



**Agra Smart City Limited
Agra (U.P)**

Tender Document For

**Sewerage system in ABD area including 5 years operation and maintenance
under Smart city Mission**

Project Cost : Rs.102,20,17,509.00/-

Agra Smart City Limited (ASCL), Office of Nagar Nigam,

Agra, UP-282001

FOR THE WORK: Sewerage system in ABD area including 5 years operation and maintenance under Smart city Mission.

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AGRA SMART CITY LIMITED
AGRA

COVER-1
TECHNICAL BID

SECTION 1

SECTION I

List of Important Dates of Bids for Construction Related to Project under ASCL

- | | | | |
|-----------|---|---|--|
| 1 | Name of Work | : | Sewerage system in ABD area including 5 years operation and maintenance under Smart city Mission. |
| 2 | Completion Period for construction : | | 24 Month AS PER NIT including rainy Season. |
| 3 | Date of Issue of Notice Inviting Bid. | | 17.12.2018 |
| 4 | Period and Places of Availability of Bidding Documents From : | | 17.12.2018 To 07.01.2019 Till 17:30 Hrs

On line on http://etender.up.nic.in |
| 5 | Time, and Date of Pre-bid meeting, | | Date: 27.12.2018 Time – 03:00 P.M

At Office of Agra Smart City Limited, Agra Nagar Nigam, Agra. |
| 6 | Deadline for Receiving Bids online only, | | Date 07.01.2019 Time– 05:30 P.M. |
| 7 | Time and Date for opening Technical Bid/Bids online, | | Date 08.01.2019 Time:- 04.00 PM onwards

At Office of Agra Smart City Limited, ASCL, Agra. |
| 8 | Time and Date of opening Financial Bids online | | Date to be notified after technical evaluation |
| 9 | Last Date of Bid Validity | | 90 days from date of submission of Bid |
| 10 | Officer inviting Bids | | Office of the Chief Executive Officer, Agra Smart City Limited, Agra |

Notice Inviting Tender

No- 04/ ASCL/Sewerage System /Dec -18
17.12.2018

Dated

1. The **CEO, Agra Smart City Limited, Agra** on behalf of Government of Uttar Pradesh invites the Item rate bids online from the eligible and approved Contractors registered with UP PWD and other state government department, class 'A', **The Bidder may submit bids for any or all of the works. Bidders are advised to note the minimum qualification criteria specified in Clause 4 of the Instructions to Bidders to qualify for the award of the contract.**

2.

S N	Name of Work	Estimated cost (Rs)	EMD (Rs)	Cost of Document (in Rs.)	Address of the Executing the work
1	2	3	4	5	6
1.	Sewerage system in ABD area including 5 years operation and maintenance under Smart city Mission	102,20,17,509.00	1,80,88,805.00	Rs.5,000 +18% GST =Rs 5900/-	ABD area under Smart City Mission, Agra

3. **Time allowed for completion of Whole work is 24 Month, including rainy season.**
4. The bids shall remain valid for acceptance for a period of **THREE MONTHS** days from the last date of submission of Bids. Bids once submitted cannot be withdrawn.
5. Bids must be accompanied by non-refundable fee as indicated in Column 5 of the above table, in the form of **Demand Draft on any Schedule bank, for amount indicated in favour of "Chief Executive Officer, Agra Smart City Limited, Agra" payable at Agra. A set of bidding documents (SBD) will be available online on website <http://etender.up.nic.in>.**
6. Bids must be submitted online on or before **05:30 PM on dated 07.01.2019** and the technical bids will be opened online, dated **08.01.2019 at 04:00 PM**. If the office happens to be closed on the date of opening of the bids as specified, the bids will be opened online on the next working day, at the same time and validity of bid will be considered from the original date. The date and time of opening of the financial bid shall be notified on website. The Financial bids shall be accordingly opened online.
7. A pre-bid meeting shall be held in the **Agra Smart City Limited Agra, Conference Hall, Agra** for the work on date **27.12.2018 at 03.00 PM** corresponding to the respective package to clarify the issues and to answer questions on any matter that may be raised at that stage.

