SDB)
1.2	LV APFC Panel
1.3	Power, Control & Instrumentation Cables
1.4	Earthing & Lightning Protection Systems
1.5	Lighting & Receptacle System
1.6	Relays, Switchgears & Instruments
2.0	INSTRUMENTATION & CONTROL EQUIPMENT
2.1	Full Bore Electromagnetic Flow Transmitter
2.2	Pressure Gauge
2.3	Pressure Transmitter
2.4	Ultrasonic Level Transmitter
2.5	Float & Board Type Level Indicator
Note:	Technical data sheets/ schedules cover only salient features of equipment offered by the Contractor. The Contractor shall certify that the system requirements as covered in tender specifications are fully complied with, except those specifically brought out in Schedule of Deviations from Technical Specification.

Bidder to provide completely filled data sheets for the equipments mentioned below. As applicable, separate data sheets needs to be filled for each equipment/ system covered under the scope.

1.0 DATA SHEET FOR ELECTRICAL EQUIPMENT:

1.1 LT METAL ENCLOSED SWITCHGEARS:

SR. NO.	PARTICULAR	DETAILS	CONFIRM/ DATA TO BE FILLED BY
1.0	SITE CONDITION		
1.1	Type / Make	Indoor / As per tender	
1.2	Mounting	Floor	
1.3	Ambient Temperature	50° C	
1.4	Atmosphere	Corrosive, Humid and Dusty	
2.0	CONSTRUCTION		
2.1	Housing	2.0 mm thick CRCA sheet for body and all partitions	
2.2	Protection Class	IP-5X	
2.3	Doors	1.6 mm thick CRCA sheet with Hinges	
2.4	Base channel	75 x 40 mm C Channel	
3.0	OPERATIVE CONDITION		
3.1	Voltage	415 V ± 10%	
3.2	No. of phase	3	
3.3	System	3 phase, 4 wire	
3.4	Frequency	50 Hz, +5% / -5%	
3.5	Fault Current	25 kA / 50kA as per SLD	
3.6	Neutral Grounding	Solid	
4.0	CONTROL SYSTEM		
4.1	Voltage		
	For Indication	230 V A.C.	
	For Metering	230 V A.C.	
	For Protection	230 V A.C.	
4.2	Control Supply Through	230 V A.C. for MCC & APFC only	
4.3	Control Wiring	1.5 / 2.5 mm ² FRLS Cu. Wire	
5.0	BUSBAR		
5.2	Neutral Bus bar Material	Same as Phase Bus bar.	
5.3	Earth Bus bar Material	As per SLD	
6.0	PLC Based System	As per SLD / BOQ.	

SR. NO.	PARTICULAR	DETAILS	CONFIRM/ DATA TO BE FILLED BY
7.0	Electronic Motor Protection Relay (with RS-485 port)	Microprocessor based	
7.1	Type	As per tender	
7.2	Make	As per tender	
7.3	Protection	Pl. furnish	
	1) over current 2) single phasing 3) phase reverse 4) Current unbalance 5) under current (dry run) 6) stall (bearing broken) locked rotor 7) Restart Inhibition 8) Ground/Earth fault (CBCT)		
8.0	PAINTING		
8.1	Sheet should be 7 tank processed, Oven Baked at 310 °C with powder coating.	Required	
8.2	Colour	RAL 7035	
8.4	Shade : Exterior & Interior	RAL 7035	
9.0	PANEL TEMPERATURE RISE		
9.1	Max. temperature rise inside the panel (°C)	35 °C above ambient	
10.0	Control Wiring		
10.1	Wire Size	1 C X 2.5 Mm ² / 1 C X 1.5 Mm ² Cu.	
11.0	Hardware (Zinc Plated)	YES	
12.0	Space Heater	230 V A.C. with thermostat	
13.0	Pocket For Drawings at door	YES	
14.0	Annunciator Window (Free standing to be mounted at convenient location with required cabling, required contacts should have separate terminal block in cable alley)	Indication for each Pump : a. Pump Trip (Red)-Through starter b. High level in sump c. Low and very low level in sump d. High and low discharge pressure	

SR. NO.	PARTICULAR	DETAILS	CONFIRM/ DATA TO BE FILLED BY
		e. Valve Motor Trip	
15.0	Instrumentation compartment	Separate compartment for energy meter, Hr meter, level controller, etc. with necessary internal wiring	
16.0	Panel Internal Lighting	Auto NO contact/switch with Panel door and CFL 18 W for Panel Internal Lighting	

1.2 LV APFC PANEL:

Sr. No	Description	Unit	Particulars	To be filled By Bidder
1	Capacitor Bank Panel Particulars			
1.1	Make		As per approved make list	
1.2	Applicable Standards		As per Tender Specification	
1.3	Quantity		As per BOQ	
1.4	Rated Capacity	kVAR	* Bidder to furnish as per design requirement.	
1.5	Capacitor losses (a) For complete bank (b) For individual units	watts watts	0.5W/ kVAr 0.2W/ kVAr	
1.6	Rated voltage	V	415	
1.7	Rated frequency and phases		50 Hz, 3 Phase	
1.8	Ambient temperature	deg.C	50	
1.9	Cable gland required		Yes	
1.10	Size of cable		As per design Requirements	
1.11	Cable entry		Bottom	
2	Unit Capacitors			
2.1	Rated voltage	V	415V	
2.2	Standard Rated Output per bank at 415V	kVAR	5 / 10 / 15 / 25 / 50 / 100 KVAR	
2.3	Maximum over voltage the unit capacitor is capable of withstanding continuously	%	As per IS 13585	
2.4	Type		Double Layer APP	
3	Constructional Requirement			
3.1	Overall dimensions of Capacitor control panel (Length x Depth x Height)	mm	Pl. Furnish	
3.2	Thickness of sheet steel a) Frame, Frame enclosures, doors covers and partition	mm	CRCA - 2.0 Partition-1.6 Gland plate -3	
3.3	Degree of protection		IP 42	
3.4	Color finish shade (Interior/ Exterior)		RAL 7032/ Light grey semi glossy Shade 631 of IS-5	
3.5	Earthing bus - material - size		GI Suitable for max.sc rating for 1	

Sr. No	Description	Unit	Particulars	To be filled By Bidder
			sec)	
a)	Earthing conductor (main grid) - material Size		GI Suitable for max.sc rating for 1 sec)	
4	Design Requirements			
4.1	Insulation level	kV (rms)	2.5	
4.2	Capacitor bank connection		Delta	
4.3	Short circuit withstand for busbars Short time (1 sec)	kA (rms)	*	
4.4	Type of switching		Automatic switching responsive to power factor through power factor sensing relay	
4.5	Switching steps	Min. 8	As per requirements	
4.6	Rating of contactor		AC 6b Duty - To suit KVAR unit	
4.7	Incomer switch current rating	150% of rated	* As per requirements	
4.8	Busbars		Al	

1.3 POWER, CONTROL & INSTRUMENTATION CABLES:

Sr. No.	Description	Unit	Particulars	To be filled By Bidder
1	11 kV (UE), multi strand, Al, XLPE insulated, inner & outer extruded PVC sheathed, GI armoured power cable (as required)	LS	As per IS 7098 Part -II	
1.1	Make		As per approved list	
1.2	Applicable Standards		As per tender specification	
2	1.1 kV, multi strand Cu/ Al, XLPE insulated, inner & outer extruded PVC sheathed, GI armoured power/submersible cable (Cu conductor cable & GI round wire armoring for sizes up to 6 sq mm & below, for balance all, above 6 sq. mm conductor size- Al conductor & GI flat strip armoring) (Cu conductor, double PVC sheathed, water tight, flexible cable for submersible pump application)	LS	As per IS 7098- Part -I	
2.1	Make		As per approved list	
2.2	Applicable Standards		As per tender specification	
3	1.1 kV, multi-strand Cu, XLPE insulated, inner & outer extruded PVC sheathed, GI armoured control cables	LS	As per IS 7098	
3.1	Make		As per approved list	
3.2	Applicable Standards		As per tender specification	
4.	General			
4.1	Type of Cable Gland (Suitable for Cable Size as per requirement)		Double compression brass type	
4.2	Type of Cable Lugs (Suitable for Cable Size & material or bimetallic - as per requirement)		Crimping type	
4.3	All Cable accessories as per specification requirements to be provided.		Yes/ No	

1.4 EARTHING AND LIGHTNING PROTECTION SYSTEM:

Sr. No.	Description	Unit	Particulars	To be filled By Bidder
1	Main Earthing Grid		To suite as per maximum SC rating & design Criteria	
2	Conductor leads to equipment		(Minimum 2 distinct earthing leads for equip. having > 125V & 1 earthing lead for equip. with < 125V)	
3	Other Items			
3.1	Main lighting D.B, Control panels and sub-lighting distribution boards	Mtr.	GI, 25x6mm	
3.2	Hand Rails	Mtr.	GI, 25x3	
3.3	Cable trays	Mtr.	GI, 25x3	
3.4	Tanks	Mtr.	GI, 25x3	
3.5	Street lighting, flood lighting poles and junctions boxes,	Mtr.	GI wire, 8 SWG	
3.6	Lighting fixtures, single phase receptacles, lighting conduits,	Mtr.	GI wire, 12 SWG	
3.6	Push button stations, limit switches,	Mtr.	GI wire, 12 SWG	
3.7	Crane rail,	Mtr.	GI, 25x3 mm	
3.8	Metallic noncurrent carrying structures,	Mtr.	GI, 25x3 mm	
4	Lightning Conductors	Mtr.		
4.1	Lightning protection down comers for building,	Mtr.	GI, 25x6 mm	
4.2	Lightning protection horizontal roof conductor for building	Mtr.	GI, 25x6 mm	
5	Electrodes			
5.1	Pipe electrode	Nos.	Heavy duty GI pipe 3000 mm long, 40NB (Quantity to achieve ≤ 1 Ohm earth resistance based on 100 ohm-m or higher resistivity on the basis of actual	

Sr. No.	Description	Unit	Particulars	To be filled By Bidder
			measurement whichever is higher)	
5.2	Plate Electrode	Nos	Minimum 2 Nos. of 600mm x 600mm x 3.15 mm Cu for each transformer neutral - Minimum 2 Nos. of 600mm x 600mm x 6 mm GI for each transformer body/ other system	
6	Earthing Resistance to be achieved		As per IS 3043	
6.1	For safety earthing	Ohm	≤1	

1.5 LIGHTING & RECEPTACLE SYSTEM AND EQUIPMENT:

Sr. No.	Description	Unit	Particulars	To be filled By Bidder
1	System Particular			
1.1	Voltage			
a)	3 Phase, 4 wire 50 Hz system			
i)	Nominal	V	415	
ii)	Maximum	V	476	
b)	D.C. system			
i)	Rated	V	24/ 110	
c)	One minute withstand voltage		2000 V AC.	
d)	System short-circuit level			
i)	At 415 V, A.C.	kA (rms)	10	
ii)	At 110 V.D.C.	kA (D.C.)	6	
e)	Reference ambient temperature		450 C	
2	Distribution Board/ Panels			
2.1	Make		As per approved list	
2.2	Applicable Standards		As per Tender Specification	
2.3	Main, floor mounted distribution boards			
a)	Main LDB (A.C.)		As per requirement	
i)	Bus bars		Al/ Cu	
ii)	Bus bar current rating	A	As per requirement	
	Incoming		As per requirement	
	Outgoing		As per requirement (With Minimum 2 spare feeders)	
iii)	Cable entry		Bottom	
iv)	Earthing terminals		50x8 mm GI flat	
b)	Emergency lighting panel		As per requirement	
i)	Bus bars		Copper	
ii)	Bus bar current rating	A	As per Requirement	
	Incoming and outgoing feeders		As per requirements (With Minimum 2 spare feeders)	
iii)	Cable entry		Bottom	
iv)	Earthing terminals		50x6 mm GI flat	
2.4	Sub DBs, wall/ structure mounting panels			
a)	SLDB for indoor area		As per requirement	
i)	Bus bars		Copper	
ii)	Bus bar current rating	A	As per requirement	
	Incoming and outgoing feeders		1 No. Incoming TPN MCB * (Minimum32A)	

Sr. No.	Description	Unit	Particulars	To be filled By Bidder
			with ELCB As per requirement Outgoing 10/16A MCB SPN and DP ELCB per phase with PPI (With Minimum 2 spare feeder circuits; a single circuit consists of SPN MCBs for R,Y, B phase)	
iv)	Cable entry		Bottom/Top	
b)	SLDB for outdoor area		As per requirement	
i)	Bus bars		Copper	
ii)	Bus bar current rating	A	As per requirement	
	Incoming		1No.-Incoming * A TPN MCB (Minimum32A) with ELCB- with timer (0- 24 hours)	
	Outgoing		As per requirement Outgoing 10/16 A SPN MCB with switch contactors. (With Minimum 2 spare feeder circuits; a single circuit consists of SPN MCBs for R,Y, B phase)	
iii)	Cable entry		Bottom/Top	
2.5	Paint Finish			
a)	Color shade (Interior/ Exterior)		As per industry standard	
b)	Epoxy paint required		Yes.	
2.6	Earthing terminals suitable for conductor			
a)	Size	mm x mm	25x3 flat	
b)	Material		G.I.	
3	Receptacle Units			
3.1	Make			
3.2	Decorative (complete with flush/surface mounted boxes/cover plates etc.)			
a)	3 pin 1-ph & N with switch	A	5/15 A, Indoor Type	

Sr. No.	Description	Unit	Particulars	To be filled By Bidder
	and plug tops			
(b)	Industrial (complete with surface mounted, pre-fabricated CRCA boxes)			
i)	3 Pin, 230V AC		As per required	
	With ELCB(30mA) & plug	A	15A, Indoor Type	
ii)	5 pin, 3 Ph., 415V		As per required	
	With ELCB(30mA) & plug	A	63A, Outdoor type	
	With ELCB(30mA) & plug	A	32A, Indoor type	
4	Lighting Wires			
4.1	Make		As per approved list	
4.2	Conductor		Stranded Copper	
a)	Size (sizes mentioned are minimum & size to be decided on circuit load & voltage drop criteria) 1100V, PVC insulated FRLS	Core x mm ²	Lighting 2x1Cx1.5 mm ² Receptacle / Sockets Decorative 2x1Cx1.5mm ² Industrial 1ph - 2x1Cx4 mm ² 3ph - 4Cx 6 /16 mm ²	
5	Conduits			
5.1	Make			
5.2	Material		Galvanized steel	
5.3	Size	mm	20	
6	Street light poles and flood light poles			
6.1	Make		As per Approved list	
6.2	Street Light Pole			
a)	Typical drawing (if any)		-	
b)	Total Height:	M	8.5/10/12	
c)	Quantity:	Nos.	As per requirement	
6.3	Junction Box with Pole			
a)	Typical drawing (if any)		-	
b)	No. of cable entries:	Nos.	Two	
c)	Cable entry suitable for :		4Cx16 mm ² Al. Conductor, PVC insulated, armoured cable	
d)	Earthing terminal suitable for		8 SWG/ 25x3 mm GS Flat	
6.4	Floodlight Light Pole			
a)	Total height	Mtr.	8.5/10/12/High Mast	
b)	No. of floodlights to be fixed per pole	No.	Minimum One/as	

Sr. No.	Description	Unit	Particulars	To be filled By Bidder
			required	
c)	Painted		Yes	
d)	Earthing terminal suitable for	mm x mm	8 SWG/ 25x3 mm GS Flat	
e)	Quantity :	Nos.	As per requirement	
7	Luminaire (Lighting fixture complete with prewired control gear terminal block & suitable lamps)	LS	As per specification requirement	
8	Note			
	<p>Supply of conduits, wires/cables, all fixing hardware, terminal connectors, cable termination kits and associated accessories for -lighting, receptacles, Earthing, cabling & wiring works, required civil works etc. shall be included in Contractor's scope.</p> <p>All ELCBs for lighting circuit shall be with 100mA sensitivity.</p> <p>All ELCBs for receptacle circuit shall be with 30mA sensitivity.</p>			

1.6 RELAYS/ SWITCHGEARS/ INSTRUMENTS DETAILS:

Sr. No.	Description		To be filled by bidder		
			Make & Model No.	Yes/ No	
1	Relay		Make & Model No.	Yes/ No	
1.1	Instantaneous Over Current & Earth Fault Protections (50 & 50N) (Element Of Numerical Relay)				
1.2	IDMT Over Current & Earth Fault Protections (51 & 51N) (Element Of Numerical Relay)				
1.3	Master Trip / Lock Out Relay (86) (Separate Relay)				
1.4	Stand By Earth Fault Relay (51NS) (Separate Relay)				
1.5	Under Voltage/ Over Voltage (27/ 59)				
1.6	Trip Circuit Supervision Relay (95)				
1.7	Auxiliary Relay (Separate Relays Based On Requirements, With At Least One Spare Element)				
1.8	Automatic Voltage Regulator (Separate Device)				
1.9	Microprocessor Based Battery Charger Controller				
1.10	Motor Protection Relay (98) (Comprehensive Motor Protection Relay for Motor Ratings 132 KW & above)				
2	Switchgear	Application	Make & Model No.	Rating / Release Type	Yes / No
2.1	ACB	Above 630A	As per approved make	Minimum as per BOQ & specification requirements	
2.2	MCCB	Up to 630 A			
2.3	MCB				
2.4	Fuse				
3	Starters (Including All Components for Type-2 Co-Ordination)	Application (Provide Feeder Range For Which It Is Applicable)	Make	Type -2 Co-Ordination (With MCCB) Ensured - Yes/ No	Yes
3.1	D.O.L.	As per BOQ		Yes	
3.2	FCMA Soft starter	As per BOQ		Yes	
4	Meters	Application	Make & Model No.	Type	Size
4.1	Ammeter	Minimum As Per SLD & Specification Requirements	As Per Approved Make List		
4.2	Voltmeter				
4.3	MFM			As Per Approved	

Sr. No.	Description	To be filled by bidder		
		Make List		
4.4	TVM/ Tariff Meter	(As Per GEB Requirements)		
5	Annunciators - Required	Quantity	Make & Model No.	Indication Lamp Type
5.1	8 Window			
5.2	16 Window			
6	Whether detailed literature for all the above (item 1 to 5) items enclosed with tender (Yes/ No)			

2.0 DATA SHEET FOR INSTRUMENTATION & CONTROL EQUIPMENT:

2.1 FULL BORE ELECTROMAGNETIC FLOW TRANSMITTER:

Sr. No.	Description	Particulars	To be filled by Bidder
1	General		
1.1	Make	As per approved vendor list	
1.2	Item	Full Bore Electromagnetic Flow Meter	
1.3	Service	Common Header of Pump Discharge	
1.4	Fluid	Raw Water/ Treated Water	
1.5	Area Classification	Non Hazardous	
2	Flow Sensor		
2.1	Type	DC pulsed	
2.2	Electrode / Sensor MOC	SS 316	
2.3	Flow Tube MOC	SS304	
2.4	Coil Housing MOC	SS 304	
2.5	Grounding Ring MOC	SS 304	
2.6	Liner MOC	Neoprene/ polyurethane	
2.7	Process Connection	Flanged	
2.8	Flange MOC	CS	
2.9	Housing Protection	IP 68	
2.10	Pressure Rating	16 Kg/cm ²	
2.11	Temperature	50° C Ambient	
2.12	Size(mm)	To suit mains flow parameters, with pipe reducer/ expander provided as necessary	
3	Flow Indicator and Transmitter		
3.1	Type	Microprocessor Based, Remote Mounted	
3.2	Power Supply	230 VAC (UPS)	
3.3	Accuracy	± 0.5 % of measured value	
3.4	Repeatability	± 0.1%	
3.5	Transmitter Protection	IP67	
3.6	Transmitter MOC	Dia-cast Aluminium with PU finish/ Polycarbonate	
3.7	Output	One Current - 4 to 20 mA (isolated) proposanal to flow	

Sr. No.	Description	Particulars	To be filled by Bidder
		rate Hart (version 6 or above) One Scalable Pulse One Status Output	
3.8	Communication	Modbus RS485	
3.9	Display	2 Line Backlit LCD, Programmable	
3.10	Maximum Digit Display	8 Digit	
3.11	Indication on Display	<ul style="list-style-type: none"> • Actual Flow Rate/ Instantaneous Flow Rate • Cumulative Forward Flow • Cumulative Reverse Flow • Cumulative Flow/ Sum/ Totalizers • Alarm 	
		<ul style="list-style-type: none"> • Five (5) digit backlit/ Normal LCD, for flow rate in m3/hr. • Eight (8) digit backlit/ Normal LCD for totalized flow in ML 	
		Display with 8 digits for main information. Index, menu and status symbols for dedicated information	
		Key for toggling through the information and reset customer totalizers and call-up function	
		Selectable default information and accessible menus: <ul style="list-style-type: none"> • Operator • Meter • Service • Data Logger 	
3.12	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.	
3.13	Facility for on line diagnosis	Required as following:	
		Diagnostic: Continuous self test shall include <ul style="list-style-type: none"> • Coil current to drive the magnetic field • Signal input circuit • Data calculation, handling and storing 	
		Features <ul style="list-style-type: none"> • Alarm statistics and logging for fault analyzing • Electrode impedance to check 	

Sr. No.	Description	Particulars	To be filled by Bidder
		actual media contact • Flow simulation to check pulse and communication signal chain for correct scaling • Number of sensor measurements (excitations) • Transmitter temperature • Low impedance alarm for change in media • Flow alarm when defined high flow exceeds • Verification mode for fast measure performance check • Statistic flow and consumption data	
3.14	Cable Gland	Required	
3.15	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site	
3.16	Data Protection:	• All data shall be stored in an EEPROM. • Totalized statistic shall be backed up every 10 min • Power consumption and temperature Measurement statistic at every 4 hour • Minimum 30 days of data shall be stored in EEPROM. • Password protection of all parameters and hardware protection of calibration and revenue parameters.	
3.17	Power Supply in case of Raw power is not available (Remote Area)	Battery power	

2.2 PRESSURE GAUGE:

Sr. No.	Description	Particulars	To be filled by bidder
1	General		
1.1	Make	As per approved vendor list	
1.2	Item	Pressure Gauge	
1.3	Service	Pump/Blower Discharge, Pump/Blower Discharge Common Header	
1.4	Fluid	Raw Water, Treated Water, Air	
1.5	Area Classification	Non Hazardous	
2	Pressure Gauge		
2.1	Type	Bourdon	
2.2	Sensor and other wetted parts M.O.C	SS 316	
2.3	Process connection	½" NPT (M)	
2.4	Dial size	150 mm	
2.5	Material of dial	Aluminium with white back ground and black numerals	
2.6	Glass	Shatterproof	
2.7	Housing material	Die cast aluminium with epoxy coating	
2.8	Accuracy	±1% of full scale or better	
2.9	Over range protection	125% of maximum pressure	
2.10	Gauge Protection	IP65	
2.11	Temperature	50° C Ambient	
2.12	Range	As per pump design (Range to be finalised during detailed engineering without any cost implication)	
2.13	Accessories	<ul style="list-style-type: none"> • Snubber • 3-way isolation valve • Impulse tubing, fittings • All other installation hardware 	
2.14	Diaphragm Seal M.O.C	SS316	
2.15	3 Way Isolation Valve M.O.C	SS316	
2.16	Impulse Tube Fitting M.O.C	SS316	

2.3 PRESSURE TRANSMITTER:

Sr. No.	Description	Particulars	To be filled by Bidder
1	General		
1.1	Make	As per approved vendor list	
1.2	Item	Pressure Transmitter	
1.3	Service	Pump/ Blower Discharge Common Header	
1.4	Fluid	Raw Water/ Treated Water	
1.5	Area Classification	Non Hazardous	
2	Pressure Sensor		
2.1	Type	Diaphragm/ piezoelectric	
2.2	Sensor and other wetted parts M.O.C	SS 316	
2.3	Process connection	½” NPT (F)	
2.4	Sensor Fill Fluid	Silicon Oil	
2.5	Temperature	50° C Ambient	
2.6	Range	As per pump design (Range to be finalised during detailed engineering without any cost implication)	
3.	Pressure Transmitter		
3.1	Type	SMART Type/ Microprocessor Based, Head Mounted	
3.2	Power Supply	230 VAC Line Power/ 24 VDC	
3.3	Accuracy	± 0.1 % of measured value	
3.4	Response Time	100 ms	
3.5	Transmitter Protection	IP67	
3.6	Transmitter MOC	SS316 / Diacast Aluminium with PU finish	
3.7	Output	One Current - 4 to 20 mA (isolated) proposanal to pressure Hart (version 6 or above)	
3.8	Display	Alphanumeric LCD Type, Programmable	
3.9	Over range protection	125% of maximum pressure	
3.10	Zero and span adjustment	Required	
3.11	Cable Gland	Required	
3.12	Accessories	<ul style="list-style-type: none"> • Snubber • 3 way isolation valve • Impulse tubing, fittings • Mounting Bracket • Tag Plate 	

Sr. No.	Description	Particulars	To be filled by Bidder
		<ul style="list-style-type: none"> • All other installation hardware 	
3.13	Diaphragm Seal M.O.C	SS316	
3.14	3 Way Isolation Valve M.O.C	SS316	
3.15	Impulse Tube Fitting M.O.C	SS316	

2.4 ULTRASONIC LEVEL TRANSMITTER:

Sr. No.	Description	Particulars	To be filled by bidder
1	General		
1.1	Make	As per approved vendor list	
1.2	Item	Level Transmitter	
1.3	Service	Sump/ Tank	
1.4	Fluid	Raw Water / Treated Water, Chemical Water	
1.5	Area Classification	Non Hazardous	
2	Level Sensor		
2.1	Type	Ultrasonic	
2.2	Sensor MOC	PP/ PVDF	
2.3	Seal MOC	EPDM	
2.4	Sensor Housing MOC	Diacast Aluminium with PU finish/ Polycarbonate	
2.5	Process Connection	Flanged	
2.6	Flange MOC	PP/ CS	
2.7	Housing Protection	IP 68	
2.8	Temperature compensation	Required	
2.9	Swirling arm arrangement for mounting of sensor	Required for access during maintenance	
2.10	Size(mm)	To suit Sump/ Tank Height	
2.11	Pressure Rating (Kg/cm ²)	Atmospheric	
2.12	Temperature	50 °C Ambient	
3	Level Transmitter		
3.1	Type	Microprocessor Based, Remote Mounted	
3.2	Power Supply	230 VAC Line Power	
3.3	Accuracy	± 0.1% of measured value	
3.4	Repeatability	± 0.1%	
3.5	Transmitter Protection	IP67	
3.6	Transmitter MOC	Diacast Aluminium with PU finish/ Polycarbonate	
3.7	Output	One Current - 4 to 20 mA (isolated) proportional to Level Hart (version 6 or above)	
3.8	Display	2 Line Backlit LCD,	

Sr. No.	Description	Particulars	To be filled by bidder
		Programmable	
3.9	Maximum Digit Display	8 Digit	
3.10	Indication on Display	Actual Sump/ Tank Level Alarm	
3.11	Zero and Span adjustment	Factory set Password protection of all parameters and hardware protection of calibration and revenue parameters.	
3.12	Cable Gland	Required	
3.13	Cable Length (sensor to transmitter)	10 Meter minimum or suit to site	

2.5 FLOAT & BOARD TYPE LEVEL INDICATOR:

Sr. No.	Description	Particulars	To be filled by Bidder
1	General		
1.1	Make	As per approved vendor list	
1.2	Item	Level Indicator	
1.3	Service	Sump/ Tank	
1.4	Fluid	Raw Water/ Treated Water	
1.5	Area Classification	Non Hazardous	
2	Level Indicator		
2.1	Type	Float and Board	
2.2	Construction	Guided	
2.3	Measuring Range	To Suit Sump / Tank Height	
2.4	Travel	Full Range	
2.5	Float	SS316	
2.6	Float / Guide wire Rope	SS316	
2.7	Calibrated Gauge Board	6" wide x aluminium powder coating with black graduations and numerical	
2.8	Pointer	Red, powder coated steel with measuring rope holder	
2.9	Protection Conduit	Vertical and Horizontal limb in galvanized steel	
2.10	Elbow pulley	Cadmium plated steel or PP pulley with PTFE bush and SS shaft housed in weather proof aluminium or PP enclosure	
2.11	Tensioner	Cadmium plated steel spring housed in CS or PP enclosure	
2.12	Anchor	SS316 plate (25mm x 6mm thick plate to be welded at bottom of sump / tank at site)	
2.13	Rope Fastener	SS316	
2.14	Gauge Brackets	Powder Coated Steel	
2.15	Counter weight for rope type probe to keep it straight	Required	
2.16	Spacers between the probes to avoid entangling with each other	Required	

CONTRACT NO.

CONTRACT NO.

**Bhavnagar Municipal Corporation
BHAVNAGAR**



(A WHOLLY OWNED BHAVNAGAR MUNICIPAL CORPORATION UNDERTAKING)

ESTIMATED COST

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

ESTIMATED COST: RS. 14,70,03,332.00/-

VOLUME - IV

PRICE BID

Bhavnagar Municipal Corporation

INDEX

SR NO.	PARTICULARS
A	Preamble to Price Schedules
B	Bid form
C	Preamble
D	Schedule of Payment
E	Schedule for Testing of materials List of registers to be maintained Vendor list for tender works
F	Schedule-B

A. PREAMBLE TO PRICE SCHEDULES

Name of work:

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGARThe bidder shall quote his firm and fixed price for the entire work under this Contract, defined in more details in various sections of this bid document.

1. The rates and prices shall be submitted in the electronic formats given by n-procure which is called Schedule-B, rates and prices received in any other formats will be rejected and the bids will be disqualified.
 2. It will be entirely at the discretion of the employer to accept or reject the bidder's proposal, without giving any reasons whatsoever and the bidder shall not be permitted to withdraw his bid on this account.
 3. The bidder should quote online the percentage above/below/at par with respect to amount put to tender with O&M at the end of schedule B.
 4. The % above/ below/at par with respect to amount put to tender shall be submitted in the electronic formats given by n-procure. The percentage (%) above/ below/ at par received in any other formats will be rejected and the Bids will be disqualified.
 5. In Price Schedule-B, bidder shall quote his price for entire work. Prices quoted in Schedule-B only will be considered for comparison and evaluation.
 6. Wherever for a particular item the quantities have been specified payment shall be on unit rate basis and unit variation in quantity will be paid with pro rata basis.
 7. The wording in the item description is for subject matter guidance only; clause references are indicative only and all other relevant clauses shall also be referred to.
 8. The prices shall allow for all the works covered under the bid digitized asset mapping and all liabilities and contractual obligations whether separately specified or not. Items against which no prices are quoted shall not be separately paid for and the bidder shall be deemed to have covered the cost of execution of such items (according to the requirements of the bid document) in the prices quoted for other items.
 9. Items not specifically listed in his Price Schedules, but required to be executed for satisfactory working/safety of the system as specified, will not be separately paid for by the Employer when executed and shall be deemed to be already covered by other items and rates listed in the price sheets No extra payment
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shall be given for any item which is required to complete and perform the project.