8. Bids must be accompanied with security of the amount specified for the work in the table. Bid security will have to be in any one of the forms as specified in the bidding document and shall be valid for 45 days beyond the validity of the bid. Bid security pledged in favour of "**Chief Executive Officer, Agra Smart City Limited, Agra.**"
9. No Engineer of Gazetted rank or other Gazetted officer employed in Engineering or Administrative duties in an Engineering Department of the State / Central Government is allowed to work as a Contractor for a period of two years after his retirement from Government service, without Government permission. This contract is liable to be cancelled if either the Contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government as aforesaid before submission of the tender or engagement in the Contractor's service.
10. Bid documents and other details consisting of qualification information and eligibility criterion of bidders, plans, specifications, drawings, the schedule of quantities of the various classes of work to be done and the set of terms & conditions of contract to be complied with by the Contractor can be seen in the office of the CEO, Agra Smart City Ltd., Agra between hours of 11.00 am and 04.00 PM on any working day between **17.12.2018 & 07.01.2019.**
11. Any bidder who is having criminal record is not allowed to participate in the bidding process.
12. Any bidder who is registered with the state Bar Council is not allowed to participate in the bidding process.
13. Each bidder is required to furnish an affidavit online on a non-judicial stamp paper of Rs. 100/- giving all information on prescribed Performa required for evaluation of the bidding capacity of the bidder.
14. Bidder must submit scan copy of original information/document on prescribed Performa i.e., T4, T5, T6 with each bid original must be produced when asked for at the time of opening of the bid.
15. Bidder's must comply with as per G.O. No. 3070/78-2-2018-42IT/2017 (22) date 03.01.2018 Non Compliance will be treated as failure. To the condition of the bid and as a valid reason to disqualify the bid's. And bid security should be submitted in the office of Chief Executive Officer, Agra Smart City Limited, Agra after opening Technical & Financial bid of participating work.
16. 1% Labour Cess will be deducted from the Contractor Bill.
17. The Extra Security /Performance Guarantee will be accepted as per G.O. No. 622/23-12-202-2Audit/08TC-2Lucknow Dated 08.06.2012.
 - A. Up to 10 Percent below Rates on BOQ @ 0.50 % Per 1 % below Rate.
 - B. In case of Bidders Quote the Rate More Than 10% below on BOQ Then Bidder Has to Provide Extra Security @ 1% Per 1% Below Rate
18. Bidder have to quote all the rates inclusive of all taxes,levies and royalties if any but exclusive of G.S.T.GST Shall Be Applicable As Per G.O.No 1614/23-10-2017-12(Samanya)/2017 Date 09.11.2017.

Section 2: Instructions to Bidders

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Instructions to Bidders (ITB)

A. General

1. Scope of Bid

- 1.1. a) Present proposals are drawn for providing comprehensive sewerage system to the ABD. Total sewage generation of Tajganj Sewerage Zone including ABD is 28.24 MLD for 2020, 41.19 MLD for 2035 & 60.08 MLD for 2050.
- b) About 30 Km length of sewers are proposed to cover the unsewered areas in the existing system.
- c) Sewage lifting stations with electrical and pumping machineries for 2 Nos in zone Kolhai, 1 No in zone Nagla Mewati & 1 No in zone Dhandupura Intermediate sewage pumping station (IPS) with electrical and pumping machineries for zone Kalalkheria & Mayapura village
- d) Sewage pumping main from Kolhai IPS and Kalalkheria & Mayapura IPS to proposed STP near Garhi village 18 Mld Sewage Pumping Station is proposed to treat sewage from Kolhai & Kalalkheria and Mayapura pumping stations.

Collection system

The ABD area falls in four existing zones namely Kolhai, NaglaMehwati, Dhandupura, & KhairatiTola and proposed zone for Kalalkheria & Mayapura villages. The collection system size varies from 150mm to upto 450mm ID. Upto 300mm dia meter HDPE DWC pipe and above 300mm diameter CI pipe are adopted. The zone wise sewer network pipe length is listed below

Kolhai --- 12.80 Kms

Nagla Mehwati ---- 12.71 Kms

Dhandupura ---- 1.88 Kms

Khairati Tola ---- 2.19 Kms

Kalalkheria & Mayapura ---- 37.61 Kms

Lifting cum pumping stations

Lift stations are provided to interconnect the proposed unsewered area with existing collection system wherever the invert level of the last manhole is lower than existing connecting manhole.

In zone Kolhai two lift stations are proposed K-LS1 & K-LS2 to integrate the proposed network with existing system and further by gravity reaches to the zonal pumping station. Necessary electrical and pumping arrangements are provided in the lifting and pumping stations.

In Nagla Mehwati Zone a lift station of M-LS is proposed to pump the sewage from proposed network to connect to the existing system. Further the sewage is also collected by gravity to the existing pumping station and conveyed by a pumping main to proposed STP.

In Dhandupura Zone, a lift station of D-LS is proposed to integrate the proposed sewer network with existing system. Further the sewage by gravity is collected at existing pumping station at Dhandupura. Existing Nagla Mewati will continue to serve as MPS to pump sewage from Taj Ganj zone to existing 28 MLD sewage treatment plant.

Sewage pumping main

As the existing capacity of STP is not adequate for Taj Ganj area intermediate sewage generation of 41.19 MLD. The sewage from Kolhai and Kalalkheria & Mayapura villages are proposed to treat at newly proposed 18 MLD STP. From Kolhai intermediate pumping station (IPS), 750mm diameter CI pumping main for a length of 7.60 Kms to proposed STP site and from Kalalkheria & Mayapura villages IPS 300mm diameter CI pumping main for a length of 5.65 Kms are proposed.

Consumer Connections

A provision has been made for providing about 15,000 consumer connections in ABD area for left out connections in existing system and for proposed network. House sewer connections are proposed with UPVC pipe of 110mm & 160mm with a connecting chamber for each household.

Operation and Maintenance

Refers to the procedures and activities involved in the actual delivery of services, e.g. collection of sewage, pumping, transmission and treatment of sewage. It includes the planning and control of the collection, treatment, and disposal of effluent. It also covers the management of client and public relations, legal, personnel, commercial, and accounting functions.

Keeping existing capital assets in serviceable condition, e.g. by repairing collection sewers, pumps and sewage treatment plants. Maintenance deals with activities that keep the system in proper working conditions including management, cost recovery, repairs and preventive maintenance. Maintenance involves Preventive and Predictive maintenance.

- 1.2. The successful Bidder will be expected to complete the Works by the Intended Completion Date specified in the Part I General Conditions of Contract.
- 1.3. Throughout these documents, the terms “bid” and “tender” and their derivatives (bidder/ tendered, bid/ tender, bidding/ tendering, etc.) are synonymous.

2. Source of Funds

- 2.1. Agra Smart City Limited as defined in the Appendix to ITB has decided to undertake the works of Sewerage System.
- 2.2. Agra Smart City Limited has decided to provide funds for the Sewerage Work

3. Eligible Bidders

- 3.1. This Invitation for Bids is open to all bidders as defined in the Appendix to ITB.
- 3.2. Bidders shall not be under a declaration of ineligibility for corrupt and fraudulent practices by the Central Government, the State Government or any public undertaking, autonomous body, authority by whatever name called under the Central or the State Government.
- 3.3. Any bidders having **criminal record** is not allowed to participate in the online bidding process. Any person who is having criminal cases against him or involved in the organized crime or gangster activities or Mafia or Goonda or Anti social activity are strictly prohibited to participate in the bidding process. If it is established that any bidder has criminal record, his bid shall be automatically cancelled.
- 3.4. The bidder has to produce attested true copies of the solvency & character certificates issued by the competent authority with the bid document along with an affidavit verifying that these two documents are valid. However, these original certificates should be produced by them at the time of opening the bids. If the competent authority is not satisfied after comparing attested copies with the originals, it may reject the bid as if the required documents were not produced all.

The bidder has also to produce self declaratory affidavit (on the attached prescribed proforma) in original with the bid documents.
- 3.5. Any bidder who is an Advocate and Registered with any State Bar Council Shall not be allowed to participate in the bidding. If it is established that the contractor is registered with the state bar council, his bid shall be automatically cancelled.

4. Qualification of the Bidder

- 4.1. All bidders shall provide in Section 3, Forms of Bid and Qualification information, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary.
- 4.2. All bidders shall include the following information and documents with their bids in Section 3, Qualification Information unless otherwise stated in the Appendix to ITB:
 - (a) copies of original documents defining the constitution or legal status, place of registration, and principal place of business; written power of attorney of the signatory of the Bid to commit the Bidder;
 - (b) Total monetary value of Sewerage works performed for each of the last five years;
 - (c) Experience in works of a similar nature and size for each of the last five years, and details of works in progress or contractually committed with certificates from the concerned officer or equivalent;
 - (d) Evidence of ownership of major items of construction equipment named in Clause 4.4 B (b) (i) of ITB or evidence of arrangement of possessing them on hire/lease/buying as defined therein.

- (e) Details of the technical personnel proposed to be employed for the Contract having the qualifications defined in Clause 4.4 (b) (ii) of ITB for the construction.
- (f) Reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past three years;
- (g) an undertaking that the bidder will be able to invest a minimum of cash up to the percentage (defined in the Appendix to ITB) of the contract price of works, during the implementation of the works;
- (h) Evidence of access to line(s) of credit and availability of other financial resources/ facilities (10 percent of the contract value) certified by banker (the certificate being not more than 3 months old.)
- (i) Authority to seek references from the Bidder's bankers;
- (j) information regarding any litigation or arbitration during the last five years in which the Bidder is involved, the parties concerned, the disputed amount, and the matter;
- (k) Proposal for subcontracting the components of the works for construction/ Up gradation aggregating not more than 25% of the contract price and
- (l) The proposed methodology and program of construction, backed with equipment and material planning and deployment, duly supported with broad calculations and Quality Management Plan proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications and within the stipulated period of completion. .

4.3. Bids from joint venture with three consortiums are allowed.

4.4.A To qualify for award of the Contract, each bidder should have in the last five years:

- a) Achieved in any one year a minimum financial turnover (in all cases of civil engineering construction works only) volume of construction work of at least the amount equal to the estimated cost of works(excluding maintenance cost for five years for which bid has been invited. The turnover will be indexed at the rate of 8 percent for a year.
- b) Satisfactorily completed, as prime Contractor, at least one similar work equal in value to one-third of the estimated cost of work (excluding maintenance cost for five years) for which the bid is invited, or such higher amount as may be specified in the Appendix to ITB.

Similar work shall mean at least one satisfactorily completed work sewerage project equal in value to one third of estimated cost of work for which the bid is invited and any of the consortium members should have experience in the following:

- i. Laying of sewer collection system
- ii. Design , Plan and construction Sewerage pumping station/Sewerage lift station
- iii. Providing house sewerage connection

- iv. Should have satisfactorily completed , atleast one work of successfully implementing vacuum sewerage system , in case bidder/consortium does not possess this experience same can be claimed as mentioned in clause 4.4D
- v. Bidder should have successfully operated and maintained atleast one sewerage system for a minimum period of two years in the last five years

4.4.B (a) Each bidder must attach:

- (i) The current income-tax clearance certificate;
- (ii) An affidavit that the information furnished with the bid documents is correct in all respects; and
- (iii) Such other certificates as defined in the Appendix to ITB. Failure to produce the certificates shall make the bid non-responsive.