10. Schedule-D gives the basis of interim payment for construction of civil works, mechanical, instrumentation & electrical works.
 11. The bidder shall be deemed to have allowed in his price for provision, maintenance and final removal of all temporary works of whatsoever nature required for construction including temporary bunds, diverting water, pumping, de-watering etc. for the proper execution of works. The rates shall also be deemed to include any works and setting out that may be required to be carried out for laying out of all the works involved.
 12. Prices shall be filled online only.
 13. The Price Schedules are to be read in conjunction with the conditions of Contract, the Specifications and other sections of these bid documents and these documents are to be taken as mutually explanatory of one another. Prices quoted by bidder shall be firm for the entire period of contract including o & m period without any escalation in accordance with the condition of contract.
 14. The bidder shall interpret the data furnished and carry out any additional survey work, or investigation work required at his own cost.
 15. The prices quoted shall also include the cost of materials utilized for testing.
 16. The bidder should acquaint himself with the site conditions including the access to Work site. The successful bidder shall have to make suitable access to work sites at his own cost. These accesses will be used by the other contractors working for Nagarpalika.
 17. The item descriptions in price schedule are for subject matter guidance only and the prices shall include all the equipments / materials / accessories and services required as per the specifications. The bidder shall fill in the price schedule furnished.
 18. Deleted
 19. 1% of the value of work will be deducted from the Running bill against labour cess, which shall be non-refundable.
 20. Third Party Inspection / CSC agency will be deployed by BMC and charges of the same will be borne by Nagarpalika. If contractor gives misleading information about their readiness for inspection, cost of such futile inspection/ visit of third party agency due to misinformation shall be recovered from contractor.
 21. Any expenditure incurred by inspection/ CSC agency for the work misinformed by the contractor and charges of inspection/ CSC agency without any work due to misinformation shall be recovered from the contractor.
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22. The rates quoted shall be exclusive of GST, but inclusive of all other taxes and cess or levies or duties which shall not be paid extra. While GST will be paid for admissible part of actual work done at the approved tender rates and tender conditions of price variation. GST shall be paid as per prevailing rates at the time of payment. The TDS shall be deducted at source as per provision of IT rules and GWSSB policy.
 23. The rates should be quoted exclusive of GST but inclusive of all other taxes as per Volume-II, General Conditions of Contract, Clause No. 47.
 24. The process requires that the bidder shall quote his price for the work components contained the price schedules for the entire work. Such prices shall remain firm and fix during the entire period of performance of the contract
 25. Payment shall be made for the components for which lump sum prices are quoted, as per the schedule of payment. Total cost will be worked out on the basis of work done of individual items and rates quoted against those particular items only.
 26. Royalties: The contractor shall be liable to pay the royalty of the quarried materials/minerals used in the construction of works at the rates specified in the Narmada Water Resources, Water Supply & Kalpsar Dept. Resolution No. GEN-2010-595- (6)-M.I. Cell (K- 1) Dt. 29-4- 2011 (Gujarati Version Copy enclosed) and shall be recovered from the running bills of the work from time to time and remaining amount if any shall be recovered from the final bill before releasing the security deposit of the work. The contractor shall furnish the statement showing the quantity of quarried materials / minerals from whom purchased (with full address of the seller) and copies of the bills for purchase to the Executive Engineer of the in charge of the work. The contractor shall also furnish such additional information as regards royalty payment to the competent authority.
 27. Agency shall have to take Insurance policy and intimate to BMC along with the evidence within time limit. In case of noncompliance entire responsibility shall be rest with the agency and required amount shall be recovered from any due amount of the agency.
 28. BMC can recover penalty amount from the agency for not taking the insurance. Though the penalty amount is recovered, responsibility of the agency for taking insurance shall be continued and will not be escaped from the responsibility
 29. The PMC/PIU certified report of successful flow test including leakages/hydro test for the components covered under the respective running bill / final bill must be attached for payment.
 30. All water, electricity, fuel (For running of DG, Diesel pumps etc. for construction purpose) charges during construction and Test & Trial Run shall be borne by the Contractor.
 31. Liquidated damages under Clause No.02 of Volume- II shall be read together in conjunction to Mode of Payment
 32. The bidder should acquaint himself with all the site conditions including but not limited to the access to work site, HFL, High/Low Tide level as etc. The
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successful bidder shall have to make suitable access to work sites at his own cost. These accesses may be permitted for the use of the other contractors working for BMC as per instruction of Engg. in charge

33. The prices quoted shall also include the cost of Temporary/Permanent plugging and blocking of sewer line, branch connections and diversion of flows and removal of all plugs, etc.
34. For any Underground and Over Head Utility, the contractor has to confirm it during site visit (as scheduled), the shifting or getting it shifted from the concern dept. (i.e. Liaisoning, follow -up and approval) required will be in contractor's scope. No extra cost will be given to contractor for any type of utilities shifting. All statutory fees/charges shall be paid by BMC on submission of proper fees receipt/challans and other relevant documents.
35. The price bid submitted by the bidder rates shall be inclusive for,
- a) Removing of Existing Pipeline incl. Removal of specials, valves jointing material including carting and stacking of removed material from site of work to the department store as directed excl. Excavation and refilling Pipes/ Pre Stressed Concrete Pipe.
 - b) Labour charges for repairing leakage in CI/DI pipeline of following diameter at different places including necessary excavation manually or by machinery, removing of mud, dewatering, cleaning of pipe, cutting of pipe, Jointing & repairing using CID joints including CID joints, rubber rings, nut bolts, hiring excavator, Hydra/ Crane, dewatering machine, fuel, operator etc complete (including cost of jointing material and cost of pipe) CI/DI Pipelines.
 - c) Labour charges for repairing of leakage in PVC pipeline of following dia meter at different places including necessary excavation manually or by mechanise excavation, dewatering removing of mud, cleaning of pipe and leakage portion, cutting the pipeline & removing piece of pipe from trench with inclusive of mechanical devices JCB, Hydra/Crain if necessary & labours required with providing material such couplers, solution etc. comp. (incl. all material but Excluding cost of pipe)
 - d) Labour charges for repairing of leakage in HDPE pipeline of following diameter at different places including necessary excavation manually or by machinery, dewatering, removing of mud, cleaning of pipe and leakage portion, cutting the pipeline, Jointing & repairing using CID joint inclusive of using all required machinery, labour, D G Set, fuel, operator, CID joints, rubber rings, nut bolts etc complete (but excluding cost of Pipe)
 - e) Tracing of existing manholes using all required tools, labours complete
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BID FORM (WITH PRICE)

Bidders are required to fill up all the blank spaces in this Bid Form.

To,
Executive Engineer
(Drainage Dept.),
BMC,
Bhavnagar

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

1. Having visited the site and examined the Bid Documents, Drawings, Conditions of Contract, Specifications, Schedules, Annexure, Preamble to Price Schedules, Price Schedules etc. including Addenda / Amendments to the above, for the execution of the above Contract, we the undersigned offer to Design, Engineer, Procure, Construct, Complete, Commission, and Run the whole of the said works from the date of commissioning including defects liability period as given in Conditions of Contract and in conformity with the drawings, conditions of Contract, specifications, Preamble to Price Schedules, Price Schedules, Annexure, Bidding Documents, including Addenda Nos. _____ (insert numbers) for Lump sum fixed price of Rs. _____.(Rupees _____) for Construction or such other sum as may be ascertained in accordance with the conditions.
 2. I / We agree that;
 - (a) If we fail to provide required facilities to the Employer's representative or any other person / Agency by the Employer to perform on his behalf for carrying out the inspection and testing of materials and workmanship.

Or
 - (b) If we incorporate into the Works, materials before they are tested and approved by the Engineer's representative

Or
 - (c) If we fail to deliver pure water of required quantity according to the conditions / stipulations of the Contract, the Engineer will be at liberty to take any action including termination of Contract and impose at his absolute discretion any penalties, and / or reject the work.
 3. We undertake, if our Bid is accepted, to complete and deliver the works in accordance with the Contract within **Duration of Project (Which is Mention in Tender Notice.)** inclusive of monsoons, from the date or receipt of Letter of Acceptance issued to us by you.
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4. We agree to abide by this Bid for a period of **180 days** from the last date of submission of bid and it shall remain binding upon us and may be accepted at any time before the expiry of that period.
 5. In the event of our Bid being accepted, we agree to enter into a formal Contract Agreement with you incorporating the conditions of Contract thereto annexed but until such agreement is prepared this Bid together with your written acceptance thereof shall constitute a binding Contract between us.
 6. We agree, if our Bid is accepted, to furnish performance Security in the forms and of value specified in the General Conditions of Contract.
 7. We have independently considered the amounts of liquidated damages shown in Appendix to Bid and agree that they represent a fair estimate of the damages likely to be suffered by you in the event of the work not being completed by us in time.
 8. We understand that you are not bound to accept the lowest or any bid you may receive.

Dated this _____ day of _____ 20__

(Signature)

(Name of the person)

(In the capacity of)

Company Seal

(Name of firm)

Duly authorized to sign Bid for and on behalf of

Witness :

Signature _____

Name _____

3.0 Summary of Price

Schedule - B: Summary of Price-Total Price for Evaluation of Bid

I/We am/are willing to carry out the work @ _____% _____ percent (should be written in figures and words) below/above /at par , the estimated rates mentioned above, amount of my/our tender works out as under:

*Estimated Amount Put _____ to _____ tender Rs..... Deduct..... Rs.....Below w Net Rs..... In _____ Words Rupees.....	*Estimated Amount Put _____ to _____ tender Rs..... Add..... Rs.....Above e Net Rs..... In _____ Words Rupees.....
--	--

(* Please strike out whichever is not applicable)

Above all items of "Schedule-B" with Item Description, Unit, Qty, Rate and Amount have verified by me and found in order.

Bidder's Stamp and Initials

C. PREAMBLE

1. As mentioned in the Conditions of contract, the Contract being a lump sum type turnkey Contract on EPC basis, the provision of measurement will be applicable only for the assessment of value of work done for inclusion in any interim certificate for part payment to the Contractor.
 2. The Schedule specifies the procedure for all such assessment of the items specified in Schedule B.
 3. Each item of Schedule-B has been divided into broad components. The Employer's Representative shall assess the value of each component as indicated in paragraph 6 herein below.
 4. Percentages are indicated against each component of each item specified in Schedule B, based on the Employer's best appreciation of the value of the component as related to the total costs of the concerned item as whole. A head titled (any other item(s)) is included in each breakdown of schedule and the tenderer shall at the time of tendering indicate any additional items which he considers necessary but cannot be covered by any of the heads indicated in the breakup.
 5. The percentage breakup as indicated in the Schedule may differ from that corresponding to the tenderer's scheme and design and he should take this into account while quoting his lump sum prices for the items specified in Schedule-B.
 6. The contractor shall, after approval of his detailed designs and drawings furnish to the Employer's Representative an initial bill of quantities to all major items, to be reviewed and updated periodically with the Employer's Representative. This bill of quantities will be used for assessment of percentage progress of the component at any stage. By measurement jointly taken by the Employer's Representative and the Contractor, mutually agreed and entered in the measurement books in the form and by the method approved by the Employer's Representative, and signed jointly by both the parties.
 7. Priority of work shall be decided in consultation with officials of ULB, BMC and PMC before starting /planning of work and the same shall be followed.
 8. The contractor after approval of his detailed designs and drawings shall furnish to the Employer's Representative an initial bill of quantities of all items as mentioned in Schedule B (to be reviewed and updated periodically). This bill of quantities will be used for assessment of percentage progress of any component at any stage.
 9. Measurements jointly taken (for Turnkey works) by the Employer's Representative and the Contractor will be entered in the measurement books and signed jointly by both the parties which shall form the basis for such interim payments.
 10. As mentioned in the preamble to price schedule, the provision of measurement will
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be applicable only for the assessment of value of work done and certified by Engineer-in-Charge for Schedule B and Schedule Part C

11. Payment for items as mentioned in Schedule B and Schedule C will be released as per provision for interim payment as given in schedule mentioned below.
 12. Percentages are indicated against each component of some of the items of Schedule B specified in Schedule D, based on the Employer's best appreciation of the value of the component as related to the total costs of the concerned item as a whole. However payment for those items which are not covered under Schedule D will be made as per quantity verified by Engineer-in-Charge for such items as mentioned in Schedule B. The extent of amount to be released against each such item will be as per decision of Engineer-in-charge.
 13. Payment shall be released within 30 days after the fulfillment of condition mentioned in Para 2 above. The decision of the Engineer In-charge in this regard shall be final and binding upon bidder.
 14. The percentage breakup as indicated in the Schedule D, may differ from that corresponding to the Bidder's scheme and bidder's design and he should take this into account while quoting his prices for the items specified
 15. During O & M, the Contractor shall be paid as per the Schedule D ,(Break up for schedule of payment) of Price Bid. The amount withheld against the O & M from the running bill of the contract shall be released as per direction of engineer in charge.
 16. The rates quoted for O&M works shall be in line to Volume-II(A), General Conditions of Contract, Clause No. 1 "Security Deposit"
 17. Release of Security deposit shall be as per Volume II (A) Clause 1 of General Conditions of Contract and Volume II (B) .
 18. The total inflow mentioned in the tender documents is indicative and only for calculation purpose. Any change in the flow as per actual design shall not lead to extra financial implication to BMC.
 19. It is clarified by way of abundant caution that contractor shall not claim any additional remuneration in the head of O & M.
 20. The price Bid submitted by the bidder is to include for,
 - a) Tracing of existing manholes using all required tools, labours complete.
 - b) Removing of Existing Pipeline incl. Removal of specials, valves jointing material including carting and stacking of removed material from site of work to the department store as directed excl. Excavation and refilling RCC Pipes/ Pre-Stressed Concrete Pipe.
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SCHEDULE - D
BREAK UP FOR INTERIM PAYMENTS
(CIVIL, MECHANICAL, INSTRUMENTATION & ELECTRICALWORKS)

Note: Payment will be released after certification of quantities recorded in the measurement book by EIC.

Item	Description of Items	Percentage Payment to be released
1	PIPELINE WORKS :- RISING MAIN, GRAVITY MAIN, DISTRIBUTION	
a	On receipt of materials at project site (limited to 10 km of unlaied length)	65 % of Quoted rate
b	On Excavation, Lowering, laying and Jointing	20 % of Quoted rate
c	On Hydraulic testing	5 % of Quoted rate
d	On refilling and disposal of surplus stuff	5 % of Quoted rate
e	After commissioning	5 % of Quoted rate
2	VALVES	
a	On receipt of materials on site	65 % of Quoted rate
b	On erection	25 % of Quoted rate
c	On Hydraulic testing	5 % of Quoted rate
d	After commissioning	5 % of Quoted rate
3	PUMPING STATION / STAFF QUARTERS / MATERIAL SAFETY ROOM / INSPECTION BUNGLOW	
a	On approval of Designs	2.0 % of Quoted rate
b	On completion of Excavation & base slab	18.0 % of Quoted rate
c	On completion of vertical wall up to plinth (incl. screen chamber)	20.0 % of Quoted rate
d	Full supporting structure incl. ring beam and top slab	15.0 % of Quoted rate
e	On completion of pump house incl. fixing doors Windows	10.0 % of Quoted rate
f	Plastering inside & outside with epoxy paint etc (completed with all respects)	10.0 % of Quoted rate

Item	Description of Items	Percentage Payment to be released
g	Painting of letters, MS ladder pipe, railing, lighting arrestor and all miscellaneous items such as snowcem paints in three coats etc. (completed with	15 % of Quoted rate
h	After Completion	10 % of Quoted rate
4	R.C.C. E.S.R.	
a	On approval of designs.	2 % of Quoted rate
b	On completion of excavation and concreting of raft.	15 % of Quoted rate
c	On completion of full shaft and braces including staircase up to bottom slab/dom level	25 % of Quoted rate
d	Completion of bottom slab or dome, vertical wall or slant wall of container without top slab or dome	20 % of Quoted rate
e	Top slab or dome staircase with RCC cabin and door	10 % of Quoted rate
f	Procurement of Inlet, Outlet, Washout, Overflow pipe valves specials chambers, lighting arrestor conductor and specials @ site.	08 % of Quoted rate
g	Fixing above pipes, specials as directed.	03 % of Quoted rate
h	Water level Indicator, painting of letters, MS ladder pipe, railing and all miscellaneous items such as snowcem paints in three coats etc including water tightness test.	07 % of Quoted rate
i	After Hydraulics Testing	10 % of Quoted rate
5	Pump House	
a	On approval of Designs	2 % of Quoted rate
b	On completion of Excavation & base slab	18 % of Quoted rate

Item	Description of Items	Percentage Payment to be released
c	On completion of vertical wall up to plinth (incl. screen chamber)	20 % of Quoted rate
d	Full supporting structure incl. ring beam and top slab	15 % of Quoted rate
e	On completion of pump house incl. fixing doors windows	10 % of Quoted rate
f	Plastering inside & outside with epoxy paint etc (completed with all respects)	10 % of Quoted rate
g	Painting of letters, MS ladder pipe, railing, lighting arrester and all miscellaneous items such as	15 % of Quoted rate
	After completion	10 % of Quoted rate
6	GROUND (UNDERGROUND) LEVEL SERVICE RESERVOIRS/ SUMPS	
a	On approval of designs	2 % of Quoted rate
b	On completion of excavation and base slab	18 % of Quoted rate
c	On completion of vertical wall and braces	20 % of Quoted rate
d	Full supporting structure including column, ring beam and completion of top slab / dome	15 % of Quoted rate
e	Plastering inside & outside with epoxy etc. complete	10 % of Quoted rate
f	Procurement and fixing of inlet, outlet, washout, overflow pipes, valves, specials, chambers, lighting arrester conductor and specials at site	15 % of Quoted rate
g	Water level indicator, painting of letters, M.S ladder, pipes, railing and all miscellaneous items such as snowcem paint in three coats etc (Completed with all respect) including water tightness test	10 % of Quoted rate
h	On hydraulic testing	10 % of Quoted rate
7	ALL ELECTRO-MECHANICAL WORKS AND INSTRUMENTATION	
a	On supply of material at work site in good condition	65% of Quoted rate
b	On erection of Equipment	25% of Quoted rate
c	On completion of Testing & Commissioning of Equipment	5% of Quoted rate
d	Satisfactory running of system.	5% of Quoted rate
8	Compound wall	
A	On completion up to GL including excavation	25% of quoted rate

Item	Description of Items	Percentage Payment to be released
B	On completion of wall up to 1 m	25% of quoted rate
C	On completion of wall up to the desired level as per approved drawings	25% of quoted rate
D	On completion of the wall including plastering, paintings etc.	25% of quoted rate
10	Miscellaneous work	
A	All other items such as encasing, columns support for culvert, pipe bridges for Canal /Drain/crossing, internal roads, railway/highway crossing, Anchor/thrust blocks, steel bridge for pipe crossing, etc.	80% of quoted rate on completion of works
B	On commissioning of the system	20% of quoted rate
	Total	100%

MILESTONE PAYMENT BREAK-UP FOR SEWER NETWORK (Part C)

Sr. No	Items	Release of Payments
1	Operation and Maintenance.	
	Every month in equal installment based on quoted prices of O & M	

Note: Payment will be released after certification of quantities recorded in the measurement book by EIC.

E. SCHEDULE FOR TESTING OF MATERIALS

For ensuring quality control and workmanship, various tests prescribed below for materials shall Be taken at periodical intervals as stipulated below.

Sr N	Brief Description of Materials to be tested	Qty. Materi Als	Prescription of test which shall be carried	Frequency @ which test shall be carried out	Total No. Test to betaken.
1	25 to 90 H. B.Metal 40 to 63 H. B.Metal 40 to 50 M. C.Metal 20 to 50 M. C.Metal Kapachi		- Gradation Test - Impact Value - Flakiness Index - Water absorption test - Sp. gravity	1 to 100 Cmt. - 1 Test 100 to 500 Cmt. - 3 Test 500 to 1500 Cmt. - 5 Test 1500 to 5000 Cmt. - 7 Test	
2	Grit		- Stripping Value, gradation, Water	One test per work	
3	Murrum		- P. I. Value - C.B.R.	One test per work	
4	Quarry spall		- C.B.R. - Gradation	One test per work	
5	Asphalt		- Penetration Test as per Specification	Tanker Test 1 1 2to15 2 16to50 3	
6	Tack Coat		- Binder temperature for application	Irregular close in intervals Two test per day.	
7	Carpet & Seal coat mix		- Grading - temperature of binder in boiler, aggregates in the dryer and mix at the time of laying and rolling (Binder content vide 45 IMD 2172) Rate of	One test on individual constituents and mixed aggregates from the dryer for each 100 tons of mix subject to minimum of Two tests per plant per day. One Test for each 100tons of mix	
8	Bricks		- Water absorption - Effloresce - Size - Compressive Strength	1 Test @ 50,000 Bricks	
9	Cement		Consistency - Compressive Strength - Initial & Final setting - Fineness - Soundness - Specific Gravity - Chemical analysis	1 Test / 50 M.T. 2 Tests / 100 M.T. 3 Tests / 200 M.T. 4 Tests / 400 M.T. 5 Tests / 500 M.T. 6 Tests / 600 M.T.	
10	Steel (TMT / M.S.)		- Tensile strength - Yield Stress - Elongation - Size - Bend - Rebend	1 Test / 40 M.T. 1 Test/ 40 M.T. 1 Test / 40 M.T. 1 Test / 40 M.T. 1 Test / 20 M.T. 1 Test / 20 M.T.	
11	C.C. Cube in M-150 M-200, M-250,		- Compressive Strength	1 to 5 C.mt. -1 Set 6 to 15 C.mt. 2 Sets 16 to 20 C.mt. - 3 Sets 20 to 50 C.mt. - 4 Sets	

	M-300, M-350 Grade			51 above - 4 One additional sample for each 100 C.mt. / or.	
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12	Coarse Sand		C.B.R., silt content, sieve analysis	One Test per work	
13	Sand (For concrete work)		<ul style="list-style-type: none"> - Specific Gravity - Alkali Reactivity - Petrography Exa. - Gradation - Silt Content - Water absorption test 	2 Tests per season or change of river	
14	Crushed stone Aggregate (For concrete work)		<ul style="list-style-type: none"> - Gradation - Water absorption - Impact Value - Abrasion Value - Soundness Test 	1 Sample / 150 Cum. or 2 Sample / Season each source.	
15	Water for all item pertaining to water		<ul style="list-style-type: none"> - Portability - Salinity - Chemical analysis 	One sample for each source of supply	
16	Earthwork for Embankment		<ul style="list-style-type: none"> - Sand content - Atterberg's limit - Density test - Moisture content - C.B.R. 	2 Test / 8000 Cum 2 Test / 8000 Cum 2 Test / 8000 Cum 1 Test / 250 Cum. 1 Test / work	
17	Cement concrete		<ul style="list-style-type: none"> - Mix design 	One time test for each concrete grade beyond M-200	
18	Geotechnical Investigation		<ul style="list-style-type: none"> - Soil Bearing Capacity 	One test for Structure Design Up to 10mtr. Depth	

LIST OF REGISTERS TO BE MAINTAINED AT SITE

FOLLOWING DOCUMENTS/REGISTERS TO BE MAINTAINED AT SITE FOR ENSURING PROPER QUALITY CONTROL OF WORK IN PROGRESS.

1. A complete set of Contract Documents
2. A Complete set of drawings (tender drawings and Good for Execution Drawings)
3. A complete set of change in specification or scope if any and approval thereof.
4. Master Test Register for Material for field Test.
 - i) Lab Report
 - ii) Lab/Field Test.
5. Register for bricks testing. Lab/Field
6. Concrete Pouring Card
7. Bitumen Test Register
8. Paint Register
9. Empty Bags of Cement Shall Be Deposited on Monthly Basis at Store of Nagarpalika And Same Shall Be Recorded in Store Register for Cement.
10. Register for approval of samples for various materials.
11. Site Order Book.
12. Register showing defects noticed during execution of work and compliance reports.
13. Hindrance Register

Vendor List for Tender work

SCHEDULE OF APPROVED MAKES/MANUFACTURER'S OF MATERIALS:

The following guidelines are to be noted regarding use of materials in the work:

1. As far as possible, materials bearing "Standard Mark (ISI)" from Bureau of Indian Standard (BIS) shall be used in the work.
2. Wherever, materials bearing Standard Mark (ISI) are used in the work, the following shall be ensured:
 - i) The supplier has a valid license form BIS during the period the material is being used in the work.
 - ii) The Contractor should maintain furnish necessary documents and proof of payments made for the procurement of materials bearing Standard Mark (ISI).
3. Mandatory Tests shall be conducted at the specified frequency specified in the Contract. In case, frequency of testing is not stipulated in the contract then standard specification (CPWD, ISI etc.) may be considered for frequency at which materials are to be tested.
4. Before bulk purchase of quantities of materials, it is the responsibility of the Contractor to get the samples of materials approved from consultant and EIC. EIC reserves the right to engage Third Party Consultant for verify the material and QAP standards.
5. All cost towards the testing shall be borne by the contractor.
6. The latest approved Vendor list for the Civil/Mechanical/Electrical/Instrumentation and other equipment mentioned in GWSSB is applicable for this contract. Approval of any other make of the same material or additional items shall be put up for approval by tendering authority. Reference: official website at <http://www.gwssb.gujarat.gov.in>.

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

SCHEDULE -B ABSTRACT (GRAND SUMMARY)

Schedule No.	Description	Amount Put to Tender
SCHEDULE - B1	RCC NP3 Gravity Main from from Chitra Market Yard Pumping Station to New Pumping Station at Plot No. 49SFC at TP-20	3,04,89,950.00
SCHEDULE - B2	Asphalt Road Resurfacing Work from Chitra Pumping Station to Railway	17,01,162.65
SCHEDULE - B3	Construction Of New Pumping Station at Plot No. 49SFC at TP-20	44,36,927.26
SCHEDULE - B4	Construction Of Screen Chamber at Plot No. 49SFC at TP-20	5,18,600.00
SCHEDULE - B5	Pumping Machinery at Pumping Station at Plot No. 49SFC at TP-20 for pumping sewage to 30 MLD Sewage Treatment Plant at Kumbharwada	8867280.6
SCHEDULE - B6	DI Rising Main from from TP-20 Pumping Station to 30 MLD Sewage Treatment Plant at Kumbharwada	69795252.47
SCHEDULE - B7	Construction Work of WMM Road Parallel to Rising Main	16,71,500.00
SCHEDULE - B8	Operation & Maintenance for 5 year	29522659.12
	TOTAL TENDER COST IN (Rs.)	14,70,03,332.10
	Say (Rs)	14,70,03,332.00
		Estimated Amount
	Sub total amount put to the tender	Rs.....
	Deduct..... % below	Rs.....
	Net	Rs.....
Total-A	In words	RS.....
Note-1	All work shall be carried out as per public works department hand book and other specifications as per tender or as directed by Engineer in charge.	
Note-3	Rates quoted include clearance of site (Prior commencement of work and at its close) in all respects and hold good for work under all conditions, site, moisture, weather etc.	

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

Schedule - B1 (RCC NP3 Gravity Main from from Chitra Market Yard Pumping Station to New Pumping Station at Plot No. 49SFC at TP-20)

Sr No.	DESCRIPTION	QTY	UNIT	Rate In Figure	AMOUNT Rs.
1	Vertical cast Providing and supplying ISI Standard and marked R.C.C. pipes(of Sulphate Resisting Cement) in standard lengths of following class and diameter spigot socket or Tongue and grove joint or Rebated Rubber Ring jointed flushing from inside suitable for rubber ring joints including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. (IS - 458/ 1989) Note : One rubber ring should be supplied with each full length socketed pipe, cost included in rates below. 1400 mm dia pipe	1821.00	RMT	7982.00	1,45,35,222.00
2	RCC precast M.H. Frame & Cover Manufacture, supply & Delivery at store or at site of work precast RCC M.200 Frame & cover suitable to drainage M.H. and as per type design & Drawing including cost of reinforcement M.S. Angles or Flate, curring mold work etc. Heavy Duty > Frame	21.00	No.	813.00	17,073.00
2.1	> Cover	21.00	No.	920.00	19,320.00
3	Total Quantity of Scraper Manhole Frame And Cover	20.00	No	14135.00	2,82,700.00
4	Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. (0.0 m to 1.5 m depth) In all sorts of soil & soft murrum	3779.00	Cum	102.35	3,86,781.00
4.1	In hard murrum,boulders	3779.00	Cum	155.25	5,86,690.00
4.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	420.00	Cum	187.45	78,729.00
4.3	In hard rock with blasting and chiseling or by chieilling only for finishing.	420.00	Cum	427.80	1,79,676.00

Sr No.	DESCRIPTION	QTY	UNIT	Rate In Figure	AMOUNT Rs.
5	Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. (1.5 m to 3.0 m depth) In all sorts of soil & soft murrum	965.00	Cum	112.70	1,08,756.00
5.1	In hard murrum,boulders	2573.00	Cum	170.20	4,37,925.00
5.2	In soft rock and/or masonry in CM or L M or Lime Concrete.(1608.00	Cum	205.85	3,31,007.00
5.3	In hard rock with blasting and chiseling or by chieilling only for finishing.	1287.00	Cum	446.20	5,74,260.00
6	Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. (3.0 m to 4.5 m depth) In all sorts of soil & soft murrum	215.00	Cum	118.45	25,467.00
6.1	In hard murrum,boulders	536.00	Cum	177.10	94,926.00
6.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	857.00	Cum	215.05	1,84,298.00
6.3	In hard rock and / or in C. C. 1:2:4 only.	536.00	Cum	456.55	2,44,711.00
7	Excavation for pipeline trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. (4.5 m to 6.0 m depth) In all sorts of soil & soft murrum	1.00	Cum	125.35	126.00
7.1	In hard murrum,boulders	1.00	Cum	185.15	186.00
7.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	4.00	Cum	224.25	897.00
7.3	In hard rock and / or in C. C. 1:2:4 only.	4.00	Cum	465.75	1,863.00
8	In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth. (Depth up 1.5 to 3.0m) In all sorts of soil & soft murrum	964.65	Cum	31.05	29,953.00
8.1	In hard murrum,boulders	2572.40	Cum	31.05	79,874.00
8.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	1607.75	Cum	31.05	49,921.00
8.3	In hard rock with blasting and chiseling or by chieilling only for finishing.	1286.20	Cum	31.05	39,937.00

Sr No.	DESCRIPTION	QTY	UNIT	Rate In Figure	AMOUNT Rs.
9	In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth. (Depth up 3.0 to 4.5m) In all sorts of soil & soft murrum	214.20	Cum	42.55	9,115.00
9.1	In hard murrum,boulders	535.50	Cum	42.55	22,786.00
9.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	856.80	Cum	42.55	36,457.00
9.3	In hard rock with blasting and chiseling or by chieilling only for finishing.	535.50	Cum	42.55	22,786.00
10	In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth. (Depth up 4.5 to 6.0m) In all sorts of soil & soft murrum	1.00	Cum	54.05	55.00
10.1	In hard murrum,boulders	1.00	Cum	54.05	55.00
10.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	4.00	Cum	54.05	217.00
10.3	In hard rock with blasting and chiseling or by chieilling only for finishing.	4.00	Cum	54.05	217.00
11	Add for restoration of infrastructures like Soak well, Electrical line, Water Supply line, Telephone cables all type, Gas line, Septic Tank etc. 0.00 m to 1.5 m depth	83.98	Cum	2121.64	1,78,176.00
11.1	Add for restoration of infrastructures like Soak well. 1.50 m to 3.0 m depth	64.33	Cum	2239.96	1,44,097.00
12	In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth. (Total for Dewatering) 1.50 m to 3.0 m depth In all sorts of soil & soft murrum	964.65	Cum	31.05	29,953.00
12.1	In hard murrum,boulders	2572.40	Cum	31.05	79,874.00
12.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	1607.75	Cum	31.05	49,921.00
12.3	In hard rock with blasting and chiseling or by chieilling only for finishing.	1286.20	Cum	31.05	39,937.00
13	In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth. (Total for Dewatering) 3.0 m to 4.5 m depth In all sorts of soil & soft murrum	214.20	Cum	42.55	9,115.00
13.1	In hard murrum,boulders	535.50	Cum	42.55	22,786.00
13.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	856.80	Cum	42.55	36,457.00
13.3	In hard rock and / or in C. C. 1:2:4 only.	535.50	Cum	42.55	22,786.00