(b) Each bidder must demonstrate:

- (i) Availability for construction work, of the owned, key equipment stated in the Appendix to ITB including equipment required for establishing field laboratory to perform mandatory tests, and those stated in the Appendix to ITB;
- (ii) Availability for construction work of technical personnel as stated in the Appendix to ITB.
- (iii) Liquid assets and /or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, of not less than the amount specified in the Appendix to ITB;

(c) The bidder must not have in his employment:

- (i) The near relations (defined as first blood relations, and their spouses, of the bidder or the bidder's spouse) of persons listed in the Appendix to ITB.
- (ii) Without Government permission, any person who retired as gazetted officer within the last two years of the rank and from the departments listed in the Appendix to ITB.

4.4.C To qualify for a package of contracts made up of this and other contracts for which bids are invited in the Notice Inviting Tender, the bidder must demonstrate having experience and resources sufficient to meet the aggregate of the qualifying criteria for the individual contracts.

4.4.D Since the project involves supply, assembling, installation Vacuum sewerage system, it is mandatory that the bidder shall have experience in Vacuum Sewerage System works (Relevant work order and completion certificate need to be submitted), failing which, in case bidder/Consortium does not have such experience,for claiming the vacuum sewerage experience the bidder shall enter into MoU with any agency specialized in such work who has executed such works of similar magnitude and submit certified copy of MoU along with the bid. The attested copies of original work orders (in case of non Government works only) and completion certificates indicating the specified required works of the agency claiming

the experience of vacuum sewerage system indicated as above issued by the clients should be scanned (PDF format) and submitted online along with the bid.

- 4.5. Sub contractors experience and resources shall not be taken into account in determining the bidder's compliance with the qualifying criteria except to the extent stated in 4.4 A above
- 4.6. Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity for construction work is equal to or more than the total bid value. The available bid capacity will be calculated as under:

$$\text{Assessed Available Bid capacity} = (A*N*M - B)$$

Where,

A = Maximum value of civil engineering works executed in any one year during the last five years (updated to the price level of the last year at the rate of 8 percent a year) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the works for which bids are invited (period up to 6 months to be taken as half-year and more than 6 months as one year).

M = M is taken 2.5

B = Value, at the current price level, of existing commitments and on-going works to be completed during the period of completion of the works for which bids are invited.

Note: The statements showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the Engineer in charge, not below the rank of an Executive Engineer or equivalent.

- 4.7. Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:
 - (i) Made misleading or false representations in the forms, statements, affidavits and attachments submitted in proof of the qualification requirements; and/or
 - (ii) Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.
 - (iii) Participated in the previous bidding for the same work and had quoted unreasonably high or low bid prices and could not furnish rational justification for it to the Employer.

5. One Bid per Bidder

- 5.1. Each Bidder shall submit only one Bid for one work. A Bidder who submits more than one Bid will cause the proposals with the Bidder's participation to be disqualified.

6. Cost of Bidding

- 6.1. The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will, in no case, be responsible or liable for those costs.

7. Site Visit

- 7.1. The Bidder, at his own cost, responsibility and risk, is encouraged to visit, examine and familiarize himself with the Site of Works and its surroundings including source of earth, water, road aggregates etc. and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense. He may contact the person whose contact details are given in the Appendix to ITB.

B. Bidding Documents

8. Content of Bidding Documents

- 8.1. The set of bidding documents comprises the documents listed below and addenda issued in accordance with Clause 10 of ITB.

1. Notice Inviting Tender
2. Instructions to Bidders
3. Qualification Information
4. Conditions of Contract

(Part I General Conditions of Contract, and Contract Data; Part II Special Conditions of Contract)

5. Specifications
6. Drawings
7. Bill of Quantities
8. Form of Bid
9. Form of Acceptance, Form of Agreement, Issue of Notice to Proceed with the Work, form of Unconditional Bank Guarantee.

- 8.2. Bidding document will be available online on the website <http://etender.up.nic.in>.

- 8.3. The bidder is expected to examine carefully all instructions, conditions of contract, contract data, forms, terms and specifications, bill of quantities, forms and drawings in the Bid Document. Failure to comply with the requirements of Bid Documents shall be at the bidder's own risk. Pursuant to clause 25 hereof, bids, which are not substantially responsive to the requirements of the Bid Documents, shall be rejected.

9. Clarification of Bidding Documents and Pre-bid Meeting

- 9.1. A prospective bidder requiring any clarification of the bidding document may notify the employer in writing or by cable ("cable" includes Telex and

facsimile) at the employer address indicated in the Notice inviting tenders. The Employer will respond to any request for clarification received earlier than 10 Days prior to the dead line for submission of bid. Copies of the employer's response will be forwarded to all purchasers of the bidding documents, including a description of the enquiry, but without identifying its source

9.2. If a pre-bid meeting is to be held, the bidder or his authorized representative is invited to attend it. Its date, time and address are given in the Appendix to ITB.

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

9.2.2. The bidder is requested to submit any questions in writing or by cable so as to reach the Employer not later than one week before the meeting.