Sr No.	DESCRIPTION	QTY	UNIT	Rate In Figure	AMOUNT Rs.
14	In all sorts of soil and soft murrum, hard Murrum and boulders, Soft Rock, Hard Rock, upto 1.5 mt. depth from G. L. Extra for dewatering in all sorts of strata's, for each 1.5 mt. or part thereof beyond 1.5 mt. depth. (Total for Dewatering) 4.5 m to 6.0 m depth In all sorts of soil & soft murrum	1.00	Cum	54.05	54.05
14.1	In hard murrum,boulders	1.00	Cum	54.05	54.05
14.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	4.00	Cum	54.05	216.20
14.3	In hard rock and / or in C. C. 1:2:4 only.	4.00	Cum	54.05	216.20
15	Shoring or timbering for trench with 50 mm thick planks and suitable size truts etc. complete.	13122.00	Sq.M.	81.65	10,71,412.00
16	Lowering, Laying & Jointing R.C.C. pipes(Horizontal-Vertical) in C. M. 1:1 1/2 of following diameters in proper position, grade and alignment as directed by Engineer-in-charge including conveyance from stores to site of work, labour, giving hydraulic testing as per ISI code. Class NP3 Test Pressure, 0.7 Kg / Sq.m. 1,400 mm dia pipe.	1821.00	RMT	591.10	10,76,394.00
17	Refilling the pipeline trenches incl. ramming, watering, consolidating desposal of surplus stuff as directed within a radius of 3 km	10255.00	Cu.M.	25.30	2,59,451.50
18	Extra lead for transportation of Surplus stuff spreading or stacking as directed (removal of excavated stuff fromsite of U/G sump sewagepumping station,filter Plant etc.)	6724.00	Cu.M.	81.65	5,49,015.00
19	Providing bedding incl. ramming, watering, levelling, consolidating etc. Complete As above with required quality Sand brought from outside including all lead as per standard and instruction of engineer incharge	2391.00	Cum	378.35	9,04,635.00
20	Supplying of graded stone aggregate of following sizes (for W.B.M. Road)(1) Hand broken stone aggregate 25mm to 90mm size.Spreading the stone aggregate for rolling and W.B.M. including filling the interstices to required camber and gradient (excluding spreading of Blindage)(iii) 25mm to 50mm size crushed stone. Stone Aggregate for bedding	619.14	Cum	493.81	3,05,738.00
21	Providing C.C.M.:100 for encasing pipes using trap metal size 12 mm to 50 mm incl. form work curing consolidation etc. complete for various location on pipe line. using trap metal 20 mm nominal size. Using trap metal 20 mm nominal size	135.00	Cum	4730.87	6,38,668.00
22	Supplying cutting, bending, binding and placing in position steel as per plan and design and as per ISS 2502 including cost of steel and binding wire for reservoirs/structures only including lift up to 6 meter height or depth below G.L. for all diameters Do – deformed (TMT) bars confirming to relevant IS Fe – 500 grade for all diameters	4.05	MT	89129.60	3,60,975.00
23	Demolition including stacking of serviceable materilas and disposal of unserviceable materials with all lead and lift. (i) R.C.C. work	160.00	Cu.M.	1030.90	1,64,943.50

Sr No.	DESCRIPTION	QTY	UNIT	Rate In Figure	AMOUNT Rs.
24	Dismantling Item: Scarifying gravelled macadam or bitumen macadam surface 6 cm to 10 cm.depth including stacking useful materials on road side and disposing off remaining stuff.	2800.00	Sq.m	39.62	1,10,943.00
25	Supply, testing & commissioning portable diesel driven self priming horizontal mono dewatering pump set with four wheel trolley, GI medium duty delivery pipes, specials, suction strainer etc. complete set Material of Constructions: Impeller: Bronze, Casing: CI, Shaft: Carbon Steel.	1.00	Unit	30864.00	30,864.00
26	Providing and erecting C. I. and MS ventilating columns 15 cms. dia. with C.I. ornamental cap and Min 6.00 Mtr. Height (Height may be varying as per site) base fixed firmly with necessary foundation with one coat of red lead oxide paint and one coat of any approved colour with 15 cms, dia.10 Mt.in length with 0.35mt*0.35mt* M100 Encasing, stoneware or R.C.C. pipe connection with M.H. including excavation and jointing as required etc. complete. as per drawing. Vent Pipe (Vent Coloumn) 6m High	3.00	Nos	38911.40	1,16,730.50
27	Drilling of 1900mm dia Horizontal borehole for watermain pipeline under the railway tracks incl all strata with required length incl fixing of 1200mm dia M.S.casing pipe of minimum 16mm thick Or IRS Casing Pipe with welding pushing etc complete Providing & fixing various size of pipe for 1259mm/1310mm/1360mm/1411mm dia watermain of G.I/M.S pipe of minimum 6.3mm thick for railway permises as per instruction & regulations of Railway authority & under supervision of Railway authority incl Provinding, supplying & fixing of spacer at specified interval if required between Casing pipe and water main,ISI make sluice valve of required size at both side of railway boundry with construction of brickedge pavement incl C:C encasing 1:3:6 in 10mtr length of pipe at both side. Incl Provinding & fixing of M.S/Iron Manhole frame with cover for valve chamber with loacking arregment etc. complete with all material labour fabrication,hydraulic testing of pipe & valve etc complete for 45mtr Length. without water main & MS casing pipe	2.00	Nos.	2952276.00	59,04,552.00
				Total Rs.	3,04,89,950.00

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

Schedule - B2 (Asphalt Road Resurfacing Work from Chitra Pumping Station to Railway)					
Sr No.	DESCRIPTION	QTY	UNIT	Rate Rs.	AMOUNT Rs.
				Rate In Figure	
1	Providing and laying wet mix macadam base course 125 mm thick in two layers using machine crushed B.T. chips as per required gradation mixing with required optimum quantity of water, conveying the mix to site of work, spreading in to grade and camber with mechanical paver and consolidation each layer with vibratory roller including cost of material labour plant and equipment etc. complete.	243.75	Cum	2150.29	5,24,133.19
2	Providing and applying priming coat with emulsion grade SS1 at the rate of 7.50 kg/ 10 Sq.mt. including cost of asphalt and preparing the surface heating, and applying etc. complete.	1950.00	Sq.m	48.18	93,945.15
3	Construction of granular sub-base 150 mm thick by providing coarse graded machine crushed B.T. material satisfying MOST specification of grading I (B.T. stone aggregate 53 mm to 26.5 mm 35 %, 26.5 to 4.75 mm - 45 % and 2.36 mm below - 20 %)including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.	292.50	Cum	1732.15	5,06,653.88
4	Providing and laying 37.5 mm thick compacted built up spray grout base course in single layer with bitumen grade 80/100 at rate of 15 Kg. per 10 Sqmt with 0.50 Cum stone aggregate and using 0.13 Cum of key aggregate per 10 Sqmt including consolidation with vibratory roller and tack coat using asphalt 80/100 at rate of 2.50 Kg/10 Sqmt etc. complete including the cost of asphalt and stone aggregate.	1950.00	Sqm	163.48	3,18,783.27
5	Providing and applying tack coat with mechanical sprayer using Emulsion grade RS1at the rate of 2.50 Kg/10 Sq.mt. including preparing the surface etc. complete.	1950.00	Sqm	41.79	81,497.91
6	Providing and applying asphalt painting on B.T. surface with mechanical sprayer using bitumen 60/70 (VG-30) at the rate of 5.00 Kg/10 Sq.mt. & spreading stone dust on painting surface at the rate of 0.03 Cu.m./10 Sq.mt. and rolling with smooth wheeled and pneumatic roller and brushing etc. complete.	1950.00	Sqm	41.79	81,497.91

Sr No.	DESCRIPTION	QTY	UNIT	Rate Rs.	AMOUNT Rs.
				Rate In Figure	
7	Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide liminance coefficinet on cemend road shall be min 130 mcd/m2/lux and Asphalt road shall be min 100 mcd/m2/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.	257.40	Sqm	367.72	94,651.34
				Total Rs.	17,01,162.65

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

Schedule - B3 (Construction Of New Pumping Station at Plot No. 49SFC at TP-20)

Sr No.	DESCRIPTION	QTY	UNIT	Rate Rs.	AMOUNT Rs.
				Rate In Figure	
1	Designing , Supplying, Instalation, Testing, Commissioning of Pumping Station including, E.O.T. Crane, Chain Pully Block, with Trriple Gear Operated, Manufacturing and casting of M.S Flats, ladders with steel bars steps, Railing, with paint coating work etc. including Construction of Pumping Station room as per Design and Is Criteria and as per Given Instruction by engineer-in-charge or Site Condition.	1.00	JOB	4436927.26	44,36,927.26
				Total Rs.	44,36,927.26

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

Schedule - B4 (Construction Of Screen Chamber at Plot No. 49SFC at TP-20)

Sr No.	DESCRIPTION	QTY	UNIT	Rate	Rate Rs.	AMOUNT Rs.
					Rate In Figure	
1	Designing and Construction of Screen Chamber with Plastering, painting, concreting work of base Slab, foundation, Vertical wall , Covering work with shuttering work, Steel Febricating work of M.S Flat and Railing, painting, polishing work, including line jointing of leakageproof job Connection with Screen chamber. complete. The Size of Screen chamber : 2.6 X 3.2.	1.00	JOB	518584.46	518584.46	5,18,600.00
					Total Rs.	5,18,600.00

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

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Schedule - B5

SCHEDULE OF PRICES

Pumping Machinery at Pumping Station at Plot No. 49SFC at TP-20 for pumping sewage to 30 MLD Sewage Treatment Plant at Kumbharwada

It No.	Description	Total Qty	Unit	Rate in Rs.	Amount Rs.
				In Fig.	
1.0	<p>Mechanical Work SUBMERSIBLE SEWAGE NON-CLOG VERTICAL PUMP : Supply, installation, testing & commissioning of sewage submersible, non clog type suitable for working on three phase, 50 Hz \pm 3%, 415 V \pm 10%, AC supply, 1450 RPM synchronous speed with 3 core flat copper cable from pump to starter panel with cable end terminations, all supports, clamps, pipe fittings along with mechanical seal, bearing bush, strainer etc. complete set & following M.O.C: Casing: CI, Impeller: SS CF8M, Wearing ring & Bearing bush: Bronze, TC mechanical seal, CS / SS bearing, SS shaft with sleeve, SS strainer & MS motor body. 75 HP x 5 set (For 2 DWF)</p>	5	kw	₹ 11,48,527.00	₹ 57,42,635.00
2.0	<p>Pressure Gauge: Design, Supply, Installation, Testing, Commissioning of Bourdon Type Pressure Gauge \pm 1% accuracy, Direct bottom 1/2" NPT (M) process connection, IP 67, Glycerine filled, SS304 case with Bayonet Type Bezel, SS316 L Bourdon Tube, SS 316, Movement materials, Aluminium dial with black graduation on white background, Micro Zero, adjustable pointer, neoprene gasket, Blow out disc. shatter proof glass, SS tag plate etc as per IS 3624. 100 mm dial size 0 to 6 kg/cm2 (For Suction, Discharge + Common Header)</p>	3	No.	₹ 1,029.00	₹ 3,087.00

3.0	<p>Full Bore Electro-magnetic Flow meter (for Common Header) Design, Supply, Installation, Testing, Commissioning of Full Bore Electromagnetic flow meter with factory calibration, Inbuilt Battery Power Operated, flanged connection, Flow sensor, Indicator, transmitter and totaliser with all accessories viz. surge arrestor, associated cables, cabinets, hardwares, etc complete as per following specifications: Flow meter/ Sensor: DC pulsed type, IP 68 Protection, Flanged process connection as per IS 1538 or equivalent standard, SS304/ Metallic Alloy Flow Tube, SS316/ SS 316 L/ Hastelloy Sensor, SS316/ Hastelloy Grounding Ring/ Inbuilt Grounding Electrode, Neoprene/Polyurethane/ Hard Rubber/ Rilsan lining, SS304/ Die Cast Aluminium/ Carbon steel with Anticorrosive Paint Coil Housing with Junction Box, CS flanges.. Flow Transmitter/ Converter (remote Field Mounted): Microprocessor based, Modular design, 2 line LCD for indication of actual flow rate, forward, reverse, sum totaliser display, ±0.5% accuracy at 0.3 to 4 m/sec velocity, one scalable pulse/ one status, one Modbus output, one GPRS/ GSM output, IP 67 protection, Die cast aluminium/ polycarbonate/ SS316 with Anticorrosive Paint/ PU finish with glass window enclosure, Inbuilt EEPROM and Data Logger, 20 meters cable length for sensor to transmitter communication, Minimum 5 years battery lifetime, 3.6 VDC Non Rechargeable Lithium-thionyl chloride/ Ni-Cd high power batteries, Hourly Basis Worldwide transmission of measured data and events via e mail and SMS by integrated GSM/GPRS modem, Reliable data storage facility through integrated SD card etc alongwith wall mounted/ stand mounted cabinet..</p> <p>Full Bore Electromagnetic Flow Meter (Battery Power Operated)- PN 10-size 800 mm</p>	1	No	₹ 3,91,026.00	₹ 3,91,026.00
4.0	<p>Expansion Bellow: Supply, installation, testing & commissioning of flange ends Expansion Bellow as per EJMA standards of overall length of minimum 300 mm, designed for 15 mm axial compression and 5 mm axial extension with tie rods etc. of following MOC & pressure ratings. MOC: Bellows: SA 240 Gr. 304; Internal Sleeve: SA 240 Gr. 304; Weldends: IS 2062 Gr. B; Flanges: IS 2062 Gr. B (Drilling as per IS 1538 / IS 6392) & Limit Rods & Nuts: CS - IS 1367., PN 1.0</p> <p>600 mm dia (Delivery line)</p>	2	No	₹ 29,280.00	₹ 58,560.00
4.1	800 mm dia (Header line)	1	No	₹ 47,976.00	₹ 47,976.00
5.0	<p>LEVEL MEASURING SYSTEM:: Ultrasonic Type Level Transmitter with Integral Display : Design, Supply, Installation, Testing and Commissioning of Non Contact Ultrasonic Type Level Transmitter with Integral Display. Sensor with Head Mounted Transmitter: The sensor should be non contact type, field mounting type, housing shall have minimum IP65 protection, PP/ PVC Sensor MOC, Microprocessor based indicator with LED / LCD digital display, panel/ wall mounting type, power supply shall be 110- 240 Vac or 15 to 36 Vdc, 50 Hz ± 10 %. Accesories: Mounting bracket, nut, bolts etc as per system requirement and Hook up diagram of the Instruments. Level Transmitter shall be suitable for following Range.</p> <p>0 to 15 Meter</p>	1	No	₹ 59,723.00	₹ 59,723.00

6.0	<p>Sluice Valve: Providing and supplying ISI mark CI D/F Sluice Valves as per IS:14846 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. including Lowering, laying and jointing in position following C. I. / D/F Reflux valves, Butterfly valves, Sluice valves and Air valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete.</p> <p>PN 1.6 with hand/wheel cap operated ALT-1 type long body. 600 mm dia (Delivery line)</p>	2	No.	₹ 1,44,767.05	₹ 2,89,534.10
6.1	800 mm dia (Header line)	1	No	₹ 3,62,964.10	₹ 3,62,964.10
7.0	<p>Dual Plate Check Valve (Reflex valve) (a)Providing and supplying ISI mark CI D/F Reflex Valves as per IS:5312 (latest edition) of following class and diameters including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. (b) Lowering, laying and jointing in position including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete as per Tender Specifications and instructions of Engineer in charge.</p> <p>PN 1.6 IS 5312 with ISI mark. 600 mm dia (Delivery line)</p>	3	No	₹ 2,26,633.05	₹ 6,79,899.15
8.0	<p>AIR VALVE:: Providing and supplying C. I. Temper proof Air valves with SS 304 Float gun metal-nozzle of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete including Lowering, laying and jointing in position following C. I. / D/F Reflux valves, Butterfly valves, Sluice valves and Air valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete.</p> <p>With Isolating Sluice Valve PN 1.0 Size: 150 mm NB - PN 1.0</p>	2	No	₹ 25,849.75	₹ 51,699.50
9.0	<p>M.S.Pipe: Manufacture, Supply & Delivery of Electric Resistance Welded (Up to 400mm)/Submerged Arc Welded(Above 400mm) M.S.Pipe having beveled ends plate or coil conforming to IS-3589-2001 or its latest revision/ ammendment for following thickness outside diameter at GWSSB store or site anywhere in Gujarat State including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading conveyance to Departmental stores, stacking etc. all complete. including Lowering, laying, jointing & welding in position to correct line & level M.S. Pipe with outside 3 LPE coating & inside solvent free liquid epoxy lining on pedestal or chairs upon prepared formation or prepared bedding in trenches the rates include conveyance from store to site of work loading, unloading, heat shrink sleeve jointing hydrotesting etc.complete.</p> <p>610 mm dia mini 6.3 mm thick(Delivery line)</p>	31.35	Mt	₹ 7,459.45	₹ 2,33,835.05

9.1	813 mm dia mini 7.1 mm thick(Header line)	38	Mt	₹ 11,065.65	₹ 4,20,494.70
10.0	<p>MISCELLANEOUS: Providing, S.I.T.C of Structure Steel at site of work with freight, loading, unloading carting, etc. including all taxes and duties complete such as joints, channels, angles, Iron Rails, ISA/ISM/ISMB/MS flat, Plates, Chequered plates (below 10mm thickness) etc. required for support structure of Electo- Mechanical equipments etc. for support on floor / wall / beam / brackets etc. as per tender and IS.</p>	800	kg	₹ 98.00	₹ 78,400.00
ELECTRICAL SECTION					
11.0	<p>Auto transformer starter suitable for local & remote pump control application consisting of Auto Transformer (vacuum impregnated, air cooled having three (3) tappings at 50%, 65% and 80%), incomer MCCB / MPCB, overload relay and contactors as per Type II coordination including digital MFM with RS 485 communication port, analogue type ammeter with selector switch, run hour meter, required protective relays & control accessories.</p> <p>A. T. S. from 71 to 80 HP</p>	1	No.	₹ 65,760.00	₹ 65,760.00
12.0	<p>Above 80A, upto & including 250A, 3 & 4 Pole, Air Break Fixed MCCB conforms to IS/ IEC 60947-2 with trip free mechanism, current limiting type with Thermal Magnetic/ Microprocessor release (O / C, S / C & E / F) with adjustable settings & having minimum 2NO+2NC potential free auxiliary contacts with all necessary Electro-Mechanical protections & interlocks etc. MCCB module, when used as Outgoing(s), shall have enclosure dimensions- 400 (H) x 600 (W) x 600 (D) & following technical features::</p> <p>(A) 3 Pole, MCCB with Breaking Capacity of Icu=25 KA at 415V (Ics =100% of Icu), TM release</p>	1	No	₹ 29,170.00	₹ 29,170.00
13.0	<p>Above 50 KVAR capacity: APFC panel consisting following items..a) 125 A, 50 kA for 1sec. TP, TM based MCCB with spreader terminals & rotary handle b) 0-125 A range analogue ammeter of 96 x 96 mm size with selector switch c) 3 nos. 125 / 5A, 10 VA CL-1.0 cast resin type current transformer d) Suitable rating MCCB / MCB & Contactors for each capacitor bank e) Suitable rating APP type capacitor banks (vacuum impregnated with non-PCB / non toxic oil, internally delta connected with built in internal fuses complete with discharge resistances & terminal cover) of approved make in required steps with well suited detuned reactor is placed in series with each capacitor step. (e.g. 50 KVAR capacity will be provided in steps of 2 nos x 5 KVAR, 2 nos x 7.5KVAR & 2 nos x12.5 KVAR).</p> <p>Enclosure dimensions: 1600 (H) x 1150 (W) x 600 (D)</p>	1	No.	₹ 1,38,383.00	₹ 1,38,383.00
14.0	<p>Supply, laying, testing & commissioning 1.1 kV grade, XLPE insulated, stranded Aluminium conductor, galvanised steel flat strip / round wire armoured, extruded PVC type ST2 sheathed, heavy duty cable (to be laid on wall surface with necessary clamps / in existing cable trench / cable trays / conduit / pipe sleeves at road crossing or floor as per site requirement) conforming to IS:7098 (Part-1) & IEC:60502 (Part-1) of following sizes: 3 Core x 16 Smm</p>	200	mtr	₹ 91.00	₹ 18,200.00

15.0	Pipe type earthing with 40 mm dia 2.5 mtr long 'B' grade G.I. pipe with necessary coupling buch buried in specially prepared earth pit & G.I. earth wire of 8 SWG erected & connected as directed (For panel)	8	No.	₹ 815.00	₹ 6,520.00
16.0	CABLE TRAY Supply & laying GI ladder type cable trays with side channels of size - 75 x 15 x 15 mm / 100 x 15 x 15 mm & rungs of size - 35 x 15 x 15 mm spaced at 250 mm apart, fabricated from 2 mm thick sheet steel in standard length of 2.5 meter, duly hot dipped galvanized after fabrication as per IS 2629-1989/ IS 4759-1984 including accessories such as coupler plates/ fish plates, bends, tees, reducers, elbows, covers and electro-galvanized hardware etc, erected on existing support as per specification and instruction of Engineer-in-charge. 150(W) x 35(H) x 2.0 mm Thick	250	Rmt	₹ 371.00	₹ 92,750.00
17.0	Float type Level Switch: Design, Supply, Installation, Testing and Commissioning of Top mounted Displacer Type level switches with 2 nos SPDT contacts of Micro switch rated 5 A, potential free power supply, Material of wetted parts shall be SS 316 and the material of accessories shall be SS. IP 65 or equivalent degree of protection for enclosure, suitable for sump, ESR, tank, vessels and underground reservoirs. The top mounted level switches shall be supplied with still tubes to suit the requirement. . Accessories like name plate, mating flange, gaskets, fasteners, bolts & nuts, etc. shall be supplied with the Level Switch of following Range. 0 to 5 Meter	1	Nos.	₹ 12,802.00	₹ 12,802.00
18.0	INTERNAL WIRING:- SITC of Main & Outlet points wiring with 1.1KV Grade FRLS PVC insulated ISI marked flexible stranded copper conductor wires with medium class min. 25mm dia. Rigid PVC Pipe and accessories to be erected conceled in/to be run on surface /wall/ ceiling with following sizes as mentioned below. The unit rate wiring shall be with connector, PVC junction box, wire holder, ceiling rose, Angle holder, switch, switchboard brass chromium/cadmium plated machine screws, phase and neutral wires, green earth continuity wires etc. as required to complete wiring from LDB panel to the final outlet termination points. The wiring shall be as per IS :732, Is : 4648 and as per tender specification / IS SITC of Main wiring with 3wire 1.5 Sq.mm	50	mtr	₹ 78.00	₹ 3,900.00
18.1	SITC of Main wiring with 3 wire 2.5 Sq.mm	60	mtr	₹ 96.00	₹ 5,760.00
18.2	SITC of Main wiring with 4 wire 1.5 Sq.mm	40	mtr	₹ 86.00	₹ 3,440.00
18.3	SITC of Main wiring with 4 wire 2.5 Sq.mm	60	mtr	₹ 119.00	₹ 7,140.00

19.0	<p>Point wiring: Point wiring for Light/ Bell with 2-1.5 sq mm & earthwire of 1.5 sq mm (Green) both are of ISI marked 1.1kV grade FRLS PVC insulated multistrand copper wires, in following type of pipe to be erected concealed in/on surface on wall/ceiling complete with 6A Modular type switch/ bell push & accessories and earth continuity of following type, erected on PVC/ Metallic box, single mounting base frame covered With textured/ metallic front plate modules erected on/ in wall/ ceiling as per pipe erected, with necessary Lamp holder/ ceiling rose/ H D.Connector as directed.</p> <p>(a) with Medium class Rigid PVC pipe and accessories erected flushed on Wall/ceiling complete.</p>	₹ 30.00	Rmt	₹ 326.00	₹ 9,780.00
20.0	<p>Supply,Installation,Testing and Commissioning of 5/15A Point wiring for Individual Plug with & earthwire of 1.5 sq.mm (Green) both are of ISI marked 1.1 KV grade FRLS PVC insulated multistrand copper wires, in following type of to be erected concealed in / on surface of wall / ceiling complete with Modular type switch & 5 pin Plug erected on PVC / Metallic box covered with appropriate front plate modules erected on / in wall / ceiling as per pipe erected with following type of accessories.</p> <p>[II] for 16A Plug and 16 amp switch with 2.-2.5 sq.mm Cu. Wire from mcb db board.</p>	20	No	₹ 663.00	₹ 13,260.00
21.0	<p>Supplying and erecting LED street light / Flood light fittings with High power White LEDs wattage of 3 Watt and above assembled on single MCPCB, efficiency more than 130 lm/w and corrosion free High pressure die cast aluminium housing with smooth finish powder coated and heat sink extruded aluminium with diffuser and Polycarbonate optics/ lenses with company mark/name engraved or embossed 160 to 270 V,Power Factor more than 0.95, THD < 10 %, CCT 3000 K to 5700K,Uniformity ratio >0.45, Luminaire efficacy > 100 lumens/watt . LED driver efficiency > 85 %.(fittings required LM-79 & LM-80 certificates)(NOTE: Below description have shown ranges of Wattage capacity of LED fittings.The Engineer incharge may select any wattage capacity between the ranges shown.)</p> <p>(A) Street Light (IP-65), Surge protection -4KV integral and ,Light must have 440VAC line supply with over-voltage protection.</p> <p>(ii) 15 to 24 Watts Cat-III</p>	6	Nos.	₹ 4,470.00	₹ 26,820.00
22.0	Supplying and erecting approved make suitable panel indicator LED type lamp, lens cover, complete erected with necessary connections	6	Nos.	₹ 43.00	₹ 258.00
23.0	Supplying & erecting carbon dioxide (CO2) fire extinguisher user of following capacity with necessary clamps made from 50 x 6 mm M.S. Flat with nut & bolts grouted in wall complete. <p>for 4.5 kg capacity</p>	1	Nos.	₹ 7,700.00	₹ 7,700.00
24.0	Providing and fixing printed instruction chart both in English and Gujarati and duly framed with front glasses,for treatment of person suffering from Electric shock with minimum 50"diagonally size.	1	No.	₹ 129.00	₹ 129.00

25.0	Supplying stand first AID box with antiseptic cream, medicine for use on wounds due bum, crepe bandage, gauge bandage, medicated ready to use bandage (Band-aid) adhesive tape for medicinal user, Scissors, anti-septic solution (savlion or similar) etc. (All above contents shall be of standard makes)	1	No	₹ 297.00	₹ 297.00
26.0	Supplying FIRE bucket round bottom of 9 litres capacity made out of 24 gauge G.I. sheet with extra handle at bottom duly painted white inside and Red out side with FIRE mark, filled with dry-sand and kept on existing stand provided or hung on wall hook.	1	Nos.	₹ 212.00	₹ 212.00
27.0	Supplying rubber matting of following thickness as per IS:15652/IEC 61111 (a) 3 mm	6.5	mtr	₹ 763.00	₹ 4,954.00
28.0	Providing pair of rubber hand gloves suitable for working on 11 KV/22 KV supply.	1	mtr	₹ 212.00	₹ 212.00
Total (Rs)					₹ 88,67,280.60

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

SCHEDULE-B6 : DI Rising Main from from TP-20 Pumping Station to 30 MLD Sewage Treatment Plant at Kumbharwada

It No.	Description	Total Qty	Unit	Amount Rs.
1	Providing and supplying D. I. K-7 grade pipes for following nominal bore diameter with internal cement mortar lining including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. (IS.8329-2000). For sewerage Project cement mortar lining shall be with sulphate resistance cement. 900mm DI	2720.00	Rmt	₹ 5,05,40,320.00
2	Manufacture, supply & delivery of Ductile Iron Flange socket spigot bends, reducers or any other specials as per BS-EN-545/1995 Class-A series K12 suitable for use with D.I. Pipes manufactured as per IS: 8329/1994 delivery of specials is to be made to GWSSB store or site of works any where in Gujarat including all taxes, loading, unloading, carting, stacking, insurance, inspection, octroi etc. complete. With external bitumen & zinc coating & internal cement mortar lining. Socket & Spigot Type 350 & Above	6700.00	KG	₹ 10,11,700.00
3	Providing and supplying ISI mark CI D/F Butterfly Valves as per IS:13095 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. Butterfly Valve IS 13095 with ISI PN-1.6 800 mm Dia	2.00	Nos.	₹ 4,66,750.00
4	Providing and supplying ISI mark CI D/F Sluice Valves as per IS:14846 (Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete. Sluice Valve PN-1 with Hand/Wheel Cap Operated (Alt-1 Type Long Body) 900. mm dia SV	2.00	Nos.	₹ 9,78,768.00
4.1	250 mm dia SV	2.00	Nos.	₹ 36,018.00

5	Providing and supplying C. I. Temper proof Air valves with SS 304 Float gun metal Nozzle of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc.comp. (With isolating Sluice valve PN 1.6) 150 mm Dia	6.00	No.	₹ 1,77,636.00
6	Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 0 to 1.5 m. depth In all sorts of soil and soft murrum	5091.25	Cu.m	₹ 5,21,089.03
6.1	In hard murrum,boulders,incl. Macadam road	565.69	Cu.m	₹ 87,823.99
7	Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 1.5 to 3.0 m. depth In all sorts of soil and soft murrum	2941.97	Cu.m	₹ 3,31,560.47
7.1	In hard murrum,boulders,incl. Macadam road	420.28	Cu.m	₹ 71,532.00
7.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	420.28	Cu.m	₹ 86,515.05
7.3	In hard rock and / or in C. C. 1:2:4 or RCC with blasting, breaking, chiseling, or by chiseling/breaking only.	420.28	Cu.m	₹ 1,87,529.83
8	Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 3.0 to 4.5 m. depth In all sorts of soil and soft murrum	1084.13	Cu.m	₹ 1,28,415.38
8.1	In hard murrum,boulders,incl. Macadam road	154.88	Cu.m	₹ 27,428.53
8.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	154.88	Cu.m	₹ 33,306.07
8.3	In hard rock and / or in C. C. 1:2:4 or RCC with blasting, breaking, chiseling, or by chiseling/breaking only.	154.88	Cu.m	₹ 70,708.61
9	Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and struting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. 4.5 to 6.0 m. depth In all sorts of soil and soft murrum	7.13	Cu.m	₹ 893.16
9.1	In hard murrum,boulders,incl. Macadam road	11.88	Cu.m	₹ 2,198.75
9.2	In soft rock and/or masonry in CM or L M or Lime Concrete.	14.25	Cu.m	₹ 3,195.70

9.3	In hard rock and / or in C. C. 1:2:4 or RCC with blasting, breaking, chiseling, or by chiseling/breaking only.	14.25	Cu.m	₹ 6,637.22
10	Extra for Dwatering for Excavation in wet condition in all streta. Depth up to 0. to 1.5 m depth	2828.47	Cu.m	₹ 55,296.59
10.1	Depth up to 1.5 to 3.0 m depth	840.56	Cu.m	₹ 26,099.51
10.2	Depth up to 3.0 to 4.5 m depth	309.75	Cu.m	₹ 13,179.94
10.3	Depth up to 4.5 to 6.0 m depth	9.50	Cu.m	₹ 513.50
11	Lowering, laying and jointing C. I. S & S Spun pipes suitable for Tyton joints / Mortar lined D. I. Pipes of various classes with CI / MS specials of following diameters in proper position, grade and alignment as directed by Engineer-in-charge including hydraulic testing etc. comp. DI K-7/9 pipe. 900 mm DI Pipe k7	2720.00	Rmt	₹ 23,96,048.00
12	Lowering, laying and jointing in position following C. I. / D/F Reflux valves, Butterfly valves, Sluice valves and Air valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete.(Sluice valve/BF valve) 900 mm Dia (DI Pipe K7)	4.00	No	₹ 34,840.40
12.1	250 mm dia Scour valve	2.00	No	₹ 2,175.80
13	Labour charges for installation of air riser(flange pipe) on the pipe line at suitable place as per design & directed by Engineer-in charge including M.S. flange pipe R.C.C. foundation block & column in C.C. M-150 etc. complete. including fixing of DAV with sluice valve. The length of pipe is 3.00 mt. above G.L. Air valves double ball flanged 150 mm	6.00	No	₹ 1,19,370.00
14	Construction of RCC valve chambers of required size for sluice valves, butterfly valves etc. as per detailed drawing and specification and as per instruction of Engineer -in-charge. Walls of the chambers should constructed in C.C. 1:2:4 and P.C.C. should be done in 1:3:6 Rate also includes RCC top cover in C.C. 1:2:4 incl.CI/MS Steps. For sluice valve and water meter. 2.50 x 2.50 x 3.0 m size	6.00	No	₹ 6,02,370.00
15	Refilling the pipeline trenches incl. ramming, watering, consolidating desposal of surplus stuff as directed within a radius of 3 km	8384.00	Cu.m	₹ 2,12,115.20
16	Providing and casting in situ mass C.C. in grade M-10 (approx corresp. to prop. 1:3:6) using granite, quartzite trap metal of size 12mm to 25mm for RCC work, incl. cosolidation, curing etc. comp. (without form work)	451.00	Cu.m	₹ 21,33,622.37