9.2.3. Minutes of the meeting, including the text of the questions raised (without identifying the source of the enquiry) and the responses given will be transmitted online (or otherwise). Any modifications of the bidding documents listed in Clause 8.1 of ITB, which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively online through the issue of an Addendum pursuant to Clause 10 of ITB and not through the minutes of the pre-bid meeting.

9.2.4. Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

10. Amendment of Bidding Documents

10.1. Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing addenda online.

10.2. Any addendum thus issued shall be part of the bidding documents.

10.3. To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer shall extend, as necessary, the deadline for submission of bids, in accordance with Clause 20.2 of ITB.

C. Preparation of Bids

11. Language of Bid

11.1. All documents relating to the Bid shall be in the language specified in the Appendix to ITB.

12. Documents Comprising the Bid

12.1. The Bid submitted by the Bidder shall be in two separate parts:

Part I This shall be named Technical Bid and shall comprise of:

I. Earnest Money;

II. Qualification information, supporting documents, affidavit and undertaking as specified in Clause 4 of ITB.

- III. Undertaking that the bid shall remain valid for the period specified in clause 15.1 of ITB.
- IV. Any other information / documents required to be completed and submitted by bidders, as specified in the appendix to ITB, and
- V. An affidavit affirming that information he has furnished in the bidding document is correct to the best of his knowledge and belief.

Part II. It shall be named Financial Bid and shall comprise of:

- i) Form of Bid as specified in Section 6;
- ii) Priced bill of quantities for items specified in Section 7;

12.2. The following documents, which are not submitted with the bid, will be deemed to be bid is non responsive.

Section	particulars
1.	Notice inviting Tender
2.	Instruction to the bidders
3.	Conditions of Contract
4.	Contract Data
5.	Specifications
6.	Drawings

13. Bid Prices

- 13.1. The Contract shall be for the whole Works, as described in Clause 1. 1 of ITB, based on the priced Bill of Quantities submitted by the Bidder.
- 13.2. The Bidder shall adopt the Item Rate Method as specified in the Appendix to ITB; only the same option is allowed to all the Bidders. Item Rate Method requires the bidder to quote a rates for each item specified in the Appendix to ITB.
- 13.3. All duties, taxes, royalties and other levies payable by the Contractor under the Contract, or for any other cause, shall be included in the rates, prices, and total Bid price submitted by the Bidder (except GST).
- 13.4. The rates and prices quoted by the Bidder shall be fixed for the duration of the Contract and shall not be subject to adjustment.

14. Currencies of Bid

- 14.1. The unit rates and the prices shall be quoted by the bidder entirely in Indian Rupees.

15. Bid Validity

- 15.1. Bids shall remain valid for a period of ninety days after the deadline date for bid submission specified in Clause 20 of ITB. A bid valid for a shorter period shall be rejected by the Employer as non-responsive.
- 15.2. In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the bidders may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by cable. A bidder may refuse the request without forfeiting his Earnest Money. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his earnest money for a period of the extension, and in compliance with Clause 16 of ITB in all respects.

16. Earnest Money

- 16.1. The Bidder shall furnish, as part of the Bid, Earnest Money, in the amount specified in the Appendix to ITB.
- 16.2. The Earnest Money shall, at the Bidder's option, be in the form of Fixed Deposit Receipt of a scheduled commercial bank, NSC, Post office saving Bank issued in favor of the name given in the Appendix to ITB. The Fixed Deposit Receipt shall be valid for six months or more after the last date of receipt of bids. Other forms of Earnest Money acceptable to the Employer are stated in the Appendix to ITB. Earnest money will be deposited, physically, with officer calling tender, before last date of submission of tender. A scanned copy of earnest money document will be submitted along with the tender
- 16.3. Any bid not accompanied by an acceptable Earnest Money, unless exempted in terms given in the Appendix to ITB, shall be rejected by the Employer as non-responsive.
- 16.4. The Earnest Money of unsuccessful bidders will be returned within 28 days of the end of the Bid validity period specified in Clause 15.1 of ITB.
- 16.5. The Earnest Money of the successful Bidder will be discharged when the Bidder has signed the Agreement and furnished the required Performance Security.
- 16.6. **The Earnest Money may be forfeited:**
 - a) If the Bidder withdraws the Bid after bid opening (technical bid) during the period of Bid validity;
 - b) In the case of a successful Bidder, if the Bidder fails within the specified time limit to
 - i. Sign the Agreement; and/or
 - ii. Furnish the required Performance Security.

17. Alternative Proposals by Bidders

- 17.1. Bidders shall submit offers that comply with the requirements of the bidding documents, including the Bill of Quantities and the basic technical design as indicated in the drawings and specifications. Alternative proposals will be rejected as non-responsive.

18. Format and Signing of Bid

- 18.1. The Bidder shall submit one set of the bid comprising of the documents as described in Clause 12 of ITB.
- 18.2. The Bid shall be submitted on line and shall be digitally signed by a person or persons duly authorized to sign on behalf of the Bidder, pursuant to Clause 4.3(a) of ITB. The person or persons signing the Bid shall sign all pages of the Bid.