17	Providing and casting in situ C.C. in grade M-15 (prop. as per mix design or as per tabel-9 of IS 456-2000 in masses by weight betching) using granite, quartzite trap metal of size 6mm to 20mm for RCC work, incl. scaffolding centering, form work, needle vibrated cosolidation, curing comp. upto 6 metre depth or height (excl. cost of reinforcement and neat finishing) with centering & shuttering etc. complete. for structure other than water retaining. (with form work)	891.00	Cu.m	₹ 50,26,932.90
18	Supplying cutting bending binding and placing in position steel as per plan and design and as per ISS 2502 incl. cost of steel and binding wire for reservoirs/ structures only including lift up to 6 meter height or depth below GL for all diameters. -do- Thermo mechanically treaed (TMT) bars Fe 415 grade for all diameters.	8.91	Kg	₹ 7,50,125.77
19	Providing and filling rubbles including hand packing and filling interstices with quarry spalls below pipeline tranches and between returns as directed.	624.00	Cu.m	₹ 7,56,536.98
20	Drilling of 1300 mm dia Horizontal borehole for watermain pipeline crossing under the railway tracks incl all strata with required length incl fixing of 1200 mm dia M.S. casing pipe of minimum 16 mm thick or IRS Casing pipe with welding pushing etc complete providing & fixing various size of pipe for 559 mm/ 610 mm /660 mm / 711 mm dia watermain of G.I / M.S Pipe of minimum 6.3 mm thick for railway permises as per instruction & regulations of Railway authority & under supervision of Railway authority incl providing, supplying & fixing of spacer at specified interval if required between casing pipe and water main ISI make sluice valve of required size at both side of railway boundary with constuction of brickedge pavement incl C:C encasing 1:3:6 in 10mtr length of pipe at both side. Incl providing & fixing of M.S /Iron Manhole frame with cover for valve chamber with loacking arregment etc. complete with all material labour fabrication, hydraulic testing of pipe & valve etc complete for 45 mtr length. Without Water main & with MS Casing Pipe.	45.00	Rmt	₹ 23,50,674.75
21	Cutting down trees with Branches and removing and stacking the same to 100 mts. Distance lincluding removing roots, completely with necessary excavation.	1.00	L.S	₹ 1,00,000.00

22	<p>Full Bore Electromagnetic Flow Meter- Regular Power operated Design, Supply, Installation, Testing, Commissioning of Full Bore Electromagnetic flow meter with factory calibrated,Regular Power Operated, flanged connection, Flow sensor, Indicator, transmitter and totaliser with all accessories viz.surge arrestor, associated cables, cabinets, hardwares, etc complete as per following specifications: Flow Meter/ Sensor: DC pulsed type, IP 68 Protection, Flanged process connection as per IS 1538 or equivalent standard, SS304/ Metallic Alloy Flow Tube, SS316/ SS 316 L/ Hastelloy Sensor, SS316/ Hastelloy Grounding Ring/ Inbuilt Grounding Electrode, Neoprene/ Polyurethane/ Hard Rubber/ Rilsan lining, SS304/ Die Cast Aluminium/ Carbon steel with Anticorrosive Paint Coil Housing with Junction Box, CS flanges. alongwith wall mounted/ stand mounted cabinet. Microprocessor based, Modular design, 2 line LCD for indication of actual flow rate, forward, reverse, sum totaliser display, ±0.5% accuracy at 0.3 to 4 m/sec velocity, 4 to 20 mA with HART/Modbus output, one scalable pulse, one status output, IP 67 protection, Die cast aluminium/ polycarbonate/ SS316 with Anticorrosive Paint/ PU finish with glass window enclosure, Inbuilt EEPROM and Data Logger, 20 meters cable length for sensor to transmitter communication etc. Flow Transmitter/ Converter (Remote Field Mounted): Full Bore Electromagnetic Flow Meter (Regular Power Operated)- PN 10 900mm Nominal Bore</p>	1.00	NO	₹ 4,45,325.00
			Total B2	₹ 6,97,95,252.47

Signature of Contractor with Stamp

**Executive Engineer
Drainage Department
BMC, BHAVNAGAR**

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

Schedule - B7 (Construction Work of WMM Road Parallel to Rising Main)					
Sr No.	DESCRIPTION	QTY	UNIT	Rate Rs.	AMOUNT Rs.
				Rate In Figure	
1	Clearing and grubbing road land including uprooting trunk vegetation, grass bushes, shrubs, saplings and tree girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable materials (C) by mechanical means in area of light jungle	0.09	Hec.	28393.04	2,555.38
2	Box cutting the road surface to proper slope & camber for making a base for road work including compacting at O.M.C. and removing the excavated stuff, and depositing on the road side slopes as directed upto 50Mt.lead.	675.00	Cum	103.86	70,104.36
3	Construction of granular sub-base 100 mm thick by providing coarse graded machine crushed B.T. material satisfying MOST specification of grading II (B.T. stone aggregate 26.5 to 4.75 mm - 75 % and 2.36 mm below - 25 %) including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.	225.00	Cum	1732.15	3,89,733.75
4	Construction of granular sub-base 150 mm thick by providing coarse graded machine crushed B.T. material satisfying MOST specification of grading I (B.T. stone aggregate 53 mm to 26.5 mm 35 %, 26.5 to 4.75 mm - 45 % and 2.36 mm below - 20 %)including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.	338.00	Cum	1732.15	5,85,466.70

Sr No.	DESCRIPTION	QTY	UNIT	Rate Rs.	AMOUNT Rs.
				Rate In Figure	
5	Providing and laying wet mix macadam base course 125 mm thick in two layers using machine crushed B.T. chips as per required gradation mixing with required optimum quantity of water, conveying the mix to site of work, spreading in to grade and camber with mechanical paver and consolidation each layer with vibratory roller including cost of material labour plant and equipment etc. complete.	281.00	Cum	2165.44	6,08,488.64
6	Rolling and watering of earth work in layers with power roller including filling in depression which occur during the process	676.34	Cum	22.40	15,151.17
				Total Rs.	16,71,500.00

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

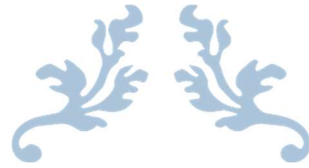
BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

SCHEDULE-B7- Operation and Maintenance for 5 Years

Item No.	Description	Quantity	Unit	Amount
1	Operation & Maintenance -Comprehensive Operation and Maintenance of Rising Main , Civil Works ,electrical mechanical and instrumental works and various components of UGD scheme undertaken in this tender . This also involves the integration of essential mechanical, instrumentation, and electrical components, alongside headwork to enhance Sewerage management efficiency including 1) Breakdown Maintenance or Emergency Maintenance, 2) Day to day Maintenance 3) Preventive orPeriodic Maintenance, 4) Major Maintenance (or Special repairs and replacement including Training to O & M staff of Municipality. The rate shall also include all consumables and deployment of Manpower . The O & M work shall be carried out as per detailed specifications in the tender & maintaining the record for the same. 1 st Year	1	Year	₹ 44,28,398.87
1.1	For 2 nd year	1	Year	₹ 53,14,078.64
1.2	For 3 rd year	1	Year	₹ 59,04,531.82
1.3	For 4 th year	1	Year	₹ 64,94,985.01
1.4	For 5 th year	1	Year	₹ 73,80,664.78
Total Amount (Rs)=				₹ 2,95,22,659.12

Signature of Contractor with Stamp

Executive Engineer
Drainage Department
BMC, BHAVNAGAR

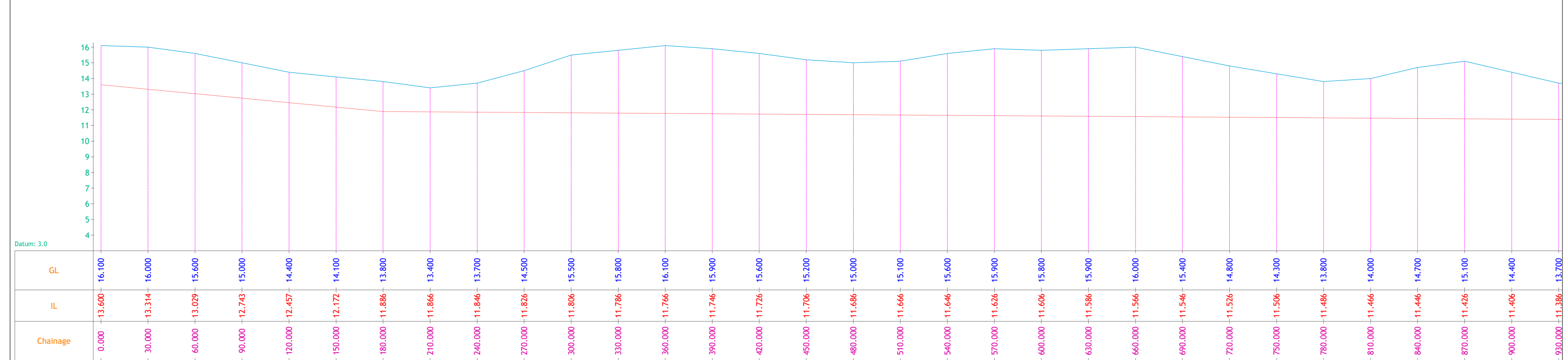
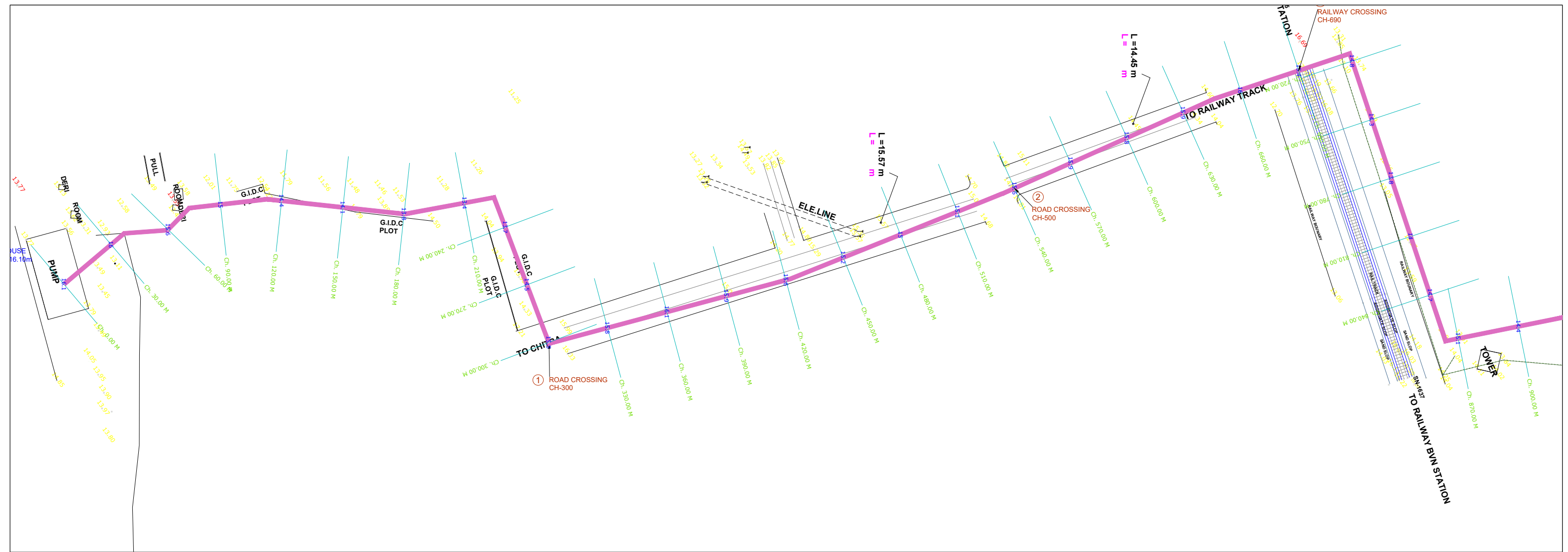



DRAWINGS



DESIGN OF PUMPING STATION			
Main Pumping Station			
1. Total capacity required at ultimate stage			
IN Ultimate Year	=	529.21	LPS
	=	45.724	MLD
Say	=	45.800	MLD
	=	45800.00	M ³ /Day
	=	1908.33	M ³ /Hr.
2. Considering Volume of Wet well			
Capacity (V)	=	T X Q/4	
Time for one pump cycle (T)	=	15.00	Minutes
Pumping Rate (Q)	=	31.81	M ³ /minute
Capacity (V)	=	120.00	M ³
3. Considering Depth of sewage			
Depth of Sewage	=	4.00	Mt.
Area Needed	=	30.00	M ²
Q	=	$\pi/4 \cdot d^2$	
d ²	=	38.22	Mt.
d	=	7.2	Mt.
Say dia of wet well	=	8.00	Mt.
Adopting dia of wet well	=	8.00	Mt.
4. Depth of Pumping station			
GL	=	9.50	Mt.
IL	=	1.50	Mt.
Free board	=	0.30	Mt.
Total depth of Pumping station	=	8.00	Mt.

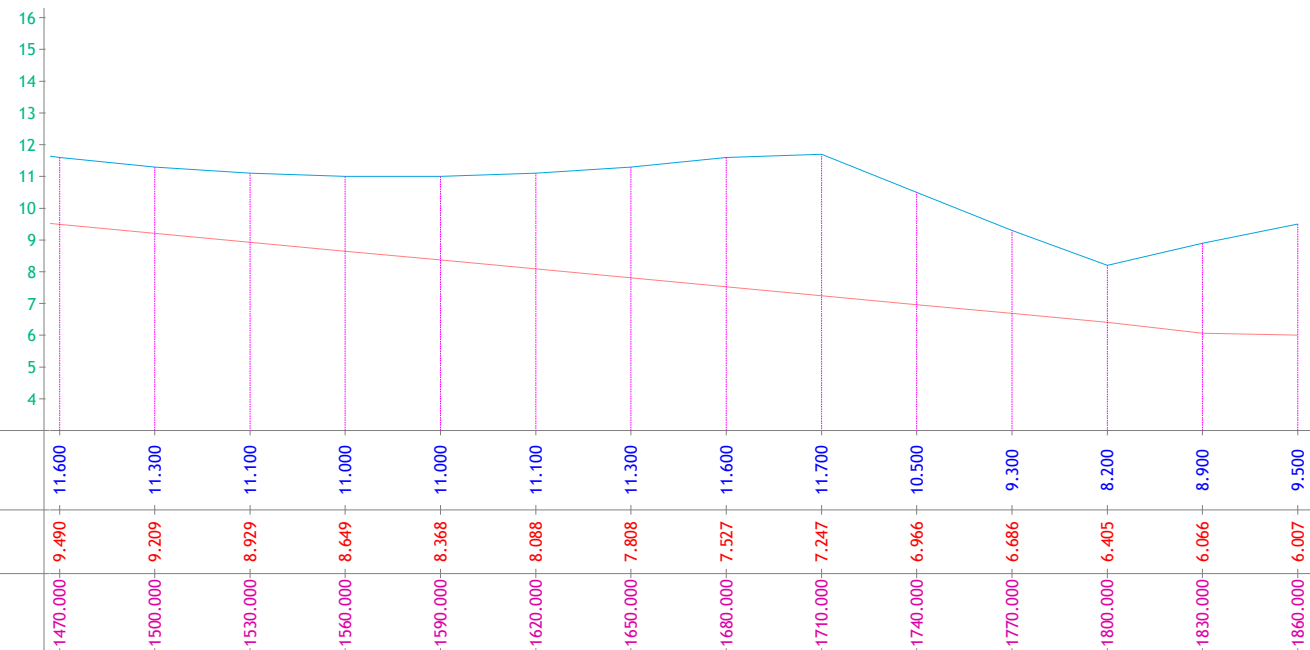
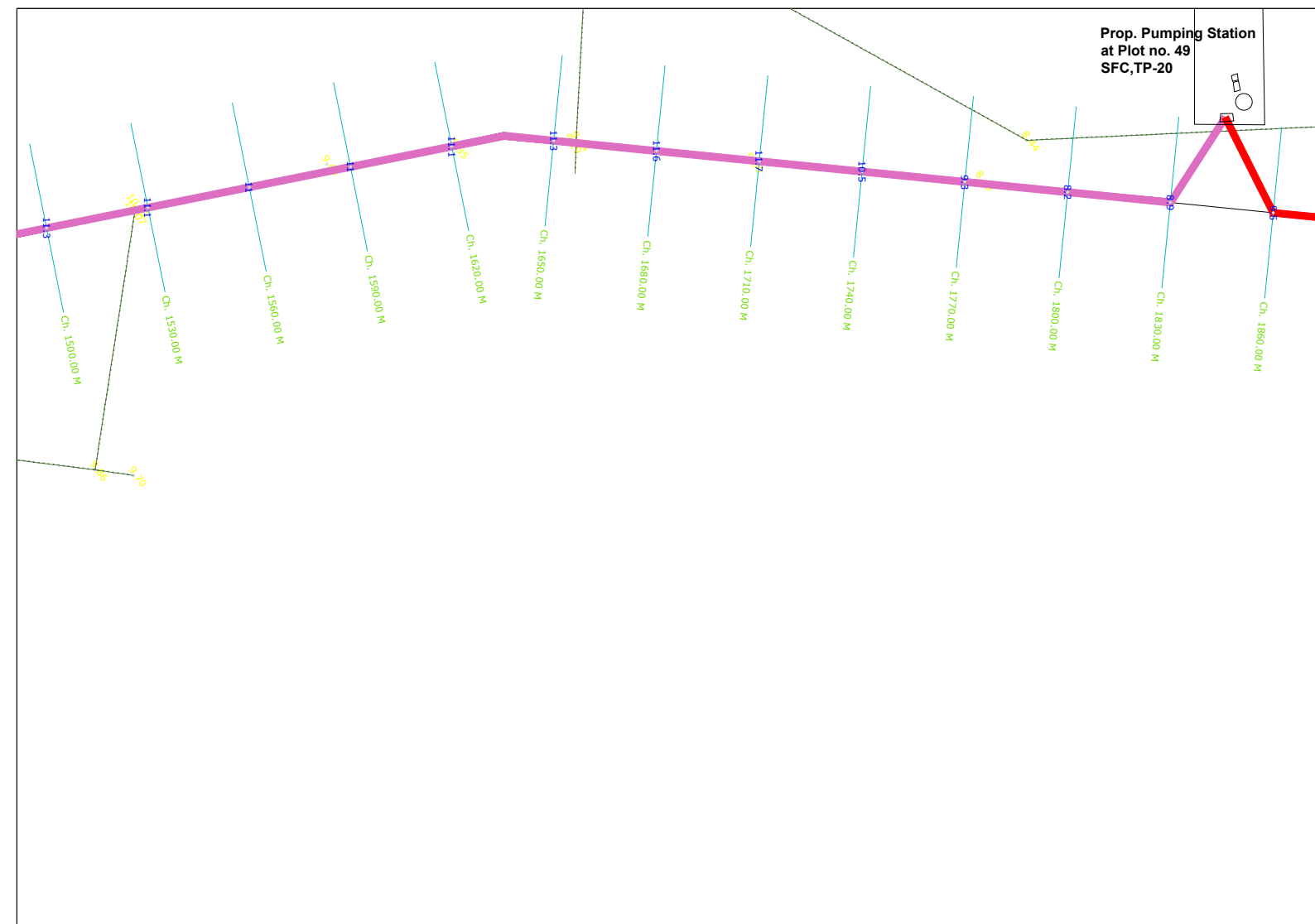
Main Pumping Station




PROJECT NAME	Providing, Supplying, Laying of Gravity Pipeline from Chitra Market Yard Pumping Station to New MPS at TP-20 and 900mm Dia. DI Rising Main from MPS at TP-20 to 30 MLD Sewage Treatment Plant at Kumbharwada		
SUBJECT	LAYOUT PLAN OF GRAVITY MAIN LINE AND L SECTION		
DRAWING NO/REV NO	DWG-1	DT : 24-02-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	BKD	BKD	
DHAVAL ENGINEERS HEAD OFFICE: D-210, SUNRISE ARCADE, ABOVE BAGRAM HOTEL, OPP. PRATIK MALL, CH-D KORA ROAD, KUDASAN, DIST: GANDHINAGAR BRANCH OFFICE: S-4, SECOND FLOOR, PLOT NO-304 SECTOR -22, GANDHINAGAR			



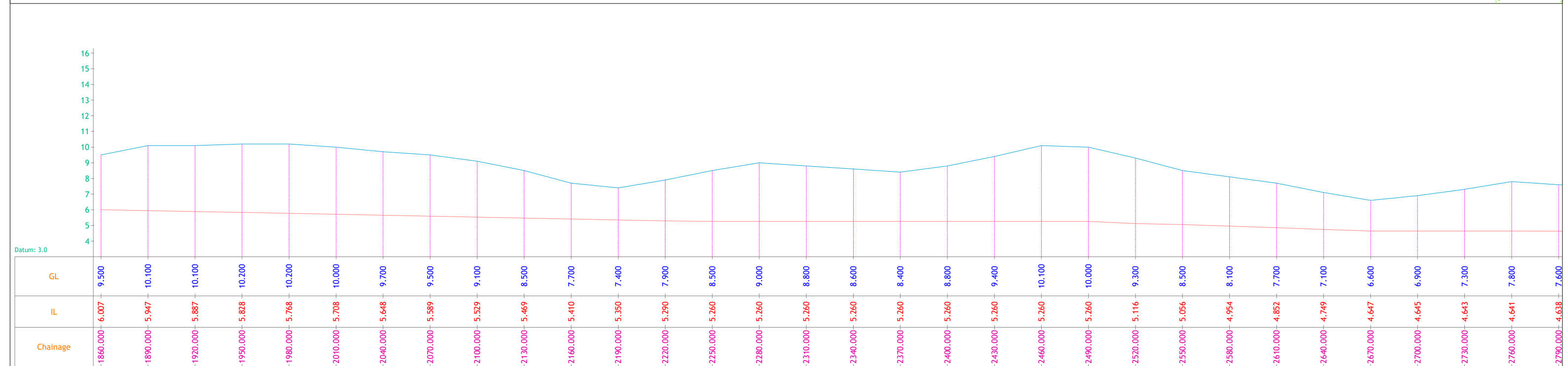
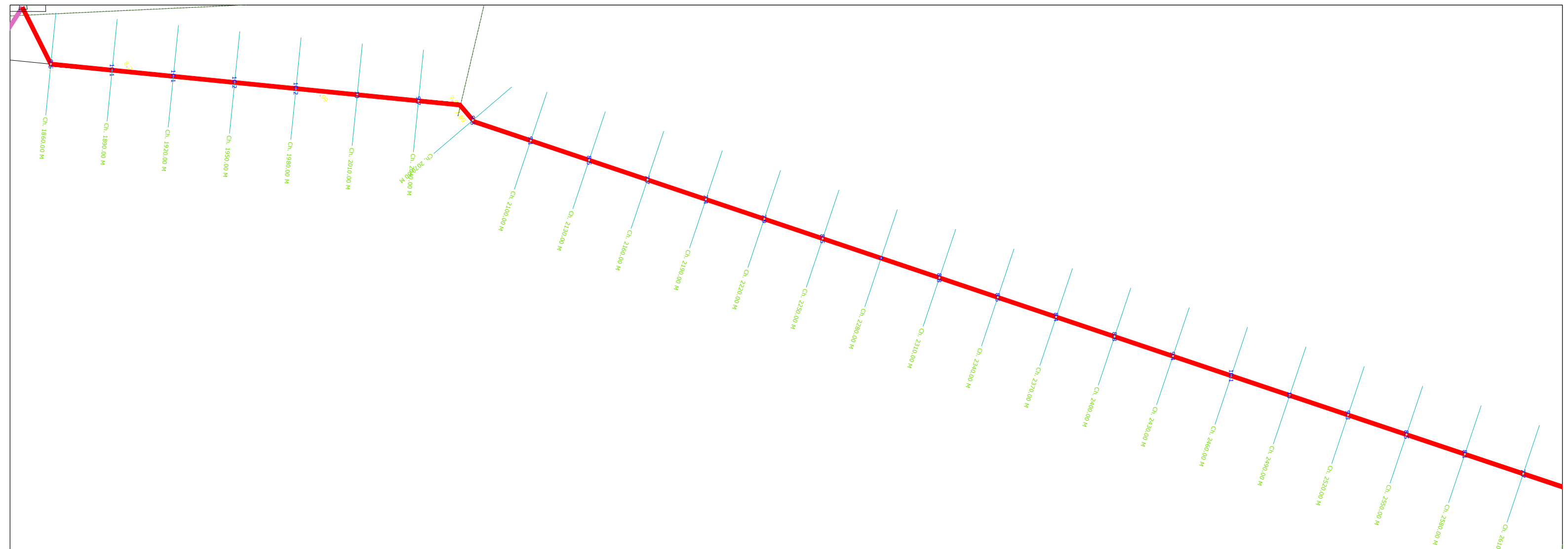
Prop. Pumping Station
at Plot no. 49
SFC, TP-20





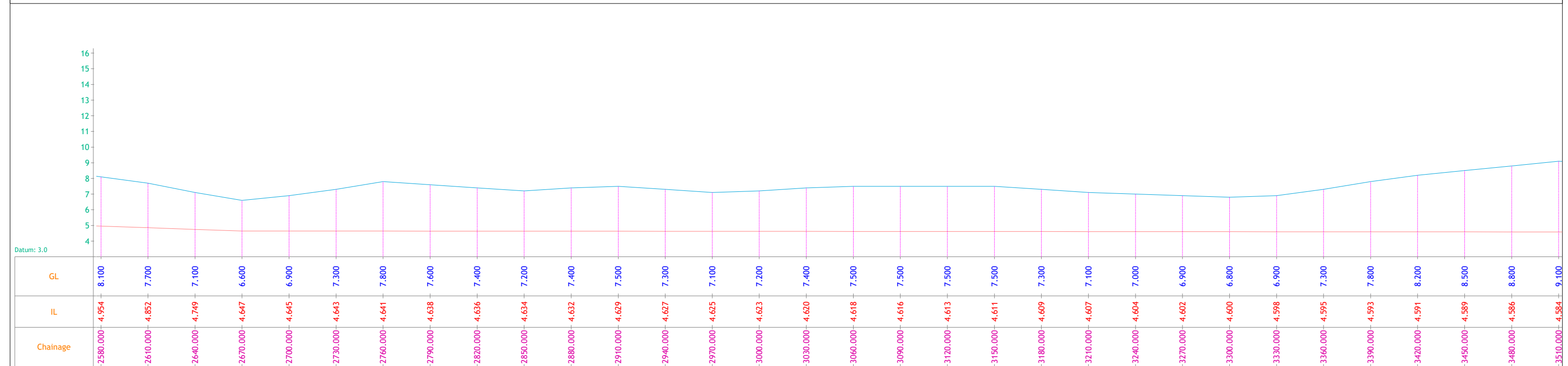
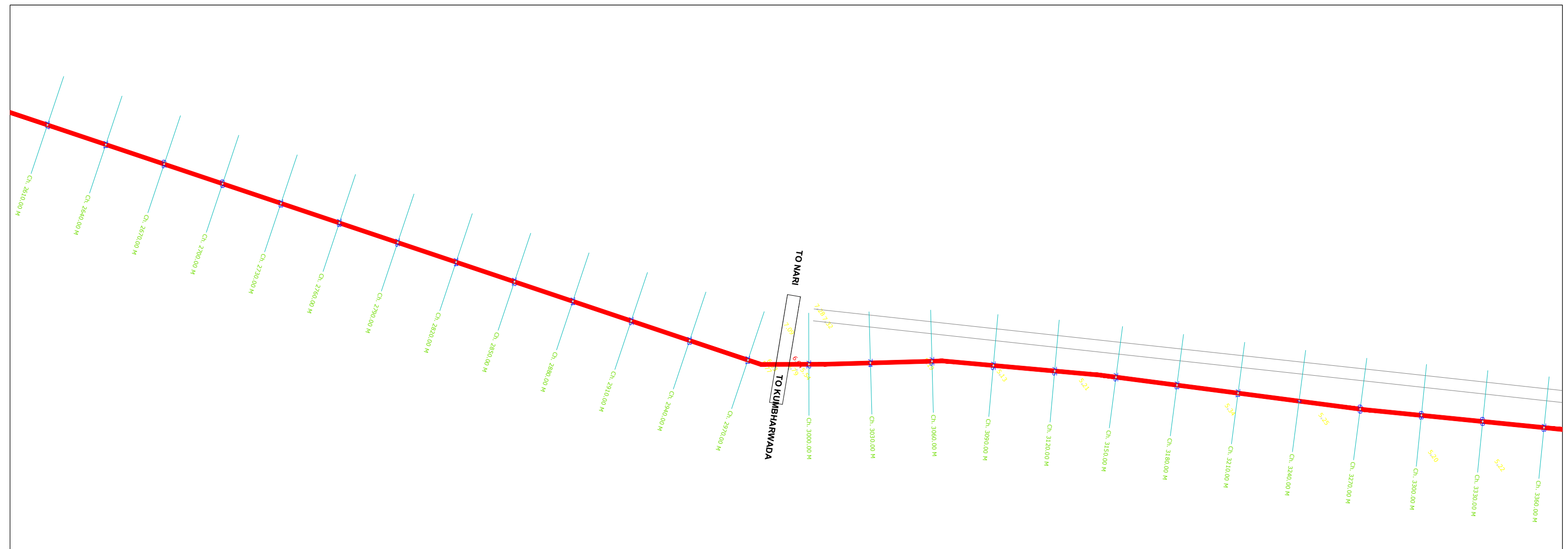
PROJECT NAME	Providing, Supplying, Laying of Gravity Pipeline from Chitra Market Yard Pumping Station to New MPS at TP-20 and 900mm Dia. DI Rising Main from MPS at TP-20 to 30 MLD Sewage Treatment Plant at Kumbharwada		
SUBJECT	LAYOUT PLAN OF GRAVITY MAIN LINE AND L SECTION		
DRAWING NO/REV NO	DWG-3	DT : 24-02-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	BKD	BKD	



DHAVAL ENGINEERS
 HEAD OFFICE: D - 210, SUNRISE ARCADE, ABOVE BAGRAM HOTEL
 OPP. PRATIK MALL, CH-0 KORA ROAD, KUDASAN, DIST: GANDHINAGAR
 BRANCH OFFICE: S-4, SECOND FLOOR, PLOT NO-304 SECTOR - 22, GANDHINAGAR

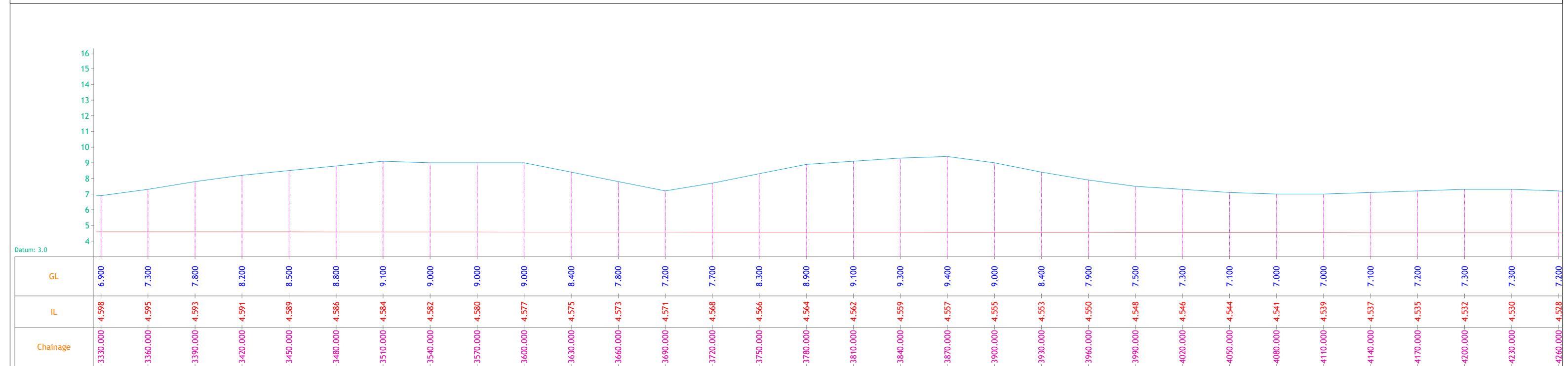
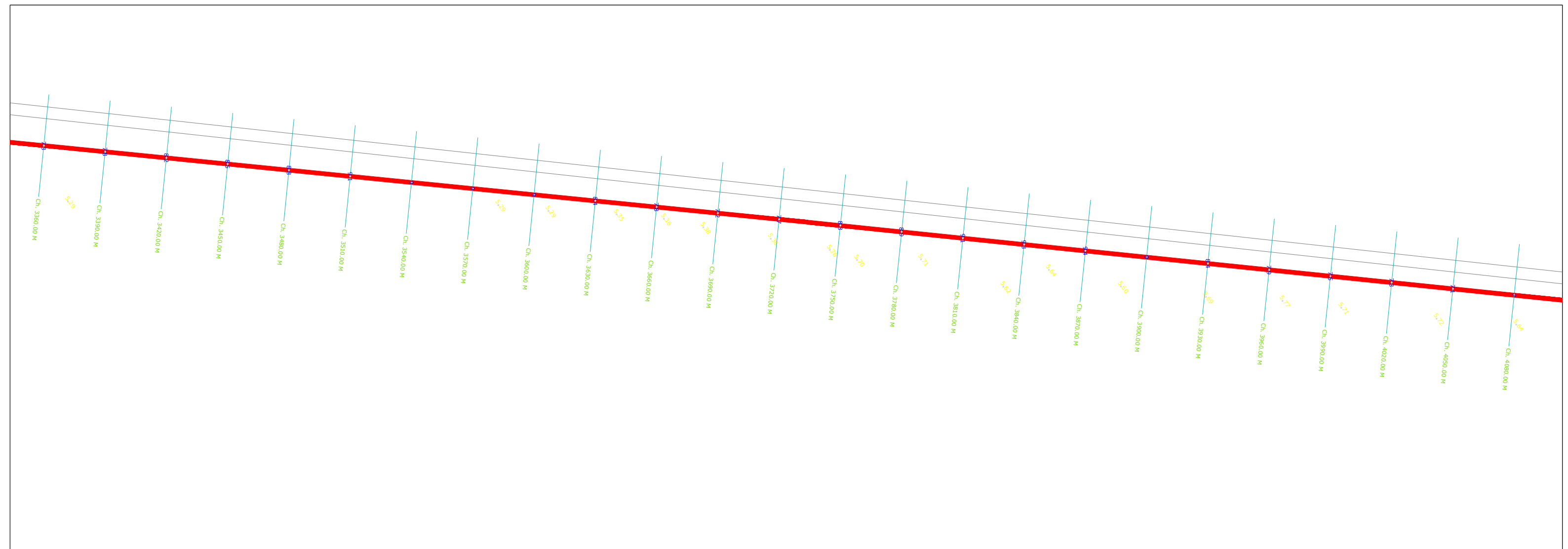






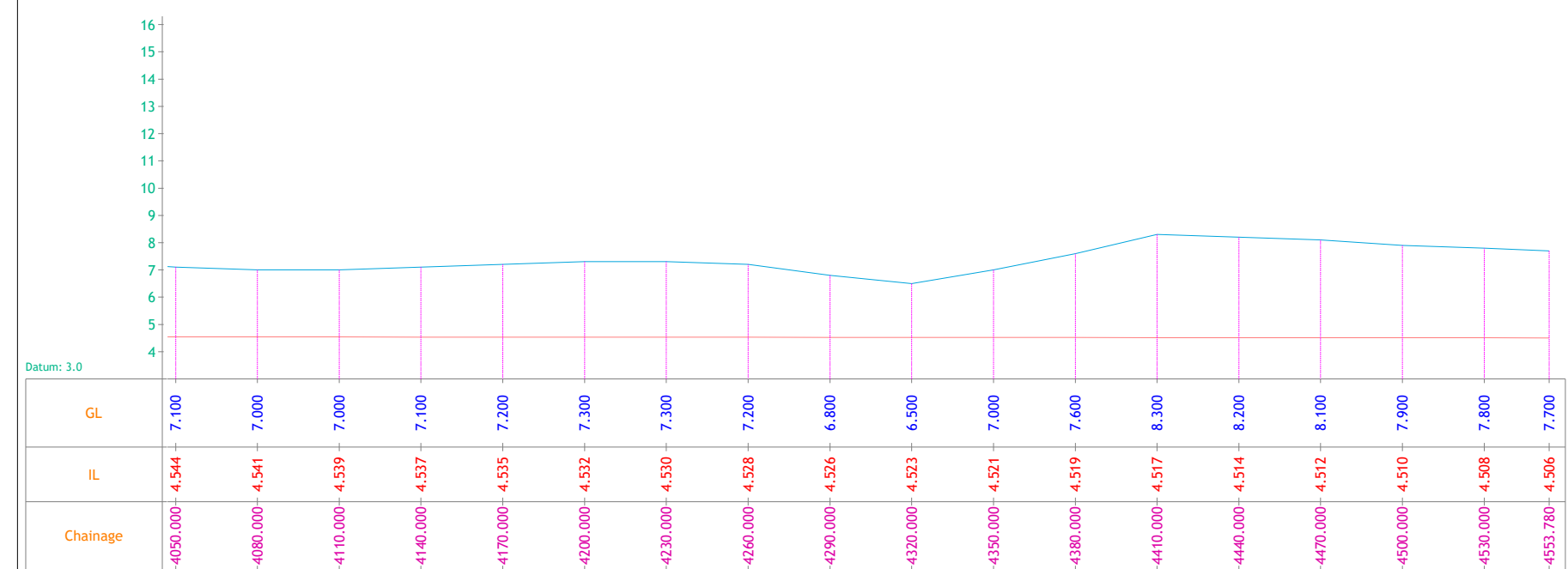
PROJECT NAME	Providing, Supplying, Laying of Gravity Pipeline from Chitra Market Yard Pumping Station to New MPS at TP-20 and 900mm Dia. DI Rising Main from MPS at TP-20 to 30 MLD Sewage Treatment Plant at Kumbharwada		
SUBJECT	LAYOUT PLAN OF RISING MAIN LINE AND L SECTION		
DRAWING NO/REV NO	DWG-1	DT : 24-02-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	BKD	BKD	
DHAVAL ENGINEERS HEAD OFFICE: D-210, SUNRISE ARCADE, ABOVE BAGRAM HOTEL, OPP. PRATIN MALL, CH-0 KORA ROAD, KUDASAN, DIST: GANDHINAGAR BRANCH OFFICE: S-4, SECOND FLOOR, PLOT NO-304 SECTOR -22, GANDHINAGAR			
			




PROJECT NAME	Providing, Supplying, Laying of Gravity Pipeline from Chitra Market Yard Pumping Station to New MPS at TP-20 and 900mm Dia. DI Rising Main from MPS at TP-20 to 30 MLD Sewage Treatment Plant at Kumbharwada		
SUBJECT	LAYOUT PLAN OF RISING MAIN LINE AND L SECTION		
DRAWING NO/REV NO	DWG-2	DT : 24-02-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	BKD	BKD	
DHAVAL ENGINEERS HEAD OFFICE: D - 210, SUNRISE ARCADE, ABOVE BAGRAM HOTEL, OPP. PRATIN MALL, CH-O KORA ROAD, KUDASAN, DIST: GANDHINAGAR BRANCH OFFICE: S-4, SECOND FLOOR, PLOT NO-304 SECTOR - 22, GANDHINAGAR			
			

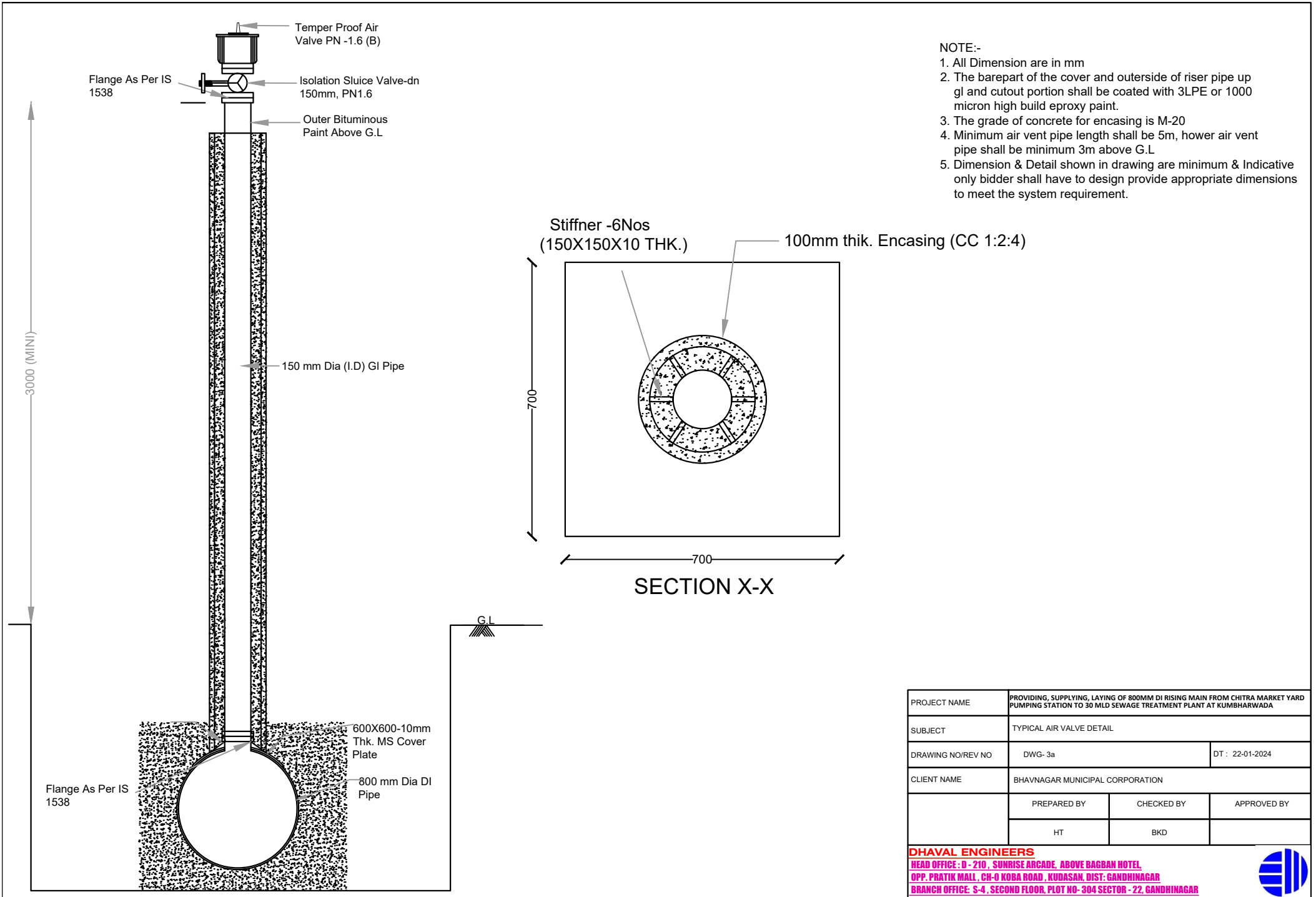


PROJECT NAME	Providing, Supplying, Laying of Gravity Pipeline from Chitra Market Yard Pumping Station to New MPS at TP-20 and 900mm Dia. DI Rising Main from MPS at TP-20 to 30 MLD Sewage Treatment Plant at Kumbharwada		
SUBJECT	LAYOUT PLAN OF RISING MAIN LINE AND L SECTION		
DRAWING NO/REV NO	DWG-3	DT : 24-02-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	BKD	BKD	
DHAVAL ENGINEERS HEAD OFFICE: D - 210, SUNRISE ARCADE, ABOVE BAGRAM HOTEL, OPP. PRATIN MALL, CH-0 KORA ROAD, KUDASAN, DIST: GANDHINAGAR BRANCH OFFICE: S-4, SECOND FLOOR, PLOT NO-304 SECTOR -22, GANDHINAGAR			
			



PROJECT NAME	Providing, Supplying, Laying of Gravity Pipeline from Chitra Market Yard Pumping Station to New MPS at TP-20 and 900mm Dia. DI Rising Main from MPS at TP-20 to 30 MLD Sewage Treatment Plant at Kumbharwada		
SUBJECT	LAYOUT PLAN OF RISING MAIN LINE AND L SECTION		
DRAWING NO/REV NO	DWG-4	DT : 24-02-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	BKD	BKD	
DHAVAL ENGINEERS HEAD OFFICE: D - 210, SUNRISE ARCADE, ABOVE BAGRAM HOTEL OPP. PRATIN MALL, CH-0 KORA ROAD, KUDASAN, DIST: GANDHINAGAR BRANCH OFFICE: S-4, SECOND FLOOR, PLOT NO-304 SECTOR -22, GANDHINAGAR			

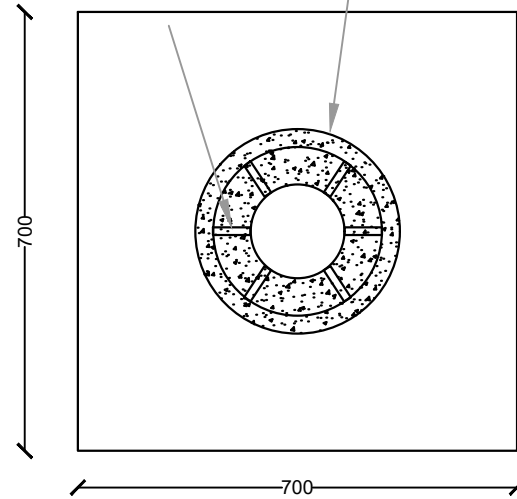




NOTE:-

1. All Dimension are in mm
2. The barepart of the cover and outside of riser pipe up gl and cutout portion shall be coated with 3LPE or 1000 micron high build epoxy paint.
3. The grade of concrete for encasing is M-20
4. Minimum air vent pipe length shall be 5m, hower air vent pipe shall be minimum 3m above G.L
5. Dimension & Detail shown in drawing are minimum & Indicative only bidder shall have to design provide appropriate dimensions to meet the system requirement.

Stiffner -6Nos
(150X150X10 THK.) 100mm thik. Encasing (CC 1:2:4)

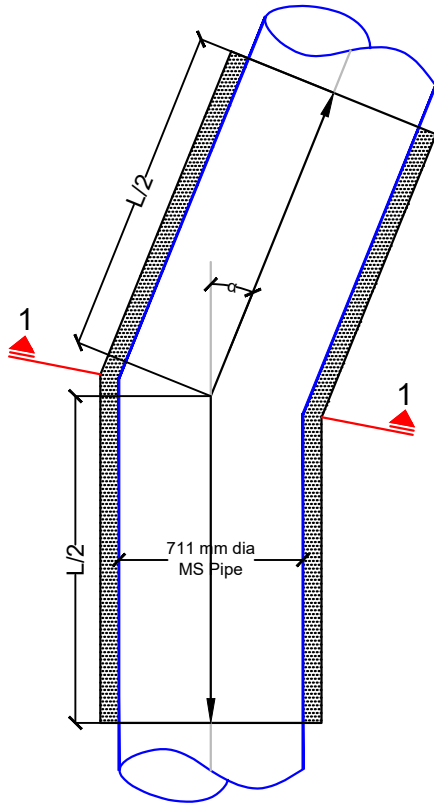


SECTION X-X

PROJECT NAME	PROVIDING, SUPPLYING, LAYING OF 800MM DI RISING MAIN FROM CHITRA MARKET YARD PUMPING STATION TO 30 MLD SEWAGE TREATMENT PLANT AT KUMBHARWADA		
SUBJECT	TYPICAL AIR VALVE DETAIL		
DRAWING NO/REV NO	DWG- 3a	DT : 22-01-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	HT	BKD	

DHAVAL ENGINEERS
 HEAD OFFICE : D - 210 , SUNRISE ARCADE , ABOVE BAGBAN HOTEL,
 OPP. PRATIK MALL , CH-0 KOBA ROAD , KUDASAN , DIST: GANDHINAGAR
 BRANCH OFFICE: S-4 , SECOND FLOOR, PLOT NO- 304 SECTOR - 22, GANDHINAGAR



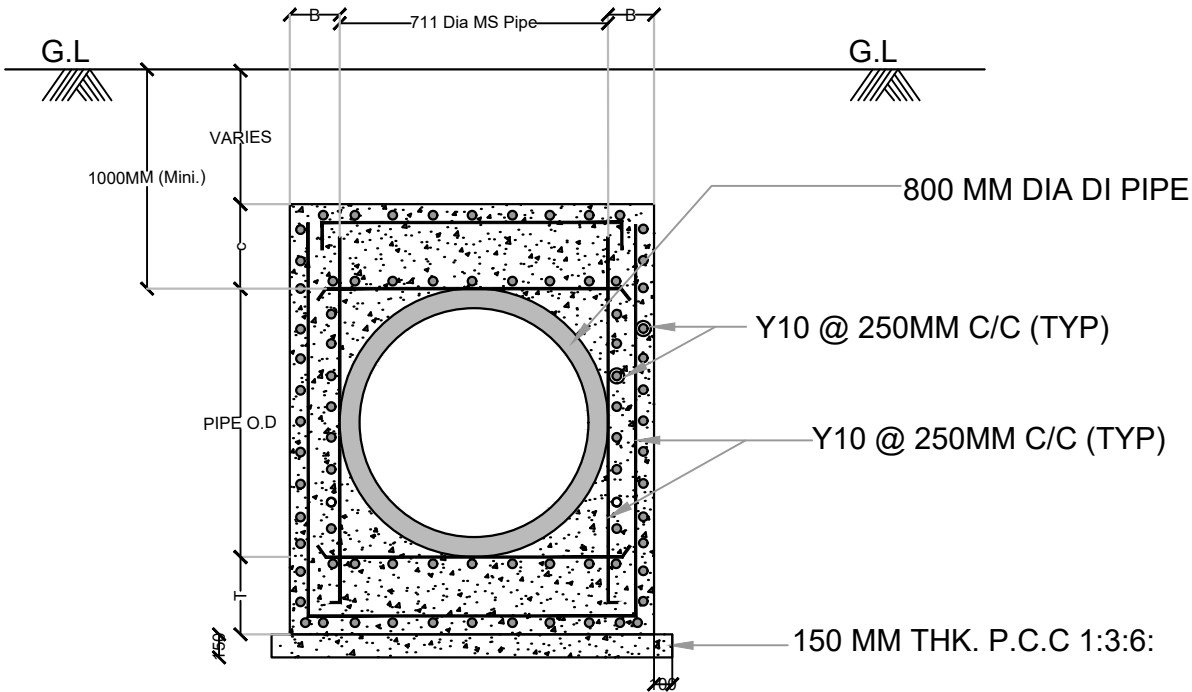


PLAN FOR BEND (TYP)

NOTE:-

1. This Drawing is not to Scale
2. All Dimension are in mm
3. All plain and reinforced concrete is conforming to IS-456.
4. Cement for RCC work shall be ordinary portland cement conforming to IS :2697,IS8112.
5. Cover to be provided to main reinforcement= 40mm.
6. All RCC shall be M-20 Grade.
7. Reinforcement steel shall be TMT -Fe 415.
8. In plan skin reinforcement is not shown for clarity. for detail please refer the typical section 1-1

S.I NO	DEFLECTION ANGLE a	SIZED OF THRUST BLOCK			
		L IN M.	B IN M.	C IN M.	T IN M.
1	Upto 15°	2.56	0.250	0.250	0.250
2	16° to 22.5°	3.54	0.250	0.300	0.250
3	22.6° to 30°	4.69	0.250	0.300	0.250
4	31° to 45°	6.94	0.250	0.300	0.250
5	46° to 60°	9.66	0.250	0.300	0.250
6	61° to 90°	12.82	0.250	0.300	0.250



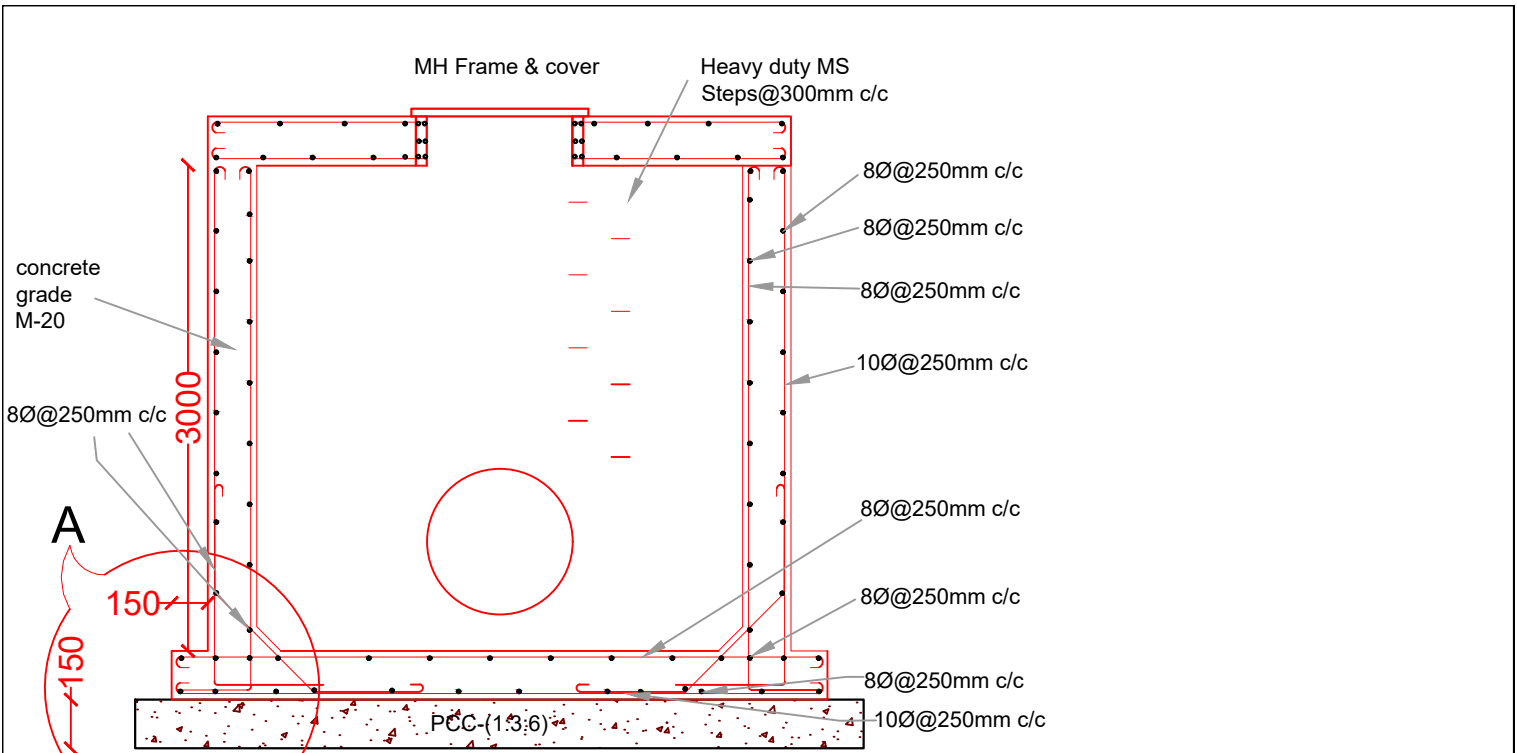
SECTION : 1-1
TYP. SECTION OF THRUST BLOCK

**THRUST BLOCK FOR
711 MM MS PIPE**

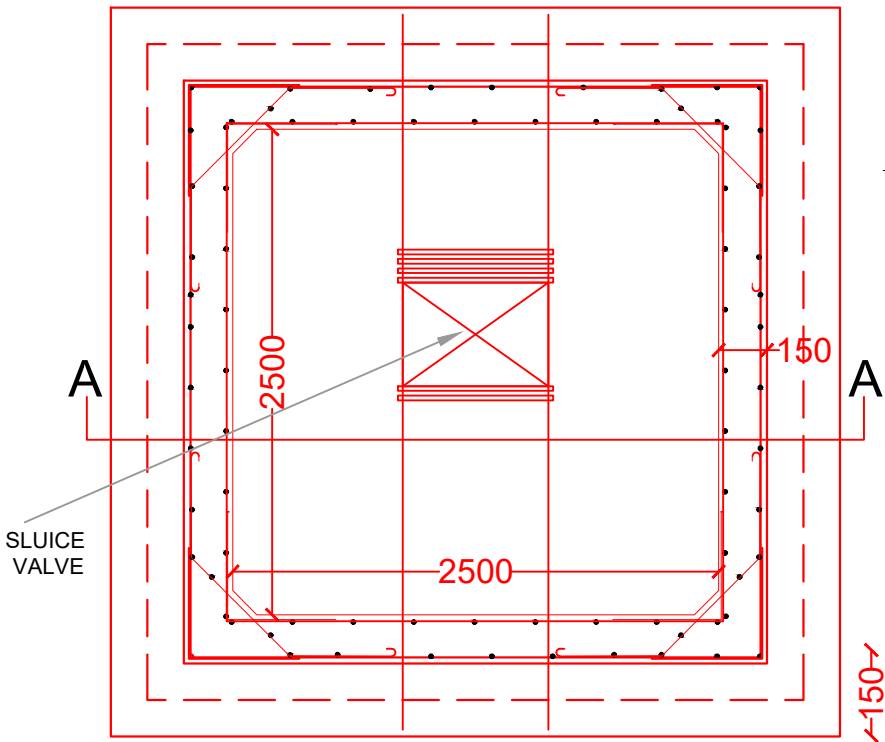
PROJECT NAME	PROVIDING, SUPPLYING, LAYING OF 800MM DI RISING MAIN FROM CHITRA MARKET YARD PUMPING STATION TO 30 MLD SEWAGE TREATMENT PLANT AT KUMBHARWADA		
SUBJECT	THRUST BLOCK DETAIL		
DRAWING NO/REV NO	DWG- 3b	DT : 22-01-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	HT	BKD	

DHAVAL ENGINEERS
 HEAD OFFICE : D-210, SUNRISE ARCADE, ABOVE BAGBAN HOTEL,
 OPP. PRATHI MALL, CH-0 KORA ROAD, KUDASAN, DIST: GANDHINAGAR
 BRANCH OFFICE: S-4, SECOND FLOOR, PLOT NO- 304 SECTOR -22, GANDHINAGAR

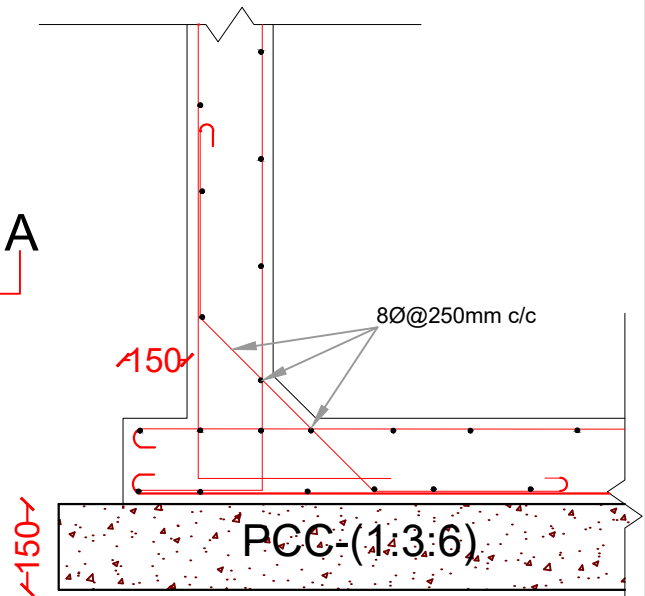




SECTION A-A



PLAN



DETAIL-'A'

PROJECT NAME	PROVIDING, SUPPLYING, LAYING OF 800MM DI RISING MAIN FROM CHITRA MARKET YARD PUMPING STATION TO 30 MLD SEWAGE TREATMENT PLANT AT KUMBHARWADA		
SUBJECT	TYPICAL R.C.C CHAMBER DETAILS		
DRAWING NO/REV NO	DWG- 4	DT : 22-01-2024	
CLIENT NAME	BHAVNAGAR MUNICIPAL CORPORATION		
	PREPARED BY	CHECKED BY	APPROVED BY
	HT	BKD	

CONTRACT NO.

**Bhavnagar Municipal Corporation
BHAVNAGAR**



(A WHOLLY OWNED BHAVNAGAR MUNICIPAL CORPORATION UNDERTAKING)

ESTIMATED COST

BID DOCUMENT FOR PROVIDING, SUPPLYING, LOWERING, LAYING, JOINTING OF RCC NP3 GRAVITY MAIN PIPE FROM CHITRA MARKETING YARD PUMPING STATION TO NEW PUMPING STATION AT TP-20 AND D.I RISING MAIN FROM NEW PUMPING STATION AT TP-20 TO 30 MLD SEWERAGE TREATMENT PLANT AT KUMBHARWADA, BHAVNAGAR. BHAVNAGAR MUNICIPAL CORPORATION (BMC), DISTRICT: BHAVNAGAR

VOLUME- V

Conditions of Contract for O & M

GENERAL CONDITIONS OF CONTRACT

FOR OPERATION AND MAINTENANCE

I - ADMINISTRATIVE PROVISIONS

The following additional clauses shall apply only during the Operation and Maintenance period.

1. DEFINITIONS AND INTERPRETATION:

1.1. Definitions:

In these Conditions of Contract ("Conditions") the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires.

1. "Applicable Law" means all national (or State) legislation, statutes, ordinances and other Laws and regulations and by laws of any legally constituted public authority.
2. "Contract" means the contract agreement, these conditions, the employer's requirements, the Tender and the further documents (if any) which are listed in the contract agreement.
3. "Contractor's Equipment" shall mean all equipment, instruments, tools, machinery and other appliances and things of the Contractor at the Site required for the fulfilment of the obligations of the Contractor under these Conditions.
4. "Contractor's Personnel" means the contractor's representative and all personal that the contractor utilizes on site, which may include the staff, labour, & other employees of the contractor and of each sub-contractor & any other personnel assisting the contractor in the execution of the work.
5. "Dispute" shall have the meaning given to it in Clause 15 of these Conditions.
6. "Employer's Risk" shall include the risks mentioned as employer's risks in the General Conditions and shall include any negligence or misconduct on the part of the Employer and also any event of Force Majeure as provided in Clause 12 of these Conditions.
7. "Employer's Personnel" means the Employer's Representative, the assistants and all other staff, labour and other employees of the employer and of the Employer's representative, and

any other personnel notified to the contractor, by the employer or the employer's representative, as employer's personnel.

8. "Employer's Requirements" means the document entitled employer's requirements, as included in the contract, and any additions and modifications to such document in accordance with the contract. Such document specifies the purpose, scope, and / or design and / or other technical criteria, for the works.
10. "Force Majeure" shall mean those events mentioned in Clause 12 of these Conditions.

"General Conditions" shall mean the conditions of tender issued by BMC for O&M works of projects.
- b) "Good Operating Practices" means the standards, practices, methods and procedures as practiced internationally and in India conforming to all Applicable Law and that degree of skill, diligence, prudence and foresight which would reasonably be expected from a skilled and experienced contractor engaged in India in the same type of undertaking under the same or similar circumstances as the Contractor pursuant to these Conditions.
11. "O & M Contract" shall mean the contract or part of any other contract having scope of operation and maintenance of facilities, entered in between the Employer and the Contractor pursuant to these Conditions.
12. "O & M Completion Certificate" shall mean the certificate to be issued by the Employer on the completion of all the obligations of the Contractor under these Conditions.
- a) "O & M Services" shall mean those services specified in Schedule [1] which the Contractor is obligated to perform under these Conditions.
13. "O & M Standard" shall mean the standards:
 - a) As set forth in the O & M Manual as accepted by the Employer,
 - b) As required pursuant to Applicable Law;
 - c) Set out in the Performance Guarantee; and
 - d) For the functioning of the Facility as required in accordance with the Contract including such requirements as may be mentioned in the Employer's Requirements.
 - e) For the functioning of the Facilities set forth in these Conditions.
14. "O & M Manual" shall have the meaning for manual of Operation and Maintenance.
15. "O & M Period" shall have the meaning set out in Clause.
16. "O & M Price" shall mean the amount stated in Price Schedule.
17. "Party" shall mean each of the Contractor and the Employer and Parties shall mean both of them together.
18. "Performance Guarantees shall mean the guarantee that the Facility shall be operated satisfying the minimum performance parameters set out in Schedule.

22. "Successor Contractor" shall have the meaning given to it in Clause.
23. "Site" shall mean that specific area specified in the bid documents & shall include any other places as may be specifically designed by the employer from the time to time as forming part of the site.
24. "Taking over Date" shall mean the date of issue of the taking over certificate at the end of Operation and Maintenance period.
25. "Taking over Certificate" means the certificate to be issued by employer to the contractor at the successful completion of the Operation and Maintenance period.
26. "Termination" shall have the meaning given to it in Clause [13] of these Conditions.