D. Submission of Bids

19. Sealing and Marking of Bids

- 19.1. The Bidder shall have to bid on line separately for Technical and financial bid . Technical Bid: To be opened on AS PER NIT (Date and time of Technical Bid opening as per clause 22.1 of ITB.) Financial Bid: Not to be opened except with the approval of the Employer.

20. Deadline for Submission of Bids

- 20.1. Complete Bids (including Technical and Financial) must be received by the Employer in the Appendix to ITB not later than the date and time indicated in the Appendix to ITB.
- 20.2. The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10.3 of ITB, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will then be subject to the new deadline.

21. Late Bids

- 21.1. No Provision/Consideration on Late Bid/Bids Submission.

E. Bid Opening and Evaluation

22. Bid Opening

- 22.1. The Employer will open the bids received, on line in the presence of the bidders/ bidder's representatives who choose to attend at the time, date and place specified in the Appendix to ITB. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the Bids will be opened at the appointed time online on the next working day.
- 22.2. The technical bid shall be opened online.
- 22.3. The Employer will prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Clause 22.3 of ITB.
- 22.4. Evaluation of the technical bids with respect to bid security, qualification information and other information furnished in Part I of the bid in pursuant to Clause 12.1 of ITB, shall be taken up and completed within Ten working days of the date of bid opening, and a list will be drawn up of the responsive bids whose financial bids are eligible for consideration.
- 22.5. The Employer shall inform, by E-mail (or otherwise the bidders, whose technical bids are found responsive, date, time and place of opening as stated in the Appendix ITB. In the event of the specified date being declared

a holiday for the Employer, the bids will be opened at the appointed time online on the next working day through they or their representative, may attend the meeting of opening of financial bids.

- 22.6. At the time of the opening of the “Financial Bid”, the names of the bidders whose bids were found responsive in accordance with clause 22.5 of ITB will be announced. The financial bids of only these bidders will be opened. The responsive bidder’s names, the Bid prices, the total amount of each bid, and such other details as the Employer may consider appropriate will be announced by the Employer at the time of bid opening. Any Bid price, which is not read out and recorded, will not be taken into account in Bid Evaluation.
- 22.7. The Employer shall prepare the minutes of the opening of the Financial Bids.

23. Process to be Confidential

- 23.1. 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 until the award to the successful Bidder has been announced. Any attempt by a Bidder to influence the Employer’s processing of bids or award decisions may result in the rejection of his Bid

24. Clarification of Bids and Contacting the Employer

- 24.1. No Bidder shall contact the Employer on any matter relating to its bid from the time of the bid opening to the time the contract is awarded.
- 24.2. Any attempt by the bidder to influence the Employer’s bid evaluation, bid comparison or contract award decision may result in the rejection of his bid.

25. Examination of Bids and Determination of Responsiveness

- 25.1. During the detailed evaluation of “Technical Bids”, the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clauses 3 and 4; (b) has been properly signed; (c) is accompanied by the required securities; and (d) is substantially responsive to the requirements of the bidding documents. During the detailed evaluation of the “Financial Bids”, the responsiveness of the bids will be further determined with respect to the remaining bid conditions, i.e., priced bill of quantities, technical specifications and drawings.
- 25.2. A substantially responsive “Financial Bid” is one that conforms to all the terms, conditions, and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the bidding documents, the Employer’s rights or the Bidder’s obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive bids.
- 25.3. If a “Financial Bid” is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation

26. Correction of Errors

- 26.1. Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:
 - a) Where there is a discrepancy between the rates in figures and in words, the rate in words will govern; and
 - b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.
- 26.2. The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount, the Bid will be rejected, and the Earnest money shall be forfeited in accordance with Clause 16.6(b) of ITB.

27. Evaluation and Comparison of Bids

- 27.1. The Employer will evaluate and compare only the bids determined to be substantially responsive in accordance with Clause 25 of ITB.
- 27.2. In evaluating the bids, the Employer will determine for each Bid the evaluated Bid price by adjusting the Bid price by making correction, if any, for errors pursuant to Clause 26 of ITB
- 27.3. If the Bid of the successful Bidder is seriously unbalanced in relation to the Engineer's estimate of the cost of work to be performed under the contract, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the performance security set forth in Clause 32 of ITB be increased at the expense of the successful Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract. The amount of the increased performance security shall be decided at the sole discretion of the Employer, which shall be final, binding and conclusive on the bidder.
- 27.4. If the Bid of the successful Bidder is seriously unbalanced in relation to the Engineer's estimate of the cost of routine maintenance of works to be performed for five years under the contract, the Employer may require the Bidder to produce detailed price analyses for routine maintenance. After its evaluation, the Employer may require that the amount of the performance security set forth in Clause 32 be increased at the expense of the successful Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract. The amount of the increased performance security shall be decided at the sole discretion of the Employer, which shall be final, binding and conclusive on the bidder.

28. Price Preference

- 28.1. There will be no price preference to any bidder.

F. Award of Contract

29. Award Criteria

- 29.1. Subject to Clause 31 of ITB, the Employer will award the Contract to the Bidder whose Bid has been determined:
- i. to be substantially responsive to the bidding documents and who has offered the lowest evaluated Bid price, provided that such Bidder has been determined to be (a) eligible in accordance with the provisions of Clause 3 of ITB, and (b) qualified in accordance with the provisions of Clause 4 of ITB; and
 - ii. To be within the available bid capacity adjusted to account for his bid price which is evaluated the lowest in any of the packages opened earlier than the one under consideration.