1.2. Interpretation:

In these Conditions, except where the context requires otherwise.

- a) words indicating one gender include all genders,
- b) words indicating the singular also include the plural and words indicating the plural also include the singular,
- c) Provisions including the word "agree", "agreed" or "agreement" require the agreement to be recorded in writing;
- d) "written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record;
- e) The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions;
- f) The words "include", "includes" and "including" is not limiting;
- g) As used in these Conditions, all defined terms include the plural as well as the singular;
- h) Any agreement, document or drawing defined or referred to in these Conditions shall include amendment, modification and supplement thereto and waiver thereof as maybe come effective from time to time, except where otherwise indicated;
- i) Any reference to any Clause or Sub – Clause shall unless specified otherwise mean Clause or Sub-Clause of these Conditions; and
- j) Any rights of the Employer to make any inspections or to review any document shall not create any obligation on the Employer to conduct such inspections or reviews to detect any errors, inaccuracies, ambiguities or other potential problems. No inspection or approval by or on behalf of the Employer shall operate as a waiver of any provision of these Conditions, any obligation of Contractor under these Conditions, or any of the rights of the Employer hereunder, except as expressly agreed in writing by the Employer.

1.3 Commencement and Duration of O & M Contract:

1.3.1. "The O & M Period" shall commence from the date of issue of certificate of successful commissioning (after 3 months of Trial run) of the facilities and shall continue for a period of 5 years there from.

1.3.2. The O & M period may then be extended subject to mutual consent and on terms and conditions agreed to by both the Parties.

1.4. Applicable Law:

1.4.1. The Contractor shall comply with all Applicable Law relevant to the Contractor's Personnel, including Applicable Law relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights.

1.4.2. The Contractor shall require his employees to obey all Applicable Laws, including those concerning safety at work.

1.4.3. In the event Employer becomes liable to any Employers Personnel, any governmental authority (including but not limited to any fines or penalties levied by or payable to such authority) or any other third party under the provisions of any Applicable Law resulting from Contractor's failure to comply with such Applicable Law, Contractor shall reimburse Employer for all payments required to be made by Employer to such Employers Personnel, governmental authority or any other third party, plus the actual expenses that Employer may incur in investigating, settling or defending any litigation or threatened litigation.

1.5. Assignment:

The Contractor will not be entitled to sub-contract any part of his obligation under these Conditions to any third party without prior approval of the Employer. Neither party may assign their rights and obligations under these Conditions without the consent of the other Party. However the Employer may assign any rights under these Conditions to any financial institution from whom any financial assistance/credit facilities have been availed by the Employer.

1.6. Safety:

1.6.1. Emergencies:

In the event of an emergency endangering life or property, the Contractor shall immediately take action as may be necessary to prevent, avoid or mitigate injury, damage or loss and shall, as soon as possible, report any such incidents, including his response thereto to the Employer.

1.6.2. Contractor Action:

The Contractor shall utilize his personnel to take such action as may be necessary in accordance with Good Operating Practices in the event of an emergency. Notwithstanding anything to the contrary herein, the Contractor may incur any expenditure or take any other operating actions as the Contractor deems to be necessary (in accordance with Good operating practices) in the case of emergencies affecting the Facilities or the operation of the Facilities to counteract the effects where the Contractor considers immediate action is required to safeguard lives or property. In case such emergency was caused due to an Employer's Risk then the Employer shall reimburse such reasonable expenses that might

have been incurred by the Contractor in relation thereto acting in accordance with Good Industry Practices.

1.7. Notification:

1.7.1. In the event of an emergency the Contractor shall forthwith notify the Employer of the emergency, the expenditures made and the operating actions taken.

1.7.2. If the Employer considers that an emergency has arisen in relation to the Facilities, the Employer may give written notice to the Contractor specifying the nature of the emergency which it has identified and the manner in which it requests such emergency to be rectified. The Contractor shall rectify such defect with all due diligence. If such emergency is on account of an Employer's Risk then the Contractor shall be reimbursed all costs and expenses reasonably incurred by the Contractor for any actions taken by it pursuant to such direction or notice. If the Contractor fails to comply with such direction or notice promptly, the Employer shall be entitled to procure that it or any third party takes such actions as may be necessary to remedy such breach by the Contractor. Any costs that may be incurred by the Employer in this regard shall be reimbursed to him in full by the Contractor and shall be a debt due to him from the Contractor.

1.8 Inspections:

Notwithstanding any provisions of these Conditions and without prejudice to any of the other rights vested by the Contractor under these Conditions, The Employer shall have the right at all times to inspect the Facilities and the Contractor shall co-operate in every manner with the representatives of the Employer inspecting the Facilities and allow them access to every part of the Facilities and produce any records requested.

2. OPERATION OF THE FACILITIES:

2.1. Operation of the Facilities:

2.1.1. The Employer appoints the Contractor to perform and undertake the O & M Services and all other obligations set out and in accordance with these Conditions during the O&M Period. The Contractor accepts the appointment and acknowledges a duty to perform such obligations.

2.1.2. The Contractor shall be in complete charge of and have custody and control over and responsibility for the Facilities, and the Contractor shall perform or cause to be performed on behalf of the Employer all O & M Services for the Facilities and shall supply or cause to be supplied all materials required therefore in accordance with the O & M Standard.

2.1.3. The Contractor shall also acknowledge that the Employer and the Employer's Personnel and other contractors may be carrying out work at the Facilities and shall Endeavour to fully co-operate and work in a manner so as not to cause any obstruction or hindrance to them.

2.1.4. The Contractor shall remain an independent Contractor and not an agent, employee and nothing in these conditions or the O & M part of contract shall be deemed to create a joint venture between the Employer and the Contractor.

2.2. Responsibility of the Contractor:

The Contractor shall be solely and exclusively responsible for:

- 2.2.1. Obtaining all necessary permits and consents required by Applicable Law or any governmental authority for the Contractor to carry out the O & M Services;
- 2.2.2. The procurement of all goods and services necessary to ensure compliance with its obligations under these Conditions,
- 2.2.3. Making available suitably qualified and trained personnel to perform the O & M Services;
- 2.2.4. Perform the O & M Services in accordance with the O & M Manuals and maintain the Facilities in good repair and condition and ensure that the Facilities are well and suitably maintained at all times in accordance with Good Operating Practices and in accordance with these Conditions;
- 2.2.5. Procuring and administering all chemicals and other consumables, tools, equipment, spare parts and other materials (which shall be of good quality and unused) necessary for the operation and maintenance of the Facilities;
- 2.2.6. Maintaining a system of records to identify all inventories related to the Facilities and preparing and providing to the Employer a complete accounting of such inventory for every fiscal quarter;
- 2.2.7. Arranging for the testing and recalibration of all scales, meters, gauges and other measuring devices at the Facilities on an annual basis and maintain the calibration certificate as records unless otherwise stated in the O & M Contract; and
- 2.2.8. for providing any and all relevant information required by the Employer.

3. DUTY OF CARE BY THE OPERATOR AND PERFORMANCE STANDARDS:

3.1. Duty of Care:

- 3.1.1. The Contractor shall manage, operate and maintain the Facilities in accordance with Good Operating Practices and in accordance with the O & M Standard so that the Facilities are capable of meeting the outputs and specifications set out in the Contract.
- 3.1.2. The Contractor shall take full responsibility for the care of the Facility from the date of start of O & M period, till the end of the O & M Period.
- 3.1.3. If any loss or damage happens to the facility, during the O & M Period due to any breach by the Contractor of any of his obligations under these Conditions including any wilful misconduct, negligence and non-conformity with Good Operating Practices then the Contractor shall, at his own cost, rectify such loss or damage so that the facility conforms in every respect with the provisions of these Conditions.
- 3.1.4. The Employer shall be liable only in case of any damage caused due to any Employer's Risk.

4. OBLIGATIONS AND RESPONSIBILITIES OF THE EMPLOYER:

The Employer shall employ the Contractor to provide the O & M Services and shall:

- 4.1. Follow the issue of certificate of successful commissioning, hand-over the custody of the facilities to the Contractor for its use during the O & M Period; and
- 4.2. Pay the Contractor all sums required to be paid in accordance with the terms of these Conditions. Notwithstanding anything else herein contained the Employer may set off any sums owed by the Contractor under the Contract for monies owed to the Contractor by the Employer under these Conditions or as a debt due from the Contractor.

5. REPRESENTATIONS AND WARRANTIES OF THE CONTRACTOR:

The Contractor hereby represents for the benefit of the Employer as follows:

5.1. Performance of O & M Services:

- 5.1.1. That the Contractor has the required skills and capability to perform, and shall diligently perform, the O & M Services in a high-quality, timely and professional manner utilizing sound engineering principles and project management procedures in accordance with Good Industry Practices;
- 5.1.2. That the Contractor shall perform his obligations hereunder in accordance with the requirements of these Conditions and shall meet the Performance Guarantee; and
- 5.1.3. That it shall not use any spare parts or material that are not new and which shall be of a quality that is in accordance with Good Industry Practices.

5.2. Knowledge of Adverse Information:

- 5.2.1. As of the Commencement Date, Contractor is not aware of any facts, conditions or events which would affect the ability of Contractor to provide the O & M Services in accordance with these Conditions.
- 5.2.2. Contractor has familiarized itself with the nature and extent of the O & M Services required to be provided under these Conditions and with all other requirements under Applicable Law

5.3. Organization, Standing and Qualification:

Contractor is validly existing and in good standing under Applicable Law and has all necessary power and authority to carry on its business as presently conducted and to perform its obligations under these Conditions. Contractor is, or will be prior to the date on which the O & M Services are to be commenced duly qualified or licensed to provide these services.

5.4. Due Authorization:

- 5.4.1. Each of the execution, delivery and performance by the Contractor of all contracts entered into pursuant to these Conditions shall be duly authorized by all necessary action on the part of Contractor.
- 5.4.2. Neither the execution and delivery by Contractor of the O&M Contract, nor the consummation by Contractor of any of the transactions contemplated hereby, requires the consent or approval of, the giving of notice to, the registration with, the recording or filing of any document with, or the taking of any other action in respect of, any governmental authority or agency, except:

- a) Such as have been duly obtained, given, registered, recorded, filed or taken and are in full force and effect or are not yet required; and
- b) Filings and recordings expressly required pursuant to the O & M part of Contract. Contractor holds, or will obtain, any and all licenses, permits and approvals on a timely basis. Contractor has no reason to believe that any of those not yet required will not be readily obtainable or done in the ordinary course of business upon due application there for

5.5. Litigation:

In the aggregate, there are no pending or, to the knowledge of Contractor, threatened actions, investigations or proceedings before any court, governmental authority or arbitrator, which would have material adverse effect on the ability of Contractor to perform its obligations under these Conditions

6. INSURANCE:

6.1. General Conditions:

- 6.1.1. Without limiting the Contractor's obligations, responsibilities and liabilities under these Conditions, the Contractor shall be required to provide and maintain in full force and effect, at his expense the insurance coverage's specified in Schedule [5] throughout the O&M Period. Any deductibles on the insurance shall be to the account of the Contractor.
- 6.1.2. Maintenance of insurance shall not relieve the obligation of the Contractor to remedy or repair any damage to the Facility in case such damage is caused due to the fraud, negligence, willful misconduct or breach of any obligations of the Contractor under these Conditions(including failure to perform the O & M Services in accordance with Good Operating Practices)at the Contractors cost promptly and regardless of the extent of settlement of claims by the underwriters or the time taken for settlement of claims. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor to the extent any such liability or damage is caused due any breach of any obligations of these Conditions (including failure of the Contractor to perform the O & M Services in accordance with the Good Operating Practices) by the Contractor or any willful misconduct, negligence on the part of the Contractor.
- 6.1.3. The terms of the Insurance shall be approved by the Employer.
- 6.1.4. The Contractor within the 14 days from work order shall submit to the Employer evidence that the insurances required under Schedule [5] of these Conditions has been obtained as approved by the Employer.
- 6.1.5. The Contractor shall not make any alteration to the terms of any insurance without the prior approval of the Employer. If the Contractor fails to effect and keep in force any of the insurance it is required to effect and maintain under these Conditions, or fails to provide satisfactory evidence and copies of policies in accordance with this Sub-Clause, the Employer may affect insurance for the relevant coverage and pay the premiums due and may claim the same from the Contractor.

The insurances;

- a) shall be in the name of the Employer and the Employer shall be the sole loss payee,

- b) shall be extended to cover liability for all loss and damage to the Employer's property arising out of the Contractor's performance of his obligations or failure to do so under these Conditions and any fraud, gross negligence or wilful misconduct on his part, and
- 6.1.6. If the Contractor fails to effect and keep in force insurance which is required to be maintained under these Conditions, and the Employer neither approves the omission nor effects insurance for the coverage relevant to this default, any moneys which would have been recoverable pursuant to such insurance shall be paid by the Contractor.
- 6.1.7. The insurance shall cover all the electrical items, mechanical items, Instrumentation & automation items, all civil works, Storage structures etc. The insurance for the work of transmission main is optional. Since the responsibility of safety of all work lies with contractor, contractor may prefer to take the insurance of optional item also if deemed fit.
- 6.1.8 The natural calamity & fire etc. (standard perils) insurance shall be limited to Electrical & Mechanical Equipments / assets of the pumping station installed indoor and / or outdoor. The beneficiary shall be BMC on A/c of bidder and "Standard Workman Compensation Policy" of manpower engaged for the work by the bidder should be on Account of the bidder c/o BMC TOWN. In short the bidder has to take adequate insurance cover for electro mechanical Equipments (value shall not be less than estimated and / or accepted value) and man power engaged for O & M work as per rates / monthly amount as per prevailing minimum wages act without fail. It would be contractor's sole responsibility to see that insurance policies are bought & renewed in time. Failure to comply with this condition the contractor shall be entirely responsible for any litigation & financial liabilities.

7. INDEMNIFICATION:

7.1. Loss or Damage to Facilities:

The Contractor shall at its own expense make good any physical loss or damage to the Facilities occasioned by it in the course of the performance of its obligations under these Conditions if and to the extent such loss or damage is caused by the negligence, willful default or breach of statutory duty or failure to follow Good Industry Practices by the Contractor

7.2. Other Loss or Damage:

7.2.1. Except as otherwise stated in this Clause 7.2 or covered by Clause 7.3, the Contractor shall indemnify, defend and hold harmless the Employer against any and all liabilities, losses, damages and claims of whatever kind and nature, including all related costs and expenses incurred in connection therewith, in respect of personal injury to or death of third parties or any employee of the Employer or the in respect of loss of or damage to any third party property or property belonging to employee of the Employer by:

- i) any breach by the Contractor of its obligations hereunder and
- ii) any negligence, wilful default or breach of statutory duty on the part of Contractor

7.2.2. Except as otherwise stated in this Clause 7.2 or covered by Clause 7.3, the Employer shall indemnify, defend and hold harmless the Contractor for all claims and losses of whatever kind and nature, including all related costs and expenses incurred in connection therewith, in respect of personal injury to or death of third parties or of any person employed by the Contractor in respect of loss of or damage to any third party property or property belonging to any person employed by the Contractor to the extent that the same arises out of any Employer's Risk

7.3. Accidents or Injury to Workmen:

- 7.3.1. The Contractor shall indemnify, defend and hold harmless the Employer or any Employer's Personnel against any and all claims for loss, damage and expense of whatever kind and nature (including all related costs and expenses) in respect of the death of or injury to any person employed by the Contractor in connection with the performance of the O&M Services and obligations hereunder except to the extent that such death or injury is caused by an Employer's Risk.
- 7.3.2. Neither Party shall be liable to the other Party for loss of use of the Facilities, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, other than under Sub-Clause [13] and this Clause [7].
- 7.3.3. The total liability of the Contractor to the Employer, under or in connection with these Conditions other than as provided in Clause 7.3.2 & 14 shall not exceed the sum of the O & Price and the Delay Damages payable under these Conditions.
- 7.3.4. This Sub-Clause shall not limit liability of the Contractor in case of fraud willful default, gross negligence and liabilities arising due to breach of Applicable Law and the liability under another Clause of these Conditions that might impose a greater liability on the Contractor

8. INSPECTION:

8.1. General Provisions:

- 8.1.1. The Employer may check the operation of the Facilities or designate an organization of his choice to carry out inspections regularly. The Employer or the organization appointed by him shall check that the Contractor is performing the tasks for which he is responsible with due diligence. The Contractor shall at his cost provide all the assistance the Employer requires to complete these inspections
- 8.1.2. Before any inspection, the Employer shall give prior notice to the Contractor, indicating the name(s) of the person(s) empowered to carry out such inspection in the name of the Employer

8.2. Measurement and Analysis:

- 8.2.1. The Employer has the right to perform any analysis or inspection he deems necessary.
Before any inspection, the Employer shall give a prior written notice to the Contractor.
- 8.2.2. The water quantity, for any such test, analysis or inspection shall be measured by flow-meters installed at the Facility, which are acceptable to the Employer, provided they are maintained and calibrated as per requirements of this contract.
- 8.2.3. Other parameters like Pressure temperature and speed shall be measured by certified calibrated meters provided by the contractor and, which are acceptable to the Employer
- 8.2.4. The flow meters shall be inspected and certified upon their availability by the Employer and the Contractor. Thereafter, the said meters shall be tested and their accuracy verified once in every six (6) months by the Contractor. After each inspection, the flow-meters shall both be

sealed in the presence of representatives of the Employer and the Contractor in a manner that is adequate to prevent the tampering of said meters by any person.

8.2.5. The Contractor shall be responsible for the security and protection of flow-meters at the designated point. If there is any malfunctioning of the meters, it should be repaired at the Contractor's cost, as per manufacturer's technical recommendations.

8.3. Plant Complex Visits:

8.3.1. At the end of each month, or at the initiative of the Employer, a visit shall be organized so that both Parties can check the condition of the installations at the Facilities.

8.3.2. A report shall be drawn up to record the opinions of both Parties. The Employer reserves the right to call in equipment manufacturers or specialized technicians for these visits.

8.3.3. These visits shall provide an opportunity for examining maintenance programs and operating procedures and improvements requiring additional investments.

8.3.4. Any test, visit, analysis or inspection and any approval thereof shall not in any way alter/modify or dilute the responsibility of the Contractor to fulfil his obligations under these Conditions.

9. RECORDS AND REPORTS:

9.1. Operating Records and Data:

The Contractor shall:

9.1.1. Prepare and maintain, on a current basis and in accordance with generally accepted Indian accounting principles, proper, accurate and complete books and records and accounts of all transactions related to the Facilities including a log book at the site which shall contain inter alia the following details

- a) Reading from the different meters, indicators and recorders (including but not limited to consumption of energy, volume of water conveyed, operating times of the different items of equipment etc which may be updated on a daily basis); and
- c) Report of visits by persons other than those of the Employer and the Contractor to the Facility

9.1.2. Establish and maintain a weekly and monthly reporting system to provide storage and ready retrieval of operating data relating to the Facilities, including such information necessary to verify calculations made pursuant to these Conditions or the O & M part of contract and provide the same to the Employer on a monthly basis

9.1.3. Provide to the Employer or such persons notified by it access to the Facilities and to data in relation to the Facilities, at all times.

9.1.4. At the Employer's request, at the end of every month, make a copy of the system performance data for that month as recorded by the instrument and control system on CDs / DVDs and printed document there from and deliver the same to the Employer with one week.

9.1.5. Provide support to the Employer to meet the data requirements of all competent authorities and under Applicable Law.

9.2. Reports:

9.2.1. The Contractor shall submit the reports mentioned in Schedule [4] at times indicated in the said Schedule.

9.2.2. The Contractor shall also provide the Employer with such reports as are required by the Employer and shall comply with all reporting requirements prescribed under these Conditions and the O & M part of Contract. In addition the Contractor shall submit the following information to the Employer.

9.2.3. Upon obtaining knowledge thereof, shall submit prompt written notice of:

- i) Any litigation or material claims, disputes or actions, threatened or filed, concerning the Facilities or the services to be performed hereunder;
- ii) Any refusal or threatened refusal to grant, renew or extend or any action pending or threatened that might affect the granting, renewal or extension of any clearance, permit or license;
- iii) Notwithstanding the aforementioned materiality, all penalties or notices of violation issued by any authority under Applicable Law;

9.3. The Contractor shall promptly submit to the Employer any material information concerning new or significant aspects of the operations of the Facilities, any material complaint about the Facilities from any person or entity with a benefice complaint who complains directly tithe Contractor and, upon Employer's request, shall promptly submit any other information concerning the Facilities or the services performed by the Contractor.

9.3.1. The Employer may from time to time specify any changes to be made to any of the format of any report or plan required hereunder.

9.3.2. If the Contractor is required by any Applicable Law to produce any projection, report or another document relating to the provision of the O & M Services of the Facilities or the Employer requests a report regarding other information relating to the Facilities, the Contractor shall prepare a draft of such document at the request of the Employer, as soon as practicable and in any event within any time limit prescribed by Applicable Law.

9.3.3. If the Contractor is required by any Applicable Law to produce any projection, report or another document, it shall prepare such report diligently and submit the same to the Employer as soon as possible thereafter. Wherever practicable, such reports shall be submitted to the Employer for review seven days before the same is issued. The Contractor shall take into account any comments or revisions proposed by the Employer thereon.

9.4. Procurement:

9.4.1. The Contractor is responsible for the procurement of all goods and services necessary to ensure compliance with its obligations under these Conditions.

9.4.2. The Contractor shall procure and keep in readiness spare parts required for urgent repairs, materials, supplies and other consumable items, and maintains an adequate inventory thereof Facilities.

9.4.3. The Contractor shall submit a report for every fiscal quarter to the Employer reflecting the status of the inventory for spare parts, materials and other consumable items.

9.4.4. The Contractor shall procure the Alum, Lime and Chlorine Gas. Necessary arrangement for procurement of Chlorine Gas in tonners/cylinders shall be made by the contractor. No extra charges shall be paid for hiring/Purchasing the tonners/Cylinders.

10. PAYMENT:

10.1. The Contractors request(s) for payment shall be made to the BMC in writing, accompanied by invoice(s) along with presence sheet of personnel of particular month duly certified by our Engineer on site, claims etc. as appropriate.

10.2. Payment shall be made by BMC as per procedure subsequent to the submission of such invoice(s)/ claim(s) by the Contractor.

10.3. The BMC will deduct from the amount payable to the Contractor, any amount paid by BMC on behalf of the Contractor (e.g. telephone bills, GVCL penalty for Power factor or any other dues and liquidated damages as per clause and, as per tender terms and condition. Any telephone bills submitted by telephone department, the payment of telephone bills will be borne by Contractor.) BMC will provide telephone facilities on site.

10.4. Contractor will provide Security Guards services for all assets in BMC head works premises for 24 hours of a day and 365 days of the year for the whole contractor period'

10.5. The contractor will get O & M work payment only for the deployed staff and insurances during the period of defect liability for pumping machinery & electromechanical works. The base for payment will be approved estimated rates

11. LIQUIDATED DAMAGES:

11.2. Leakages in pipeline.

The contractor shall ensure that leakages from transmission mains due to faulty air release valves, scour valves, joints, damage to pipeline are urgently attended.

11.3. For Higher Power consumption, due to lower pump efficiency:

At Testing / Commissioning stage, the following minimum guaranteed parameters must be achieved for the pumps and motors installed for this work shall be as under:

- a. For each pump, the minimum efficiency shall be as mentioned in contract / HIS.
- b. For each motor, the minimum efficiency shall be as per contract.

Note: No negative tolerance shall be allowed in above.

During Testing/ Commissioning, each pump and motor set shall be tested and efficiency shall be worked out up to TWO Decimal. The combined efficiency of each pump and motor set shall also be worked out. If the guaranteed combined efficiency of each pump motor set found lesser than the specified above, then the pump and/or motor set shall be liable for rejection. Therefore, the contractor shall rectify/ repair / replace the system/ part and retesting/ re- commissioning to be carried-out for the pump and/or motor set within a week period. Thereafter, In case, the guaranteed combined efficiency of each pump and motor set not meeting the above guaranteed combined efficiency, then the pump and/ or motor set shall be rejected. No any claims from the Contractor against this shall be entertained.

11.4. For delay in Restoration:

The Restoration Period shall be subject to the following liquidated damages & penalties for its failure to carry out.

11.5. For the non-compliance of employment of key personnel:

If the successful bidder does not recruit/depute the key personnel identified as per schedule, then liquidated damages will be deducted at double the rate of applicable scale of BMC/Local body or the rate quoted, whichever is higher.

12. FORCE MAJEURE:

In this Clause, "Force Majeure" means an event or circumstance, which materially and adversely affects the ability of the affected Party to perform its obligations.

- i) Which is beyond a Party's control,
- ii) which such Party could not reasonably have provided against before entering into the O & M part of Contract;
- iii) which, having arisen, such Party could not reasonably have avoided or overcome, and
- iv) which is not attributable to the other Party, Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied:
- v) war, hostilities (whether war be declared or not), invasion, act of foreign enemies)
- vi) rebellion, terrorism, revolution, insurrection, military or usurped power, or civil war,
- vii) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel and other employees of the Contractor;
- viii) As result of war, explosive materials, harmful radiation or contamination by radioactivity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity, and
- ix) Natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity. Heavy rainfall, cyclone, strike and lockout.

12.1. Notice of Force Majeure:

12.1.1. If a Party is or will be prevented from performing any of its obligations under these Conditions by Force Majeure, then it shall give notice to the other Party of the event or circumstances constituting Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 7 days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.

12.1.2. The Party shall, having given notice, be excused performance of such obligations for so long as such Force Majeure prevents it from performing them.

12.1.3. Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.

12.2. Duty to Minimize Delay:

12.2.1. Each Party shall at all times use all reasonable endeavours to minimize any delay in the performance of the Contract as a result of Force Majeure.

12.2.2. A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.

12.2.3. Notwithstanding anything else herein contained the Employer may terminate the O & Part of Contract if the Force Majeure event continues for more than a period of 90 days.

13. TERMINATION:

Termination shall mean the termination of the O&M part of Contract by the Employer or the Contractor in accordance with Clause 13.1 or 13.2 respectively.

13.1. Termination by Employer:

The Employer may terminate the O & M part of Contract by notice on:

- i) the dissolution or insolvency of the Contractor, pursuant to an order of a court or the bankruptcy of the Contractor; or;
- ii) if 45 days having passed since the Contractor is in material breach of his obligations under these Conditions, or
- iii) if the Contractor ceases to carry on its business; or
- iv) abandonment;
- v) The subsisting Force Majeure event as provided in Clause 12.2.3 above.

13.2. Payments upon Termination:

13.2.1. Upon termination or as soon as practicable thereafter an account shall be taken of the net amount owing from the Employer to the Contractor or from the Contractor to the Employer (as the case may be). The Employer shall forthwith pay to the Contractor (if the balance is due to the Contractor) all moneys due to the Contractor. If the account shows a balance due to the Employer from the Contractor, the Contractor shall forthwith pay any such balance to the Employer.

13.2.2. As part of the calculation made pursuant to clause 13.1 of the amounts due to the Contractor on Termination, the following amount shall be taken into account.

13.2.2.1. The portion of the O & M Price outstanding and payable by the Employer for the period prior to the Termination;

13.2.2.2. Any Delay Damages or indemnities for which the Contractor would be liable under these conditions up to the date of Termination;

13.2.2.3. Any other amounts due to the Employer under these Conditions by the Employer including return of any amount of the O & M Price paid in advance by the Employer to the Contractor under Clause [10].

13.3. In case of a Termination by the Employer in accordance with Clause 13.1 the Employer may recover other than the amounts due to him under Clause 13.2.2.2, any costs incurred by him in finding any replacement contractor.

13.4. Successor to the Contractor upon Termination:

- 13.4.1. The Contractor shall use all endeavours to facilitate the appointment and commencement of duties of any person to be appointed by the Employer to operate and maintain the facilities (the "Successor Contractor") so as not to disrupt the normal Operation & Maintenance of the facilities and shall provide full access to the Facilities and to all relevant information, data and records relating thereto by the Successor Contractor and its representatives and accede to all reasonable requests made by such persons in connection with preparing for taking over the Operation & Maintenance of the Facilities;
- 13.4.2. Promptly after Termination, the Contractor, shall deliver to (and shall, with effect from Termination, hold on trust for and to the order of) the Employer or (if so required by the Employer by written notice) to the Successor Contractor all property in its possession or under its control owned by the Employer or leased or licensed to the Employer;
- 13.4.3. The Contractor shall transfer to the Successor Contractor, as from the date of Termination, its rights as the Contractor under all contracts entered into by it in the performance of its obligations under these Conditions or relating to the Operation & Maintenance of its obligations under these Conditions or relating to the Operation & Maintenance of the Facilities. Pending such transfer, the Contractor shall hold its rights and interests there under for the account and to the order of the Successor Contractor.
- 13.4.4. The Employer shall be reimbursed any cost and expenses incurred by the Employer due to default of the Contractor in discharging its obligations under this Clause [13].
- 13.4.5. The Contractor shall, upon Termination of the O & M part of Contract, co-operate with the Employer and the Successor Contractor and comply with all reasonable requests thereof, including the execution of documents etc.
- 13.4.6. Upon Termination of the O & M part of Contract on expiry of the terms of the O & M part of Contract, the Parties agree that: -
- 13.4.7. The Contractor will use reasonable efforts to ensure a transition to the next Contractor that will avoid operating difficulties for the Facilities.
- 13.4.8. For a six (6) month period after Termination or six (6) months prior to the expiration of the O & M part of Contract, the Contractor shall, at his expense, provide sufficient assistance to the Employer in the hiring and training of replacement personnel for those Facilities.
- 13.4.9. Notwithstanding anything else herein contained the Employer shall be entitled to terminate the O & M part of Contract, at any time at the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 days after issuance of the notice of termination.
- 13.4.10. On the expiry of the O & M Contract or Termination of the O & M Contract, all the installations, works and equipment placed under the Contractor's responsibility shall be handed over to the Employer, at no cost, in good working order, except for normal wear and tear. The Employer may perform any inspections; tests or expert appraisals he shall consider necessary with a view to checking that the property is in good working order. The Contractor shall also hand over any unutilized spares, consumables etc. Purchased for the Facilities.

13.4.11. At the end of O & M Period, the Contractor shall be entitled to receive an O & Completion Certificate within thirty (30) days

13.4.12. The delivery of such O & M Completion Certificate will relieve the Contractor from his responsibility as regard to the operation & maintenance of the Facilities and confirm that the Contractor has fulfilled all of his obligations under these Conditions.

14. CONFIDENTIALITY AND INTELLECTUAL PROPERTY RIGHTS:

14. 1. Confidential Information:

Subject to Clause [14.2], the Contractor shall at all times during the O & M Period and for a period of two years after that:

14.1.1. use all efforts to keep all information regarding the terms and conditions and any data or information acquired under or pursuant to these Conditions confidential and accordingly shall not disclose the same to any other person; and

14.1.2. not use any document or other information (whether technical or commercial) obtained by them it by virtue of these Conditions or the Contract concerning the Employer's undertaking for any purpose other than performance of the obligations under these Conditions; Provided that the provisions of this Clause 14.1 shall not apply to information, which at the time of disclosure was in the public domain other than by breach at the foregoing obligations of confidentiality.

14.2. Disclosure of Confidential Information:

The Contractor shall not be entitled to disclose the terms and conditions of these Conditions and any data or information acquired by it under or pursuant to these Conditions without the prior written consent of the Employer unless such disclosure is made in good faith:

14.2.1. To any outside consultants engaged by or on behalf of the Contractor and acting in that capacity, having made them aware of the requirements of this Clause [14].

14.2.2. To the lenders, any security trustee, any bank or other financial institution and its advisers from which the Contractor is seeking or obtaining finance, having made them aware of the requirements of this Clause [14].

14.2.3. to the extent required by Applicable Law;

14.2.4. To any insurer under a policy of insurance; or

14.2.5. to the Contractor's Personnel having made them aware of the requirements of this Clause [14];

14.3. Information:

The Contractor shall:

14.3.1. make available to the Employer without charge such materials, documents and data of any nature (except any materials documents and data protected by legal privilege or which is subject to any duty of confidentiality to any third party) acquired or brought into existence in

any manner whatsoever by it as the Employer may request for the purposes of exercising its rights or carrying out its duties in respect of the Facilities or exercising its rights under or performing its obligations under these Conditions.

14.3.2. make available to the Employer other such materials and documents and data acquired or brought into existence by third parties as the Employer may request for the purposes referred to in sub-paragraph (l) above

14.4. Third Party Intellectual Property:

The Contractor shall:

14.4.1. Procure that any intellectual property owned or developed by third parties and utilized by the Contractor in connection with the performance of its obligations under these Conditions is licensed to the Contractor for the purposes of the Operation & Maintenance or repair of the Facilities and otherwise for the purposes of the Facility; and

14.4.2. Ensure that the Contractor shall have the right to sub-license that intellectual property to the Employer and any Successor Contractor for use in connection with the operation, maintenance and repair of the Facilities. These licenses should survive termination under these Conditions. The Contractor shall grant all such sub-licenses. If any fee is payable to the licensor in consideration of any such sub-license, the Contractor shall pay such amount during the O & M Period and each such license shall be irrevocable

14.4.3. Indemnify and hold harmless the Employer against any action, claims, and damages, losses caused to the Employer by the owner of the Intellectual Property due to the allegedly unauthorized or improper use of this intellectual property by the Contractor for the fulfilment of his obligations under these Conditions.

14.5. Successor Contractor:

If the licenses and sub-licenses of intellectual property granted under this Clause respectively shall survive termination of the O & M part of Contract in accordance with the terms of this Clause, the Employer shall be permitted to grant sub-licenses of intellectual property licensed to it there under to any Successor Contractor of the Facilities for use only in connection with the operation, maintenance and repair of the Facilities provided that such Successor Contractor concludes an agreement with the Contractor or, as the case may be, the licensor of any such intellectual property on terms which it may reasonably require any payment in connection with those sub-licenses. Where intellectual property has been sub-licensed to the Employer under this Clause and such sub-license is not subject to revocation by the Contractor there under, the Contractor shall take such actions as the Employer may request in connection with the grant of licenses to any Successor Contractor for the purposes set out above.

15. ARBITRATION AND DISPUTE RESOLUTION:

A) SETTLEMENTS OF DISPUTES:

i) If any dispute of any kind whatsoever may arise between the Employer and the Contractor in connection with or arising out of the Contract, including without prejudice

to the generality of the foregoing any question regarding its existence validity or termination, or the execution of the works whether during the progress of the work or before or after the termination, abandonment or breach of the contract, the either parties shall have to raise/ refer their disputes/ differences / claims in writing to the other party, within a period of 30 days on occurrence of such events, to resolve any such dispute or difference.

- ii) The contractor shall have to refer their disputes to the concerned In Charge Engineer. After receipt of the dispute from the contractor under this clause, the Engineer In-charge of works shall have to submit their report to the Chief Officer within a period of 90 (Ninety) days. The Chief Officer shall offer an opportunity to the contractor to be heard and to furnish evidence in support of their disputes within 30 (Thirty) days after the receipt of the disputes duly compiled by In Charge Engineer. After hearing the contractor regarding their disputes along with their documentary support and the concern In Charge Engineer of the work, the Chief Officer shall give decision within a period of 120 (One Hundred Twenty) days or the contractor is dissatisfied with the decision within 120 (One Hundred Twenty) days after the contractor has been heard. If The Chief Officer does not give decision within 120 (One Hundred Twenty) days or the contractor is dissatisfied with the decision of the Chief Officer, the contractor shall within 30 (thirty) days after receiving the instruction or decision, appeal to the BMC. After hearing both the parties the BMC will give reasonable decision within 180 (One Hundred Eighty) days from the date of receipt of appeal by the contractor. The decision of the BMC shall be final and binding on both the parties. If the BMC does not give decision within 180 (One Hundred Eighty) days after the date of appeal by the contractor, the contractor will have right to refer the dispute to arbitration tribunal as per provision of clause "Arbitration".

B) ARBITRATION:

- i) Subject to Clause (A) mentioned above and in the event of any dispute or difference arising out of or in any way relating to all concerning these contracts or the construction or effect of these contracts shall on the initiative of either party to the contract be referred to "The Arbitration Tribunal Constituted Under The Provision Of Gujarat Public Work Contract Dispute Arbitration Tribunal Act, 1992".
- ii) The arbitration shall be conducted in accordance with the provisions of the "Gujarat Public Work Contract Dispute Arbitration Tribunal Act, 1992" or statutory modifications there on. The Arbitration shall be held at such place and time as the Tribunal may determine.
- iii) The decision of the tribunal shall be final and binding upon both the parties. The expenses of the arbitration shall be paid as may be determined by the Tribunal.
- iv) Performance of the contractor under the contract shall if reasonably be possible, continue during the arbitration proceedings and payments due to the contractors by the owner shall not be withheld, unless they are the subject matter of the arbitration proceedings.
- v) The dispute is deemed to have arisen on the date, on which BMC shall not give his decision as mentioned above in Clause (A) or in the case of intimation of any decision, the contractor intimates in writing that he has finally refused to accept the offer made by the BMC.
- vi) Where any dispute arises between the parties to the work contract either party shall irrespective of whether such works contract provides for any arbitration or not, refer,

within one year from the date that BMC has not given the decision as per Clause (A) such dispute in writing to the Tribunal for arbitration in such form and accompanied by such documents or other evidence any by such fees, as may be prescribed.

- vii) Legal jurisdiction: All question relating to this Tender shall be governed by the law of India and shall be subject to jurisdiction of court at Gandhinagar, Gujarat.

16. GOVERNING LAW AND JURISDICTION:

These Conditions and the O & M part of Contract shall be governed in accordance with Indian Law. The Contractor agrees that any legal action or proceedings arising out of these Conditions may be brought in the courts or tribunals at Gandhinagar in India and irrevocably submits themselves to the jurisdiction of such courts or tribunals. The Employer may, however, in its absolute discretion commence any legal action or proceedings arising out of these Conditions in any other court, tribunal or other appropriate forum, and the Contractor hereby consents to such jurisdiction.

17. MATERIAL, TOOLS AND TEST EQUIPMENTS:

All materials required for the O&M of the project shall be new and of best quality and suitable for the purpose intended. These shall be got approved from the Engineer in charge before use.

17.1. Electricity Supply:

Contractor shall keep good liaison with concerned Electric Authority for power supply in case of electric power failure (break down/shut down) it shall be the responsibility of the agency to inform all the concerns as well as to contact concern authorities to restore the power supply. The contractor shall keep good liaison with concern substation for voltage Up and Down and restore the power. The vehicle kept at site by the contractor shall be provided for this purpose along with operation and maintenance staff in case of requirement as per direction of Engineer in charge or his representative without any extra claims.

17.2. Work Order Book:

A bound half sheet size work order book shall be provided by the contractor and handed over to the owner for maintaining at the work site. This shall be a permanent record. The contractor or his Resident engineer shall sign against instructions & orders recorded by the Engineer in-charge or his representative for the maintenance work. He may take out a copy thereof if necessary. He shall take prompt action as per the instruction/orders of the owner and necessary compliance shall be recorded against each instruction/order.

17.3. Electrical Installations:

All electrical work shall be carried out as per the provisions of Indian Electricity Act, Indian Electricity Rules, Instructions and requirement of authority/authorities i.e. Electrical Inspector and Gujarat Urja Vitran Nigam Limited or as mentioned in the Volume of General Condition for contract.

17.4. Accident on the works:

The contractor shall be fully responsible for any accident that may occur to the labour on his work on duty and report the same to the Engineer in charge and concerned Govt. labour department authority and shall pay all necessary compensation as per rules. Contractor shall also be fully responsible for any loss to any individual or public property occurred due to him or his worker's negligence under the scope of this contract.

17.5. Use of site:

The contractor shall not unreasonably encroach the site with materials and equipment. The contractor shall not use land for any private purpose.

17.6. Compliance:

The contractor shall be bound by all ordinance acts, codes, rules, regulations and orders of which in any way affects conduct of works, or workmen engaged for the work. The contractor shall be responsible for any violation of any govt. rules & regulations. It shall be the responsibility of the contractor against any claim or liability arising from violation of above.

17.7. Accommodation for Staff:

Contractor shall provide necessary accommodation to their labours & engineers at his own cost. However, owner shall give vacant staff quarters available at each head works, subhead works or available in the jurisdiction at the rate prescribed by the owner.

17.8. Transportation:

Contractor shall have to make his own arrangements for conveyance of his staff at his cost. No facility will be provided by the owner.

17.9. Medical:

Contractor shall provide medical facility to his staff at his cost.

18. CONTRACTOR'S STAFF & THEIR CONDUCT ETC.:

18.1. Nationality & Address:

All employees shall be Indian Nationality and it shall be contractor's responsibility to give temporary and permanent address: Convicted or penalized person shall not be employed.

18.2. Salary to Employees:

Contractor shall strictly follow labour laws and shall also ensure regular monthly salary payment to his staff. The owner will not take any liability of any of his employees appointed for operation and maintenance under this contract. Contractor shall submit monthly certificate for full payment to his staff on or before 10th of every month. Owner reserves the right to conform the contents of the certificate from contractor's employee for their last pay. The owner will not be responsible for any delayed payment/ compensation/ overtime or any other claims by employees of contractor during the tender period and even after the tender period.

18.3. Identification Dress Code with Badge/ Identity Card:

Contractor shall have to provide special dress code with identification badge with name plate strip to be displayed on front pocket to each staff as approved by Engineer in charge along with Identity Card etc.

18.4. Holidays and Leave:

Holidays and leaves shall be given to staff as per relevant labour rules. During holidays/ causal leave/earned leaves etc. and contractor shall arrange for the substitute. The owner shall not make any separate payment of overtime for these substitutes provided by the contractor during above periods.

18.5. Conduct:

All employees of the contractor shall follow the instruction of Engineer in charge. If any employee misbehaves with Engineer in charge he/she shall be immediately removed from duty and substitute for that shall be employed by the contractor. If contractor fails to do so, non-refundable penalty of Rs.200/- (Rupees Two hundred only) per day per such case will be levied, this amount shall be recovered from the bill or any due amount of Agency.

18.6. Visitors:

The plant is one of its own kinds. Visitors are expected to visit this plant. It is expected that all staff and Engineers be present and follow the directives of Engineer in charge.

SCHEDULE 1
Operation and Maintenance Services

The Contractor shall be required to perform the following services under these Conditions:

The Contractor shall be responsible for corrective maintenance of civil, hydraulic, mechanical, electrical and computing equipment as well as miscellaneous equipment.

The Contractor shall be responsible for carrying out regular servicing and lubrication of rotary machines, complying with maintenance instructions as defined in the Operation and Maintenance Manual and ensuring that electromechanical equipment and motors operate correctly at all times.

The Contractor shall ensure that measurement systems are calibrated, within the valid period of certification and operate correctly at all times.

The Contractor is responsible for the maintenance of the landscaped areas inside the Employer plant fences.

The Contractor shall be responsible for maintenance of civil structures including intakes, pump houses, reservoirs, administration buildings, workshops, garages, etc.

The Contractor will operate and maintain in a state of continuous operational readiness all plant and systems to meet the flow requirements. It shall remain the Contractor's responsibility to ensure that plant systems are at all times able to operate to the maximum capacity of the installed duty plant.

Provided here are certain standard services that BMC could require. However, BMC may wish to review this and make changes depending on the exact nature of services they require from the Contractor.

The Contractor shall be entitled to appoint a representative who shall together with Employers Representative on the last day of each month or if such day is not a working day on the following day, jointly carry out a reading of water meters and jointly certify the record of such readings.

For the duration of the O & M period, the Contractor will be responsible for the supply and control of lubricants, spare parts and consumable materials excluding electrical power, necessary for the continuous operation of the works.

The Contractor will manage the consumables and utilities services to ensure their most economic consumption and to minimize wastage.

The quantities of all the unutilized spare parts and consumable materials will be fully handed-over to the Employer at the end of the O&M period.

The store's inventory, the issuing and recording of spare parts will be the responsibility of the Contractor.

The Contractor is also responsible for providing spare parts and material required for the operation and maintenance during the operation period, and shall bear the cost for the same, including the cost of storing and safeguarding.

The Contractor will make all necessary arrangements to ensure the continuous supply of spare parts and material for the works; and the rate of advance supply of these materials shall be in such quantities and amounts as would ensure uninterrupted operation.

All the furniture and administrative office equipment etc. required shall be furnished by the Contractor. Costs of operating administrative office and supplies shall be borne by the Contractor.

The Contractor shall take out subscriptions for standard telephone lines/ wireless sets. Running cost for the telephone / wireless sets will be borne by the Contractor.

Cost of operation and maintenance and housekeeping of housing complexes including domestic water supply and drainage, roads, gardens, electrical installations, etc. will be borne by the contractor.

The Contractor will provide staff personnel for the full term of O & M as per schedule of establishment given in Annexure- I.

Contractor has to do painting to Every Civil Structures including Pump House, Valves, pipeline etc. with the same quality of paint used while construction of structures or as directed by Engineer in charge at and interval of every two and half years. If Contractor fails to do same, this work will be carried out by BMC and expenditure occurred will be deducted from contractor's Bill.

SCHEDULE - 2

Performance Guarantees

The Contractor shall guarantee that:

- a) The total transmission losses in the raw water and / or treated water system shall not exceed 5 %.
- b) The total reduction in duty point efficiency of the pumps after one year of operation shall not exceed 0.25% than the guaranteed efficiency of each type of pump.

(The Bidder to fill the format and specify guaranteed efficiency of each type of pump)

SCHEDULE- 3

O & M Price

The Contractor shall be paid at the quoted rates per month. The amount withheld against them from the bill of the main contract shall be released by end of each year.

SCHEDULE- 4

REPORTS

MONTHLY REPORT

The monthly report shall include but not be limited to:

Volume of water conveyed, to each consumers off-take point end.

All the problem areas in the facility,

O & M works carried out during the month.

Electricity consumed totally.

Monthly materials consumption statement

SEMI- ANNUAL REPORT

A semi-annual report shall include the measurement of noise level at the site boundary at plant, to be indicated by the Employer.

ANNUAL REPORT

The Contractor shall provide the Employer by March 31 of the current year (n) with an annual report for the preceding year (n- 1). This report shall include:

*All technical statistics related to plant operation as supplied by the operation;

*A statement of works carried out during the preceding year n-1 in connection with the contractor's obligations under these conditions.

NOTE: The Employer may consider if it requires these reports or requires reports and provide for the same. This will need to be looked at in the light of reporting requirements in these Conditions. The Employer will also need to determine what information is required in these reports

SCHEDULE- 5

Insurances

Insurance against Injury to Persons and Damage to Property;

The Contractor shall insure against each liability for any loss, damage, death or bodily injury which may occur to any physical property (mechanical, electrical, automation work, all civil works, Storage etc. excluding pipe line) or to any person which may arise out of the Contractor's performance of his obligations under these Conditions during the O & Period.

This insurance shall be for a limit of per occurrence of not less than the amount of Rs. 5 Lacs, with no limit on the number of occurrences.

Insurance for Contractor's Personnel;

The Contractor shall effect and maintain insurance against liability for arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel.

The Employer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.

Contractor shall have to take insurance for Electrical, Mechanical and instrumentation equipment under this packages and whereas the insurance of other component like pipeline will be optional. This General Insurance for the work will be in the name of BMC. The depreciated value is to be considered for the purpose of insurance for respective year. The insurance for skilled, semi- skilled and unskilled labour is compulsory. The same should be taken by agency as per labour act laws in force.

SECTION B

SPECIAL TERMS AND CONDITIONS

SECTION B:

SPECIAL TERMS AND CONDITIONS OF CONTRACT **FOR OPERATION & MAINTENANCE**

PART- 1: Technical Conditions

- 1) The operation and maintenance of all the works included in this tender as per details given should be carried out by contractor at his own cost.
- 2) All the storage structures situated at H.W. sites should be kept in fill-up condition as per requirement during the full day period. (24 Hours)
- 3) A weekly report for supply of water with Quantity should be submitted to the office of the Engineer in charge concerned. A certificate of the concern in-charge Engineer for daily receipt of required Quantity of water at each head works / off take points at the end of week should be received and submitted with weekly report.
- 4) Electric bill for running the plant at head works site will be paid by department. Bill should be submitted to office for payment as soon as received from concern GVCL. If charges for delay in payment, levied on account of late payment, due to late submission of bill by contractor, then the same will have to be paid by contractor.
- 5) All the required electrical goods / fixtures like bulb, tube light, chock, starter, fuse, wire etc. required for operation and maintenance shall be procured by contractor at his own cost and lighting arrangement should be kept in good condition.
- 6) At the time of breakage in pipeline or valves for repairing purpose contractor shall have to make arrangement at his risk and cost for labours, fitter, required all materials like rubber packing, nut, bolts, gland, all required parts of valves in Plant & transmission main including transportation arrangement like pickup van, Jeep, welding machine, welding rods, Tractor etc. should be provided by contractor at his own cost. All consumable material should be of standard quality as approved by Engineer-in-charge of work.
- 7) All type of rising main and gravity main including chambers should be maintained and repaired by contractor at his own cost.
- 8) At the time of repairing or replacement of Pipes and valves required for repairing or replacement after verification by concerned engineer or his representative, fitting work of pipe or valves shall be carried out by contractor at his own cost including, labour, excavation cutting, fitting, welding, testing, refilling etc. complete. During the repairing work scrap materials received should be returned to concern departmental store at the cost of contractor after duly entering in register. Repairing work shall be started within

One hour after breakage or leakage come into notice, care should be taken to prevent wastage of water otherwise recovery at the Rs.16/ per m³ of cost of water will be made from contractor. Due to leakage and repairing work, contractor will be responsible for loss of any property or crop of private land owner and compensation will have to be paid by contractor,

if contractor fails to do so and complain is received by department than department will make the payment to private owners and recovery will be made from contractors bill.

- 9) Any type of valve or part of the valve not working properly after repairing and requires replacement, as per opinion of Engineer in charge or his representative, then required valve will supplied to the contractor free of cost from departmental store if available. Replacement shall be done by the contractor and old valve should be shifted to department store and entered in concerned register including cost of loading, unloading, carting stacking etc. complete.
- 10) Contractor shall have to do leak detection survey along the pipeline regularly such as Pipes joint leakage, pipe bursting etc. and leakage observations and repairing work record should be maintained section wise by contractor. all the valves fixed on it such as sluice valves scour valves, air valves, air cushion valves, butterfly valves, zero velocity valves, flow meters, water meters and valve chambers should be maintained by contractor. Quantity of water as pumped from head works same quantity should reach to distribution point. For any unauthorized connection taken or given by anybody the Contractor will be responsible for it. Prevention and removal of unauthorized

Connection will be carried out by contractor and intimated to department. For unauthorized consumption of water or misuse of water recovery at the Rs.100 per m³of cost of water will be made from contractor. All type of valves including air valve and scour valve should be inspected regularly by contractor, a programme for inspection for air valves & scour valve should be prepared by contractor and strictly observed it. Special care should be taken by contractor for air valves.

- 11) During the period of contract a person other than responsible representative of contractor or persons employed by him should not enter into the premises of the head works site. Every care should be taken by contractor to prevent such type of unauthorized entry or interruption in the premises or surrounding the property of BMC TOWN.
- 12) Persons required for security of materials in the stores at sub head works sites will be deployed by contractor.
- 13) At any time during the visit of Engineer in charge or his representative if it is observed that the operation and maintenance is not carried out properly, water supply is stopped and contractor is responsible for it recovery will be made at double rate of contract for that particular day or contract will be terminated.
- 14) Operation and maintenance of meters installed at head works sites should be carried out by contractor and entry shall be made in the register at every one hours. If any meter is not working properly it should be properly repaired by contractor from any technician of such type of repairing work.
- 15) After issue of work order contractor or his responsible representative should joint visit the site of every work accompany with officer concern. A list and position of works and all valves with dia and nos. a report will be prepared and should be jointly signed by contractor and department. A copy of same report shall be issued to contractor. At the time of completion of contract period same type of report should be prepared and possession of all the works and

components should be handed over to department. If repairing & maintenance work is not done properly by contractor, the cost of repairing work will be recovered by department from contractor.

- 17) All the works executed under this project & covers in the scope of this tender will be deemed to be handed over to contractor from the date of successful commissioning of facility. Proper operation and maintenance of the same works/components shall be carried out by contractor and at the time of completion of contract period or termination of contract, contractor should have to give possession of all the work and components to the department in good condition. Before handing over the possession to the department account of contract will not be finalized and deposit will not be refunded to contractor. For all type of legal activities and expenditure for the same, contractor will be fully responsible.
- 18) During the period of contract for any type of dispute, decision of EIC, will be final and binding to both the parties.
- 19) Prescribed registers as maintained by agency during the period of operation and maintenance period shall be submitted to the department. All the materials received during repairing and replacement shall be deposited in departmental store at the cost of contractor. All repairing work should be carried by contractor at his own cost during the period of contract contractor should be fully responsible for injury to any public person omen engaged by contractor for work and contractor shall be fully responsible for compensation for it.
- 20) If water storage or supply could not be continued due to any reasons it should be informed to department. As per condition of contract required steps should be taken immediately by contractor to solve the problem and start the water supply. After starting the water supply department shall be informed accordingly.
- 21) Proper care is to be taken by contractor to keep neat and clean. Every component of headwork sites and maintenance of all the components shall be done by contractor.
- 22) Servicing of all the valves cleaning of all civil works and maintenance shall be carried out regularly by contractor and entered into the concerned registers.
- 23) History sheet shall be maintained by contractor for replacement of material in pipeline, or valves, spare parts of Electro-mechanical equipment.
- 24) Leakage repairing shall be carried out in proper way and technically workmen like manner. Repairing by rubber tubes or by fixing wooden Peg shall not be allowed. Register of leakage repairing shall be maintained with reasons properly.
- 25) All the works included in the scope of work shall be oil painted once during contract period at the cost of contractor.
- 26) All the gardens and plants situated at head works sites shall be supplied water and maintained properly by contractor. No any extra payment will be made on account of this work.

- 27) Telephone/wireless message shall be received and entered in the register and message should be conveyed to concern party head works for action. If any interruption in the system of any important message should convey immediately to concerned Engineer in charge.
- 28) All the information regarding labours, staff, vehicles etc. is incorporated in this tender for preparation of estimate. As per list staff having proper qualification/labours and vehicle shall be deployed by contractor. If due to negligence of contractor for providing sufficient staff and vehicles water is not supplied properly remaining labours/staff and vehicles will be deployed by department at the risk and cost of contractor and recovery for such expenditure will be made from the bill of contractor.
- 29) The contractor has to make all the arrangements required for the proper operation, maintenance and safety of all the works included in this contract at his own cost during the whole contract period.
- 30) Continuous patrolling with Jeep and Driver throughout the alignment should be carried out by the contractor.
- 31) All the storage structure located at H/W site should be kept in fill up condition as per the requirement during the full day period.
- 32) Separate log book for arrival & releasing of water from each storage structure will be maintained day to day by the contractor and shall be submitted to department at the end of month.
- 33) Repairing of all electro-mechanical and civil work shall be carried out at site including valve chamber located at site without any extra cost.
- 34) Except in unavoidable circumstances all the storage structures should be filled with water as per requirement & availability of electricity & pressure during the period of day or night. If electric supply is not available for 15 minute, contractor shall contact to concern GVCL to start the electric supply & intimate to Department with reasons for non- availability of electric supply.
- 35) List of all the assets, pipeline apparatus plants & machineries, all types of valves, chambers, pump houses, security cabin, office building, hydraulic civil structure, spare parts, store malts, wireless sets, telephone, air-conditioner, electric panels etc. will be handed over to contractor for Maintenance & Repair purpose & same has to return to Department with good conditions as soon as the project is taken over by department for further M&R period to any other party.
- 36) During the period of contract if water is not supplied satisfactorily at head works/ off take point at any day & reasons given by contractor is not suitable in the opinion of officer of department recovery at the double rate of contract rate will be made for such a day from the bill of contract.
- 37) Any damage / breakage found from mischievous element found in the system, the contractor should lodge police case immediately under intimation to concern Engineer in charge.
- 38) The total wastage of water due to leakage & all other reason should not be more than 1%,if it is more than prescribed quantity, recovery at the rate of Rs. 15/- per 1000 letter (Or as revised from time to time) shall be made from the running bill of contractor. Quantity wasted will be decided by Engineer in charge will be final.

- 40) Material consumption register in prescribed format should be maintained by the contractor. During the visit of Engineer- in- charge if required it should be produced.
- 41) Vehicles will have to be maintained and to be kept ready for whole contract period at Headwork's site by contractor and to be used for day to day routine checking. Any fault time for providing such facilities for betterment of operation period will be sublet to reduced payment by department and all logbooks to be maintained by contractor for such movement of vehicle.
- 42) "The Contractor" shall operate the complete services, on a continuous 24hours basis to supply all the flow conveyed through pipeline up to desired point of supply with assured quantity.
- 43) "The Contractor" shall operate and utilize all the control and monitoring systems, provided and if found to be necessary and if approved by the engineer, shall make adjustments within the operating range of the control system and equipment so that the plant operation matches the requirement.
- 44) "BMC TOWN" shall directly pay all the power bill to UGVCL but the Contractor will be required to furnish Electricity Consumption in the Schedules provided.
- a) Telephone bills will have to be paid by the successful bidder. No reimbursement shall be made.
 - b) Electric /Battery operated flow meter has to be maintained by Contractor in case failure of batteries, same has to be replaced by contractor at his own cost.
- 45) All miscellaneous items, for example, vehicles, tools, testing equipment, cleaning or green keeping equipment, security and safety equipment, electrical fixtures, etc shall be provided by the Contractor at his expense.
- b) The qualification and capability of the Contractor's personnel shall be appropriate for the task they are assigned to perform. The staff provided shall be fully trained in the operation of the Raw Water Pumping Station before being given responsibility for operating any part of the plant. If in the opinion of the Engineer, any member of the Contractors staff is considered to be insufficiently skilled or otherwise inappropriate for the task he is required to perform, he shall be replaced by the Contract with a person with the appropriate skills and experience for the task, to the approval of the Engineer. The Contractor will be required to submit to the Employer the Schedule of 'Manpower 'and 'Organization Chart'
 - c) The Curriculum Vitae (CV) /Resumes of the Contractors personnel shall be submitted to the Engineer for acceptance at least 7 days before the anticipated commencement of the O & M, period. Any change of personnel shall be promptly informed to the Engineer within a day's time. Normal time duty hours for the contractors' operation & maintenance personnel may be modified as necessary and agreed by the Engineer. Rotating shift schedule shall be established by the Contractor and agreed by the Engineer which will ensure that an adequate number of the Contractor's staff, fluent in Hindi as well as Gujarati is on duty at Plants 24 hours per day, 7 days per Week, Including all holidays

d) Contractor will submit one photograph of each personnel, with his resume, permanent address, etc and department will issue identity cards to each personnel. Any replacement in Employment by Contractor shall have to be reported in 24 hours to Engineer in charge concerned. Contractor has to put the name person on duty shift wise on display board. Display board shall be kept in each pumping station

47) a) The Contractor shall be responsible for safety on Site during the O & M of the Works by the Contractor.

b) The Contractor's duties with respect to Safety shall include the following;

i) Utilize safety awareness procedures in every element of operation and maintenance.

ii) Give emphasis to site including:

47) a) The maintenance service provided by the Contractor for the period specified in the Contract shall ensure the continuous operation of the that the breakdown or deterioration in performance, under normal operating conditions, of any items, of Plant and equipment and component parts thereof is kept to a minimum.

b) The Contractor shall adhere to the manufacturer's recommendations with respect to equipment maintenance, the type and grades of lubricants to be used. Frequency of lubrication, adjustments to be made regularly and recommended spares to be held in store.

49) The Contractor shall be responsible for:

a) The maintenance of electrical, ventilation and air conditioning, plumbing and drainage installations.

b) General Building Maintenance and housekeeping.

c) Full maintenance of the site services, cabling and earthing systems, together with the site road lighting system. Painting of all Civil, Mechanical, Electrical structures which are open to sky every three years.

d) Site maintenance including the upkeep of landscaped areas.

The building services and house-keeping maintenance shall be undertaken on all building and services installation.

The Contractor shall ensure that all unwanted or redundant items are removed from the building and sites. Depending on their condition such items shall either be placed into storage or disposed of site.

50) a) The store's inventory, the issuing and recording of spare parts will be the responsibility of the Contractor.

- b) The Contractor is also responsible for providing spare parts and material required for the operation and maintenance during the operation period, including the cost of storing and safeguarding.
 - c) The Contractor will make all necessary arrangements to ensure the continuous supply of spare parts and material for the works and the rate of supply of these materials shall be in such quantities and amounts as would ensure uninterrupted operation.
 - d) Spare parts shall be supplied by the Contractor and the same will be used during Operation and Maintenance Contract period.
 - e) The contractor shall have to procure the required spares from original manufacture or authorized dealer at his cost.
 - f) The required spare parts which will be available with BMC will be issued to the contractor from its stock and subsequently contractor shall have to replace the same without any extra cost.
- 51) a) The Employer reserves the right to arrange the visits of VIP's dignitaries, public representatives and other persons of Social or Political repute, any organizations and when necessary, to the Raw Water Pumping Station. The Contractor shall offer full cooperation to the BMC on the occasions of such visits.
- b) Inspection register will have to be maintained, wherein inspection officers will note their instructions duly dated signature. Successful bidder has to follow the instructions strictly.
- 52) On the date of Contract Completion or if the Contract is terminated, all the installations, works and equipment placed under the Contractor's responsibility shall be handed over to the Employer, at no cost, in good working order. The Employer may perform any inspections, tests or expert appraisals he shall consider necessary with a view to checking that the property is in good working order and will certify to that effect to the Contractor while taking over.
- 53) No accommodation/ guest house/ transportation facility will be provided by the BMC to Contractor.
- 54) For smooth & efficient O & M of the plant, and in case of emergency just like fire, fault, accidents, or other rescues operation, the contractor must keep at least one four-wheeler like jeep or Matador type with seating arrangement. In working condition for 24 hours of a day & 365 days of the year for the whole contract period.
- 55) While handing over the spares to the contractor, Contractor should maintain the record of spares of inventory of utilization the spares.
- 56) In the event of any dispute or difference arising, the Jurisdiction of the court shall be Gandhinagar (Gujarat) only.
- 57) It is mandatory for the contractor to operate the pumping machinery not less than limit efficiency of pump. If deviation is noted in respective energy bill for succeeding month than corrective measures shall have to be taken by the contractor immediately otherwise the difference in amount based on m³/KWH will be invoked through O & M bills of successful bidders.

- 58) All protective Relays testing, Calibration system for service and maintenance of Relay shall be carried out systematically by trained personnel authorized in Power system protection at once in a three year during O & M contract Period Without any extra cost. The Contractor/Agency should be approved first prior to commence of work for such special testing of job. Proper testing equipment shall be used so to avoid the misleading of settings & call for nuisance tripping.
- 59) Contractor shall have to bear the expense for annual inspection fee for Electrical installation during the O&M contract period. No extra payment shall be given. Energy audit has been made mandatory by the Government of Gujarat; vide Gujarat Use of Electrical energy (Regulation) Order, 1999. Contractor shall have to carry out energy audit per the said regulation in the first year and thereafter strictly as per prevailing regulation.
- 60) Repair of PLC based instrumentation and Automation work shall have to be carried out by System Integrator. The agency for System Integrator should be approved first prior to commence the work of such special type of job.
- 61) Contractor should provide security guard round the clock with uniform. He should also maintain register for visitors.
- 62) If any work specified in the scope of tender but not carried by the contractor, the recovery will be done at the double the market rate from the contractor.

ANNEXURE –I
SCHEDULE FOR ESTABLISHMENT

The contractor shall employ the minimum staff for each package as under with qualification and experience stated below, Contractor may employ additional staff over and above minimum prescribed as per his requirement in order to run the system efficiently. The staff mention below its obligatory.