30. Employer's Right to accept any Bid and to Reject any or all Bids

- 30.1. Notwithstanding Clause 29 above, the Employer reserves the right to accept or reject any Bid, and to cancel the bidding process and reject all bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or bidders or any obligation to inform the affected Bidder or bidders of the grounds for the Employer's action.

31. Notification of Award and Signing of Agreement.

- 31.1.1. The bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by cable, telex or facsimile confirmed by registered letter. This letter (hereinafter and in the Part I *General Conditions of Contract* called the "Letter of Acceptance") will state the sum that the Employer will pay to the Contractor in consideration of the execution, completion by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").
- 31.2. The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance security in accordance with the provisions of Clause 32.
- 31.3. The Agreement will incorporate all agreements between the Employer and the successful Bidder. It will be signed by the Employer and the successful Bidder after the performance security is furnished.
- 31.4. Upon the furnishing by the successful Bidder of the Performance Security, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.

32. Performance Security

- 32.1. Within 10 (ten) days after receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Security of five percent of the Contract Price, for the period of one years and the time for completion of works plus additional security for unbalanced Bids in accordance with Clauses 27.3 and 27.4 of ITB and Clause 46 Part I General Conditions of Contract and sign the contract.
- 32.2. The performance security shall be either in the form of a Bank Guarantee or fixed deposit Receipts, in favour of "Chief Executive Officer, Agra Smart City Limited Payable at Agra, U.P., from a Scheduled Commercial Bank.

- 32.3. Failure of the successful Bidder to comply with the requirements of Clause 32.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Earnest Money. He will also be debarred from participating in future bids under U.P. P.W.D. for one year.

33. Advances:

- 33.1. The employer will provide mobilization advances and advance against security of equipment as provided in Part I General Condition of Contract.

34. Corrupt or Fraudulent Practices

The Employer requires the bidders/Contractors to strictly observe the laws against fraud and corruption in force in India, namely, Prevention of Corruption Act, 1988.

35. Return of Security Deposit & Retention Money:

Security Deposit shall be returned only after issuance of Virtual Completion Certificate by Engineer in charge / Project Management Consultant for the project. The schedule for returning the Security Deposit & Retention Money shall be as specified hereunder.

1. The return of SD shall start after 1 year of operation and maintenance (from date of issuance of Completion Certificate) of the sewerage work as specified in Detailed Tender Notice.
2. The SD shall be released on successful completion of operation and maintenance of the sewerage work during that period as specified in Detailed Tender Notice.
3. Starting from completion of year 1 of O&M, the SD shall be returned at the rate of 1% every year (Total 5 % in 5 years) after submission of equivalent Bank Guarantee by the contractor for balance period of operation and maintenance.

36. Completion Certificate:

It is obligatory for the contractor to obtain the completion certificate within 01 (one) months of completion of time period or valid extension period. Only 90 % payment for the work shall be released to the contractor upon 100 % physical work completion. Upon completion of 90 % physical work, the contractor shall apply for Completion Certificate and balance amount of 10 % shall be released along with Completion Certificate and Final Bill. The completion certificate will depend upon achieving NRW, if 30 % NRW achieved then 5 % will be released and 20 % will be achieved 2.5 % will be released and balance 2.5 % will be released after achieving 15 %. It shall be mandatory on the contractor to receive completion certificate from ASCL / Consultant within 01 months of completion of Tender Period or Valid Extension Period failing which suitable amount shall be deducted from his Security Deposit as directed by the Engineer-in-Charge.

If during any period the contractor fails to complete the operation and maintenance of the work as specified in the Detailed Tender Notice, the cost of this work shall be deducted from the balance SD payable to the contractor.

Appendix to Invitation to Bidders (ITB)

Instructions to Bidders

Clause Reference

(1.1) The Employer is CEO, Agra Smart City Limited Represented by: **CEO, Agra Smart City Limited Agra.**

(1.1) The Works of following sewerage work with allied works as shown below

FOR THE WORK: Sewerage system in ABD area including 5 years operation and maintenance under Smart city Mission.

(2.1) The State is Uttar Pradesh

(3.1) Eligible Bidders Are: contractors registered with CPWD or Public Works Department in class A or any Uttar Pradesh Govt. department or Other State Govt. department certificate.