Sr. No.	Designation	Qualification	Experience
1.	Supervisor	Diploma Mechanical / Civil with 1 year experience of O&M of Water Supply Scheme.	<ul style="list-style-type: none"> • 1 Person for overall coordination and reporting purpose to be deployed at HW site. Contact number of the person is to be declared to beneficiaries for complain redressal.
2	Electrician	PWD supervisory certificate pass & having license of Govt. of Gujarat for HT Installations or ITI (Electrician) with NCTVT Certificate	<ul style="list-style-type: none"> • 1 Competent electrician with qualification is to be provided separately at WTP HW site (Total 1 Nos). Services of electrician should be available 24X7 when required for which extra person can be deployed by agency.
3	Operators:	Diploma/ ITI. Experience of water supply scheme is preferable.	<ul style="list-style-type: none"> • At HW - Round the clock 2 Operators at main Headwork in shift shall be provided for operation of WTP and Pumping Machinery • 1 Operator at each sub headwork as per the requirement of pumping hours are to be deployed in shift manner. • Appropriate arrangements for substitute shall be made in case of leave.
4	Helper	Stout Body physique (Unskilled)	<ul style="list-style-type: none"> • 1 helper with each Operator as mentioned above shall be provided in shift manner according to operator. • Appropriate arrangements for substitute shall be made in case of leave.

5	Pipe Fitter/ Linemen/Valve men for MS/AC /HDPE/PVC pipe	Experience of maintenance and repairing work of pipeline network.	<ul style="list-style-type: none"> • Fitter/ Lineman/ Valve man shall be provided as per requirement to operate and maintain scheme smoothly and as instructed by Engineer in Charge. Enforced labor laws shall be followed. Manpower shall provide such that all the Main Valves/ Branch valves shall be operated regularly on daily basis. Repairing of pipeline shall be carried out as per schedule.
6	Security	From registered licensee service provider.	<ul style="list-style-type: none"> • Round the clock 2 security persons at Main head work and all Sub head works are required to be deployed in 8 hour shift manner. • Security provided must be hired from registered licensed security service provider. • Appropriate arrangements for substitute shall be made in case of leave.
7	Gardner	Gardening experience	<ul style="list-style-type: none"> • A Gardner with proper gardening equipment's should be provided for maintenance of horticulture, cutting of grass etc. at WTP head works separately. The services of same Gardener shall made available to all sub head works also.
8	Sweeper	Stout Body physique (Unskilled)	<ul style="list-style-type: none"> • Force of cleaning persons should be provided for good housekeeping. Toilets are to be cleaned regularly at least twice a day.
9	Utility Vehicle with Driver	Utility Vehicle for Maintenance with driver having valid License.	<ul style="list-style-type: none"> • 2 Utility Vehicle shall be provided with skilled driver having valid Indian driving license.
10	Basic Water Testing Laboratory Instruments with analyst	Science Pass out with appropriate experience	<ul style="list-style-type: none"> • Basic laboratory instruments like 1) Turbidity meter (handheld), 2) table top pH meter, 3) Chloroscope, 4) water distiller, 5) Jar test apparatus with accessories shall be provided in addition to the online water testing analyzer for stationary or mobile water

			testing at site with science passed out analyst having water testing experience.
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Note:

The above staff shall be required minimum as per mutual agreement between contractor & BMC TOWN. The arrangement of reliever for weekly off/all holidays etc. shall be made by the contractor separately.

The adequate staff is required for normal operation & maintenance. The contractor has to call respective engineer for rectification of fault at any time of the day, during contract period. The contractor shall have to provide additional manpower for maintenance and repair on as and when require basis. No extra payment shall be made for hiring services of additional manpower.

However Superintending Engineer may give relaxation in qualification and experience for suitable cases and necessary recovery if any, will be made accordingly.

ANNEXURE- II

SCHEDULE OF ROUTINE CHECKING OF VALVES

A) Daily in each shift:

- 1) Leakages through gland packing and tightening, loosening to ensure that extent of leakages is in drip form.
- 2) Bearing temperature if highly check-up cause and take remedial action.
- 3) Noise &Vibration: If undue check-up cause and take remedial action.
- 4) Pressure: If high or low, check-up cause.
- 5) Check oil level for bearing lubricant and topping up if necessary.
- 6) Clean and remove dust from pumps, piping and valves etc.

B) Weekly:

- 1) Greasing to the stuffing boxes. Greasing to valve actuator gear

C) Monthly:

- 1) Check tightness of all nut bolts. Check coupling bushes for wear.
- 2) Checking and replacing gland packing if necessary (valve)
- 3) Check oil in air compressor. Check valve actuator bushes.

D) Quarterly:

- 1) Inspection of gland packing and replacing if necessary. Cleaning and oiling of gland bolts.
- 2) Checking and lubrication of all bearings.

E) Half Yearly:

- 1) Removing plant packing and checking wear on line shaft at gland portion.
 - 2) Replacing gland packing.
 - 3) Cleaning and examination of all bearings for flaws and checking and play. Replace oil/grease of bearing.
 - 4) Replacing gland packing of sluice valves.
- F) Records/Messages through Electronic Media.

Agency has to give SMS every day to concerned officer of BMC stating water pumped from each station from specific pump with flow meter reading, water supplied to villages etc as asked officers.

Sr. No	Name of Head Work	Capital cost of Electro-mechanical component
1	All Components Included in this Contract	

ANNEXURE- III

**LIST OF THE TOOLS AND TACKLES TO BE PROVIDED AT EACH PUMPING STATION,
TREATMENT PLANT FOR OPERATION AND MAINTENANCE.**

21.	Kaichin (For Gardening)	2 Nos.
22.	Vile(For Gardening)	3 Nos.
23.	Plastic Bucket 10 Litres	2 Nos.
24.	Rope 1/2"	30 meter
25.	Torch/Battery	2 Nos.
26.	Multi Meter Digital	1 Nos.
27.	Crimping Tool Set	1 Set
28.	Bearing and Coupler puller	1 No. Of Each
29.	Portable Air blower for cleaning & De rusting of Panel	1 No.
30.	Heavy Duty Grease gun	1 No.
31.	Garden Scissors	1 No.
32.	Dial Gauge with Magnetic stand for alignment checking	1 Set
33.	Precision Spirit Level	1 No.
34.	Filler Gauge with Magnetic stand for alignment checking	1 set
35.	Storage Bins & rack/cupboard for above tools	1 No.
36.	Portable Welding Set	1 No.
37.	Portable DG Set	1 No.
38.	Portable Dewatering Pump Set.	1 No.

Note:

Above list is only for guidance purpose. Requirement of any other tools or tackles for ensuring smooth & uninterrupted operation, maintenance & repairs of all the equipment in all the pumping stations shall have to be arranged by the Contractor as per instructions of the EIC.

Statement- 1

Name of Project: As Per Mentioned in Tender Notice

Period: Month

Monthly report of material consumed for O & M

Sr. No.	Materials Used	Qty.	Average Cost	Issued/ Purchase by	Remarks
1	2	3	4	5	6
1					
2					
3					
4					
5					
6					
7					

Signature of Contractor

Statement- 2

Name of Project: As Per Mentioned in Tender Notice

Period: Quarter

Quarterly report of material consumed for O & M

Sr. No.	Material	Part No(if any)	Qty.	Average Cost	Remarks
1	2	3	4	5	6
1					
2					
3					
4					
5					
6					
7					

Signature of Contractor

Statement- 3

Name of Project: As Per Mentioned in Tender Notice

Period: Month

Monthly report of Vehicles deployed for O &M work

Sr. No.	Type of Vehicle	Model &Year of Manufacture.	Registration no.	Working condition	Remarks
1	2	3	4	5	7
1					
2					
3					
4					
5					
6					
7					

Signature of Contractor

Statement- 4

Name of Project: As Per Mentioned in Tender Notice

Period: Month

Monthly report of Staff deployed for O &M work

Sr. No.	Name of Person	Designation	Age	Qualification	Experience.	Remarks
1	2	3	4	5	6	7
1						
2						
3						
4						
5						
6						
7						

Signature of Contractor

Statement- 5

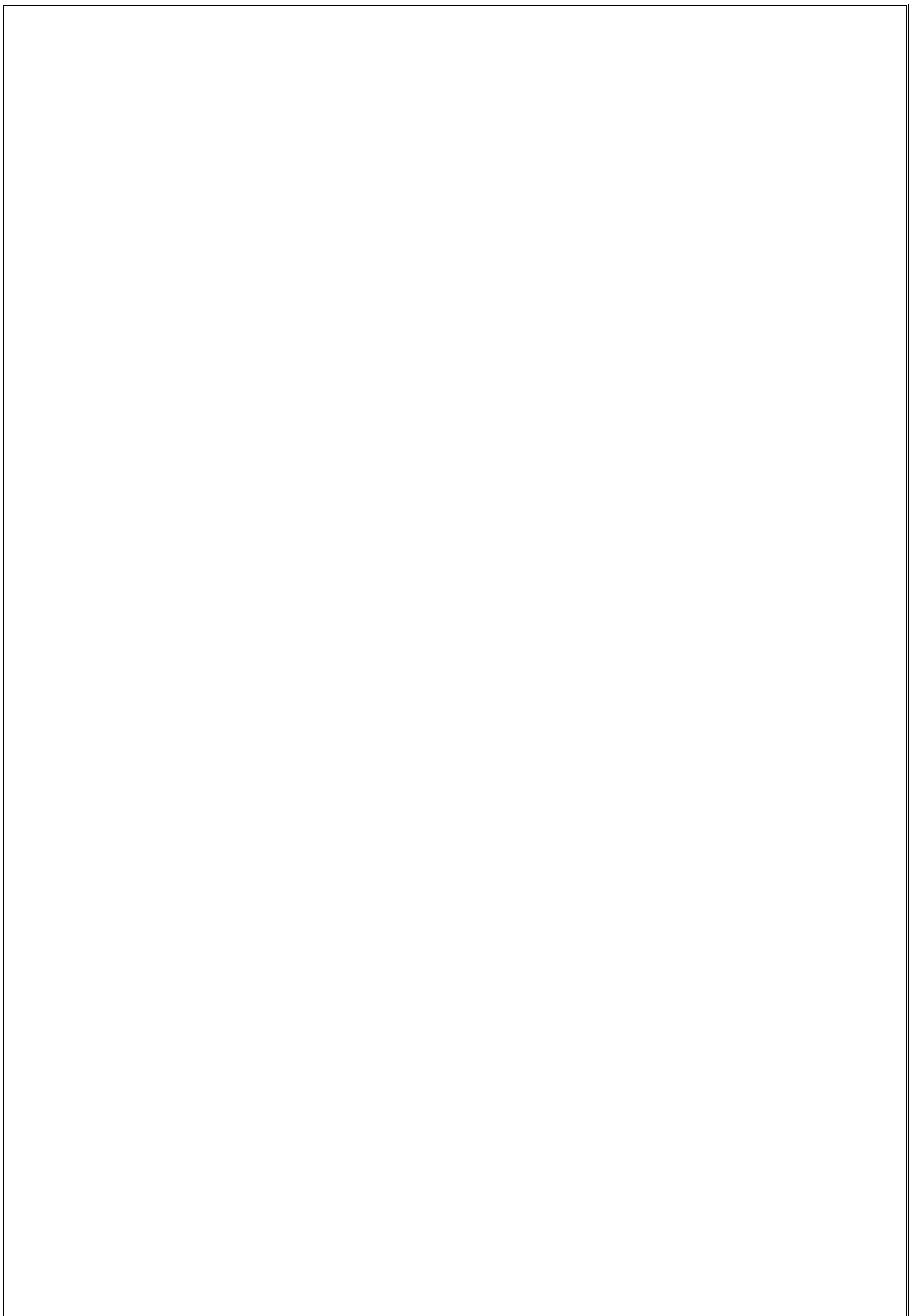
Name of Project: As Per Mentioned in Tender Notice

Period: Month

Monthly report of maintenance work

Sr. No.	Date	Nature of work attended	Remarks
1	2	3	4
1			
2			
3			
4			
5			
6			
7			

Signature of Contra



[REDACTED]

[REDACTED]

[REDACTED]

(A) LIST OF APPROVED VENDORS FOR CIVIL WORKS

Sr. No.	ITEMS	Approved Brands / Quality
1	CEMENT PPC 53 Grade & SULPHATE RESISTANT CEMENT,S.R.C.	Ambuja, Hathi, Ultra Tech, Sanghi, Siddhi, Hi-bond
2	BRICKS	MBM, Arjun, PBM, 555, Kisan, ABM, TRD, Paresh, Dhara, B.R.C., Kiran, BMB, Kirit, Sonal
3	Steel TMT, CRS	TISCO, SAIL, VIZAG, Kamdhenu, NATIONAL, Electrotherm, JSW, Welspun steel, Pollad Steel, DIAMOUND TMT, M. G. Steel, Friends Steel, Crown next TMT, Briskon TMT
4	VITRIFIED TILES	Asian, Kajaria, Jonson, Varmora, Simpolo, OASIS
5	CERAMIC TILES	Asian, Kajaria, Johnson, Varmora, Simpolo, OASIS
6	GLAZED TILES	Asian, Kajaria, Johnson, Varmora, Simpolo
7	ACRYLIC PAINT	ICI, Asian, Nerolac, Burger
8	OIL BOUND DISTEMPER	ICI, Asian, Nerolac, Burger
9	EXTERIOR WEATHER PROOF EMULSION PAINT	ICI, Asian, Nerolac, Burger
10	Oil Paint	ICI, Asian, Nerolac, Burger
11	SANITARY WARE	Cera, Hindware, Parryware
12	CAST IRON PIPES AND FITTINGS.	NECO, Swayarhoo, Bengal, Oriental Castings, Electro steel Castings
13	P.V.C. PIPES AND FITTING (UPVC/CPVC)	Finolex, Supreme, Jain, Kisan, Astral, Dutron, Prince
14	CHROMIUM PLATED WATER SUPPLY FITTINGS	Jaquar, Ess Ess, Plumber ,ESSCO, Crown, Metro, Prince
15	GALVANIZED PIPE	Tata, Essco, Jaquar, Ess Ess, Plumber
16	GALVANIZED FITTINGS	'R' Brand, 'RV' Brand, Kranti
17	C.I. MANHOLE COVER	Manish, Sil, NECO
18	PLUMBING FIXTURES	Jaguar, Plumber, Essco
19	PVC WATER TANK (100% VIRGIN PVC)	Sintex, Aqua
20	ALUMINIUM SHEETS AND ACCESSORIES	Nalco, Jindal, Hindalco, Banko

Sr. No.	ITEMS	Approved Brands / Quality
21	ALUMINIUM EXTRUDED DOOR/ WINDOW SECTION	Jindal, Hindalco, Banko, Ajin India, Aldowin, Alumilite
22	ALUMINIUM HARDWARE	Rajdoot, Belu, Diamond, Glider, Ajin India, Aldowin, Alumilite
23	WATER PROOFING MATERIALS	Zycosil, Dr. Fixit, Kerakoll, Pidilite, Roff
24	DOOR CLOSER	Efficient Gadget, Everite, Hardwin, Aldowin, Ozone
25	DOOR FITTINGS	Godrej, Efficient Gadgets (E.G.) Dunex, Doorset, Suzu, Coral
26	HINGES	Suzu, Yama, E.P.P.W.
27	SCREW AND BOLTS	Nettle Folds, GKW, Stud
28	BOLTS & FASTENERS	Hilti, Fisher
29	LIFT	Top, Express, Omega, OTIS, Schander, TRIO, Aegis Elevator, Mitsubishi, Aditya, Siemens slider
30	ROOFING MATERIAL – Galvalume sheets	TATA, Essar, Jindal
31	Slag Cement	SANGHI CEMENT Sanghipuram
32	CPVC PIPES FOR AUTOMATIC SPRINKLER FIRE EXTINGUISHING SYSTEM	ASTRAL POLY TECHNIK LIMITED પાર્કિંગ એરિયા, બેઈઝમેન્ટ એરિયા જેવા વિસ્તારો સિવાય માત્ર કન્સીલ્ડ પાર્કિંગ માટે આ કંપનીના CPVC pipe નો ઉપયોગ fire sprinkler piping માટે કરવાની મંજૂરી આપવામાં આવે છે.
33	AAC Blocks	NXTBLOC
34	Jointing Mortar	NXTFIX Block
35	Ready Mix Plaster	NXTPLAST
36	Block joining Masonry Mortar	Unifix
37	Tile adhesive	Unifix
38	RCC bench	Sardar Pre cast
39	Rubber mould garden curbin	Sardar Pre cast

Sr. No.	ITEMS	Approved Brands / Quality
40	Rubber mould Paver block	Sardar Pre cast
41	Fencing Pole	Sardar Pre cast
42	RCC Masonry block	Sardar Pre cast
43	Pre cast wall	Sardar Pre cast

(B) LIST OF APPROVED VENDORS FOR MECHANICAL & ELECTRICAL WORKS

Sr. No.	Description	Name of Manufacturer
1	HSCF Pump	Crompton Greaves Ltd
		Kirloskar Brothers Limited (KBL)
		JASCO
		Mather & Platt Pumps Ltd.
		Jyoti Ltd.
2	Electric Motor	Lubi Industries LLP
		Bharat Bijlee Ltd.
		Jyoti Ltd.
		JSL Industries Ltd.
		Jeumont Electrical India Pvt. Ltd.
		LHP
3	Electrical Panel	Crompton Greaves Ltd
		Bhagyashree Power Control
		Dynamic Control System
		Elembica Services
		JSL Industries Ltd.
		Nutral Power Tech
4	Kinetic Air Valve	Kirloskar Brothers Limited (KBL)
		FOURESS Engineering (India) Limited.
		Durga Valves Pvt.Ltd
		Orbinox
		श्री. डि. ए. ए. ए. ए.
5	Expansion Bellows	Precise Engineers
6	Dewatering (Drain) Pump(Submersible/ Horizontal)	KSB Pumps
		Kirloskar Brothers Limited (KBL)
		JASCO
		Crompton Greaves Ltd
		La Gajjar Machinery Pvt Ltd.
		Pullen Pumps Industries Pvt. Ltd.
		MBH
7	Sluice Valves and Sluice Gate	Kirloskar Brothers Limited (KBL)
		DURGA Valves Pvt.Ltd
		L & T Valves
		Jupiter
		SACHDEVA
8	UPVC Pipe	Supreme Industries Ltd.,Mumbai
		Dutron Polymers Ltd
		Parixit Industries Ltd., A'bad
		Jain Irrigation Systems Ltd., Jalgaon
9	HDPE Pipe	Parixit Industries Ltd., A'bad
		Jain Irrigation Systems Ltd., Jalgaon
		Dutron Polymers Ltd
		Jindal
10	C.I. Pipe	Essar Steel
		Electro Steel, Kejrival, Oriental Castings, BIC, Jindal, Lanco Industries Ltd.,Chennai, Kesins
13	EOT Crane	Grip Engineering Pvt. Ltd., JAPS Project, Brady & Morris Engineering Co. Ltd., Techno Industries

Sr. No.	Description	Name of Manufacturer
14	Cable & Wires	KEI Industries Ltd.
		Polycab Wires Pvt. Ltd.
		Aerolex Cables Pvt. Ltd.
		Allwin Industries
		Finolex Cables
		L&T Cables
		ULTRA CAB (India) Limited
15	Transformer	Atlanta Electricals Pvt. Ltd.
		Powerlite Electricals
		Voltamp Transformers Ltd.
		SKP Transformers
		Arya Electronics
16	Components for MCC :	
	Switch	L&T, Siemens
	HRC Fuse	L&T, Siemens
	Timer	L&T, Siemens
	Relay	L&T, Siemens
	Push Button Stations	L&T, Siemens
	Indicating Lamp	L&T, Siemens
	Cable Jointing Kit	CCI, M. Seal
	MCB/DB's	MDS, Siemens, Indokupp
17	Capacitors	L&T, Crompton, Khatau Note: Capacitors shall be oil fill type
18	KWH Meter	Simco, Jaipur, GEC
19	Light Fittings: (Indoor & Outdoor Luminaries)	Philips, Crompton, Bajaj, NESSA Illumination
20	Exhaust Fans	Crompton, Bajaj,
21	Ceiling Fans	Crompton, Bajaj, Havells
22	Air Blowers	Everest Ltd.
		Swan Pneumatics (P) Ltd
23	Alum Dosing Pumps	Asia LMI
		VK Pumps
		Swelore
24	Pressure Gauges	General Instruments
		Bells Control
		H. Guru Marketing
25	Level Gauge / Indicator	R K Dutt
		Levecon
		S. B. Electromec
26	Clarifier Equipment	Enviro Control Associates
		Voltas Ltd
		Hindustan Dorr-Oliver
		Geomiller/Triveni
27	Chlorination System	Industrial Device (I) Pvt. Ltd
		Metito
		Chloroequip
		Pennwalt
28	Gear Box	Greaves
		Radicon
		Elecon
		Shanti

Sr. No.	Description	Name of Manufacturer
29	Level Switches	Level-Tech
		Revathi Electronics
		Levec
30	Refrigerator	LG, Samsung, Kelvinator
31	PVC Pipes for Fluid	Finolex, Jain Irrigation
32	PVC Conduits for Electricals	Precision, Shakti
33	Butterfly Valve	KIRLOSKAR Brothers Limited(KBL), DURGA valves Pvt Ltd, L & T valves, R&D MULTIPLE, Jupiter, श्री कृष्णा इंटरवैल्व IVC, IVI, Audco, R & D multiple, Jupiter, Cair, Orbit Engineers
34	Check Valve (Dual Plate check Valve)	KIRLOSKAR Brothers Limited(KBL), DURGA valves Pvt Ltd, Orbinox, R&D MULTIPLE, Orbit Engineers
35	Metallic Expansion Bellow	Beloflex(B.D. Engineers), Stanfab Engineering Pvt. Ltd., D. Wren Engineering Pvt. Ltd., Sur Industries,
36	Centrifugal / Centrifugal Non Clog Pumps	Beacon Weir, KSB, Mather & Platt (Wilo), Worthington, WPIL, Xylem pumps , Grundfos Pumps Pvt. Ltd., MBH, JASCO
37	Submersible non Clog Pumps / Submersible Centrifugal Pumps	Kirlosker, KSB, ABS, ITT- Flyght, Xylem pumps, Grundfos Pumps Pvt. Ltd. , MBH, JASCO, AQUA, Jyoti, PULLEN PUMPS, Alpha, Het Pump
38	Screw Pump	Roto, Netzsch, Tushaco, Seepex
39	Metering / Dosing Pumps	Swelore, V.K. Pumps, Shapotools
40	Non Return Valves (Single / multi door) / Dual Plate Check Valves	Kirlosker, IVC, IVI, R & D multiple, Durga, Jupiter, Cair, Orbit Engineers
41	Knife Gate valves	Jash, Fouess, Vass (Dezurick), Vag, Orbinox, Orbit Engineers
42	Sluice gates / open Chanel Gates	Jash Engineering, IVC, R & D Multiple, Jupiter
43	Mechanical Fine Screens – Step (Mat) Type / Drum Type	Jash, Huber, Johnson, Savi, Italy, Apollo Screens
44	Mechanical Course bar Screen	Jash, Huber, Johnson, HDO, Triveni, Savi, Italy
45	Manual Bar Screen	Jash, Japs, HDO, Triveni, Auric
46	Grit mechanism	EIMCO – KCP, Hindustan Dorr – Oliver, Jash-Shivpad, Triveni, Voltas
47	Diffused Aeration System	EDI, OTT, Rehau
48	Air Blower	Kay, Swam, Everest, Usha Compressors, Gardner Denver
49	Agitator / mixer	Remi, Schurtek, Fibre & Fibre, Milton Roy
50	Gear Boxes	Greaves, Elecon, CPEC, PEPL, Bonfiglioli
51	Centrifuge	Humboldt, Alpha Laval, Hiller

Sr. No.	Description	Name of Manufacturer
52	HDPE Pipes	Astral, Dutron, Duraline, Narmada, RIL (PIL), Penwalt, Anjney, Jain Irrigation, Sangir
53	Air Compressor	Ingersoll – Rand, Khosla, Kirlosker, CPE, Alpha
54	Bearing For All Equipments	SKF, FAG, Tata
55	Fasteners	Precision, Durakhanawala, Echjay, Tata, Sundaram
56	Mechanical Seals	Eagle Seals (Sealol), Durametallic, Burgman
57	Electric Actuator	Auma, Rotork, Emerson, Pentair
58	(1) CATEGORY III Indoor LED fittings, LED Panel light, LED down light, outdoor LED light (street light, LED flood light, LED Post top lantern, LED bollard) (2) Solar LED Light	NESSA ILLUMINATION TECHNOLOGIES PVT.LTD., Litsun, Nextray
59	STREET LIGHT POLES	AMBICA POLES (for octagonal poles, swage poles, street light poles, high mast poles, decorative poles, conical poles, JETCOTECH Engineering LLP
60	Resilient Seated Slice Valve	Cair
61	Air Valve	Cair, Orbit Engineers
62	Flow Control valve	Cair
63	Altitude Control valve	Cair, Orbit Engineers
64	Pressure reducing valve	Orbit Engineers
65	Pressure relief valve	Orbit Engineers
66	Ball valve	Orbit Engineers
67	Mast pole	JETCOTECH Engineering LLP
68	Earthing material	JETCOTECH Engineering LLP
69	Hot dip galvanizing	JETCOTECH Engineering LLP
70	LED Highbay	Litsun

(C) LIST OF APPROVED VENDOR FOR INSTRUMENTATION SYSTEM

SR NO	DESCRIPTION	Name Of Manufacturer
1	Electromagnetic Flow Meter	E+H, Siemens, Abb, Fuji, Yokogawa, Krohne-Marshall, AAROHI Embedded System Pvt Ltd., Emerson, SBEM
2	Pressure Gauges	Wika, H.Guru, General Instruments Consortium Manometer (India) P. Ltd. , Baumer, Waaree
3	Pressure Switch	Danfoss , Indfoss , Switzer
4	Process Analyzers (pH, DO, Free / Residual Chlorine , BOD / COD)	E+H , Emerson , Hach , Chemitech , Polymetron, Wtw (Forbes Marshall),Yokogawa
5	Ultrasonic transmitter level / diff. level / flow	E+H, Siemens – Milltronics, Krohne, Vega
6	Hydraulic level transmitter	E+H,Siemens, ABB, Forbes- Marshall, Emerson, SBEM
7	Displacer/Float Switches	Levcon, Nivo, Toshbro, Pune Techtrol , SBEM
8	PP Float / Buoyancy switch	Pepprl + Fuchs, Baumer, Waaree, E+H , Pune Techtrol , SBEM
9	Float & Board Type Level Gauge	Levcon, Nivo, Toshbro, Pune Techtrol, SBEM
10	Electromagnetic Flow Meter	E+H, Siemens, ABB, Fuji, Yokogawa, Krohne-Marshall
11	Field Transmitter (P, DP,F, L , T)	ABB, Fuji, Yokogawa, Honeywell, Emerson
12	Pressure Gauges	Wika, H.Guru, General Instruments Consortium Manometer (India) P. Ltd., Baumer, Waaree
13	Panel Mounted Process Indicator & Flow Integrator	Masibus, Nishko, Nivam, Selectron, Radix, Yokogawa, ABB
14	Pressure Switch	Danfoss, Indfoss, Switzer
15	Programmable Logic Controllers	Rockwell (Allen Bradeley), Siemens, Schneider, Fuji, ABB, GE Fanuc
16	Control Panel Enclosure	Rittal, Enklotek, Bartakke, BCH, Eldon
17	Alarm Annunciator	Aplab Ltd., Minilec , IIC
18	Solenoid valves	Asco, Rotex, Schrader
19	Tube Fitting	Excel Hydropneumatic, Multimetal, Placka

20	Instrument Valves , Manifolds	Aptek, Anmol (Superlok), Excel Hydropneumatic, General
21	Fitting	Instrument Consortium , Multimetal, Technomatic, Placka
22	Pneum , Brass Fitting	Swagelok, Multimetal Industries, SMC, Festo
23	Control Panel Accessories / Components	
a.	Miniature Relay	Wago, Omron,Phoenix, Rockwell
b.	Indication Pilot Lamps (LED Type)	Teknic, Schneider, Siemens
c.	Push Button / Selector Switch (with NO/NC Elements)	Teknic, Schneider, Siemens
d.	DC Power Supplies (DIN Rail mounted)	Phoenix, Omron, Schneider, Rockwell
e.	Terminals	Elmex, Phoenix, Wago, Connectwell
f.	Panel Wires	Finolex , Havell's , R R Kabel
g.	Panel Illumination	Philips , Crompton , GE
24	Instrument Cables (Power , Signal , Control)	Associated Cables, Associated Flexible and Wires P.Ltd., Brooks Cables, Thermo Cables, Udey Pyro
25	Cable Glands	Ex- protecta, Braco, Sudhir, Comet, Connectwell
26	Junction Box	Ex- protecta, CEAG, Sudhir, Baliga, FCG
27	Cable Tray	M.M.Engineering, Globe, Jacinth, Equi. Reputed, JETCOTECH Engineering LLP
28	Computer System	HP-Compaq, Dell, IBM, Sony, Samsung
29	UPS	Hirel-Hitachi, Emerson, APC
30	<ol style="list-style-type: none"> 1. PLC (Programmable Logic Controller) 2. SCADA (Supervisory Control and Data acquisition) 3. VFD (Variable Frequency Drive Up to 500 KW) 4. ACB (Air Circuit Breaker up to 	MITSUBISHI ELECTRIC INDIA PRIVATE LIMITED, Emerald House, EL-3, J Block, M.I.D.C., Bhosari, Pune 411026

	<p>6000A)</p> <ol style="list-style-type: none"> 5. MCCB (Moulded Case Circuit Breaker up to – 1600 A) 6. MCB (Miniature Circuit Breaker up to – 63 A) 7. ELCB (Earth Leakage Moulded Case Circuit Breaker up to 1600 A) 8. Contractor up to – 800 A & OLR (Over load Relay) up to 630 A 9. Multi Functional Meters 10. MPCB (Motor Protection Circuit Breaker up to 32 A) 	
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**(D) LIST OF APPROVED VENDORS FOR MATERIALS RELATED TO WATER
SUPPLY AND SEWERAGE NETWORK**

SR. NO.	ITEMS	NAME OF AGENCIES
1	A C Pressure pipe MAZZA process	Lotus, Kirti
2	A C Pressure pipe MEGHNANI process	Lotus, Kirti, Hindustan
3	Sluice Valve	Durga, kartar, Kirloskar, Jupiter, SACHDEVA (C.I. & D.I.), શ્રી ક્રિષ્ના ઈન્ડસ્ટ્રીઝ, Cair, Orbit Engineers
4	DI Pipe	Electrotherm (I) Ltd.,Ahmedabad, Lanco Industries Ltd.,Chennai, Electrsteel, Jindal Saw Ltd.,Ahmedabad, Kesins, Welspun
5	R.C.C. PIPE (COLLAR JOINT & SOCKET SPIGOT JOINT) CLASS NP3 & NP4, & R.C.C. COLLARS	VIPUL SPUN PIPES (SIHOR & LATHIDAD,BOTAD), KATARIYA & CO. (DHASSA), OMKARESHVAR PIPES (NAVAGAAM), OMKAR PIPES (LATHIDAD, BOTAD), MARUTI PIPES (BAGODARA ,AHMEDABAD), KALATHIYA PIPES(BAGODARA ,AHMEDABAD), R. S. PIPES (BODELI), UMA HUME PIPES (KALOL, GANDHINAGAR), SIDHDHIVINAYAK (KARDEJ ,BHAVNAGAR)
6	R.C.C. MACHINEOLE FRAME & COVER, INLET FRAME COVER 10T.(600*450 MM.) , 20T.,35T., & 50T.	SONI CEMENT PRODUCT , VIPUL SPUN PIPES, KATARIYA & CO., OMKARESHVAR PIPES, OMKAR PIPES, MARUTI PIPES, KALATHIYA PIPES , R. S. PIPES, UMA HUME PIPES, SIDHDHIVINAYAK , S.K. Corporation, Laxmi Price Industries, S.J.Corporation, Sardar pre cast
7	Stone ware PipeManufacturer having BIS Certificate for ISI marking	Krishna Pipe, j.K. Pipe, Taya ceramic, Burn & co., perfect Potteries, Navroji Vakil, Kashmira
8	D.I. & C.I. FITTINGS	RG BRAND, ESSEM Engineering Industries, Bikaners Engineers works
9	CID Joints	ESSEM Engineering Industries
10	Valves & Graded Castings	ESSEM Engineering Industries
11	Pipe Fittings	ESSEM Engineering Industries, Bikaners Engineers works
12	CI/DI/MS graded castings	Bikaners Engineers works
13	Scaper machine hole	Sardar Pre cast