(4.2) The information required from bidders in Clause 4.2 is modified as follows:

NONE

4.2 (g) The percentage is Ten

(4.4 A) (b) One Third of the estimated cost of works

(4.4 B) (a) (iii) Other certificates required with the bid are: As per ITB

(4.4. B) (b) (i) The key equipment and field testing laboratory required for Sewerage system in ABD area including 5 years operation and maintenance under Smart city Mission are:

Sl.	Name of Equipment (Documents to be attached)	Cost Of Work Up To 2 Crores	Quantity /No Cost Of Work More Then 2 Crores
1	R.M.C. plant	-	1
2	Transport Miller	-	4
3	Tar Boiler	2	-
4	Mixture/Mixer	1	1
5	Concrete Mixture	1	1
6	Water Tanker	8	8
7	Diesel Road Roller (8-10 Ton Capacity)	4	-
8	Vibratory Roller	-	-
9	Tractor	-	4
10	Truck	-	2
11	Hot mix plant with sensor paver	-	-
12	Air compressor	1	-
13	Mechanical Broom	1	-
14	Bitumen Distributor/ mechanical	1	-

	sprayer		
15	Tipper	-	4
16	J.C.B.	-	2
17	Pockland	-	2
18	Wet Mix Macadam Plant with paver	-	-
19	Pin vibrator	2	-
20	Generator 250 KVA	1	1
21	Grader	-	-
22	Soil Compactor	1	1
23	Concrete Vibrator with niddle	1	1
24	Field Laboratoy	1	1
25	Hydra (CAPACITY 8 TON)	-	As per requirement
26	Mastic Cooker	-	-
27	Trolly	-	As per requirement
28	Barrier	-	-
29	Cone	-	-
30	Reflective Tape	-	As per requirement
31	Pressure pump for testing of pipeline	-	As per requirement
32	Dumpy level	2 Nos.	2 Nos.
33	Total Station	1 No.	1 No.

For field testing Laboratory:

- Contractor will have to establish one Laboratories in between of stretch of working site fully equipped and consumable as per SP-20-2002 Jal Nigam Uttar Pradesh
 - Contractor will have to provide 2 Jeeps in good condition with driver and POL etc. exclusively to departmental officers for checking and inspection execution of work free of cost.

Note: (a) The bidder must produce the following documentary evidence in support of his owning the above equipment: Documents showing proof of ownership.

(4.4 B) (b)(ii) The Number of Technical personnel, Qualifications and Experience will be as follows:

A. The technical Personal are

Technical Personnel	Number	Experience in sewerage work
A. Degree Holder in Civil / Mechanical/ Electrical Engineering	1	Minimum 20 years of Experience out of which five years of experience of having handled/executed independently large sewerage work project.
B. Degree Holder in Civil Engineering	1	Minimum 5 years of Experience
C. Degree Holder in Mechanical Engineering	2	Minimum 5 years of Experience
D. Degree Holder in Electrical/ Electronic Engineering	1	Minimum 5 years of Experience
E. Diploma holder in Civil Engineering	2	Minimum 2 years of Experience

F. Diploma holder in Mechanical / Electrical Engineering	2	Minimum 2 years of Experience in Maintenance of plant & machinery
G. Surveyor	3	Minimum 2 years of Experience
H. ITI Certified Plumber/ Electrician/ Welder/ Fitter	10	Minimum 2 years of Experience

To ensure employment of Technical Personnel, the contractor would require giving the proof of payment of their salaries/ Wages by Cheque/ Demand Draft.

B. For field testing laboratory:

Technical Personnel	Number	Experience in sewerage work
A. Degree Holder in Civil / Mechanical/ Electrical Engineering	2	Minimum 5 years of Experience in Testing and Quality control in sewerage work.
B. Lab Assistant/Technical (ITI/B.Sc)	2	Minimum 2 years of Experience in maintenance of plant & machinery.
E. Draftsmen	2	Minimum 2 years of Experience in preparation of shop drawing

(4.4 B) (b)(iii) The minimum amount of liquid assets and/or credit facilities net of other contractual commitments of the successful Bidder shall be 10% of the contract value

(4.4 B) (c) (i) The bidder must produce an affidavit stating that the near relations of the following departmental officers are not in his employment: J.E.'s, A.E.'s, E.E.'s, S.E.'s, and other staff of equivalent rank

(4.4 B) (c) (ii) The bidder must produce an affidavit stating the names of retired gazetted officer (if any) in his employment who retired within the last two years with the following ranks from the departments listed below: U.P.P.W.D., R.E.S. and. U.P. Irrigation. (Assistant Engineer, Executive Engineer, Superintending Engineer, Chief Engineer, Director cum Chief Engineer, Engineer-in-Chief) In case there is no such person in his employment, his affidavit should clearly state this fact.

(4.6) M = 2.5

(7.1) The contact person is:

Designation: Chief Executive Officer,

Office of Agra Smart City Limited, Agra

Ph No-0562-2520615

(9.2.1) Place, Time and Date for pre-bid meeting are:

As per NIT

(11.1) Language of the bid is: English

(12.1) Part I (v) The other documents required are: NONE

T-4,T-5,T6

- (13.2.) Bids may be submitted only in Item Rate Method
- (16.1) The amount of Earnest Money shall be as per NIT
- (16.2) Fixed Deposit Receipt must be drawn in favour of:
Chief Executive Officer, Agra Smart City Limited, **Agra.**
- (16.2) Other acceptable forms of Bid Security pledged in favour of : **Chief Executive Officer, Agra Smart City Limited, Agra** National savings certificate issued by P&T Deptt., Post Office Saving account Pass book .
- (16.3) Exemption from Earnest Money is granted to: As per N.I.T/G.O.
- (20.1) The Employer's address for the purpose of Bid submission is online submission
- (20.1)1. The deadline for submission of bids shall be:
As per NIT
- (22.1) & (22.6) The date, and time for opening of the Technical Bids online are:
(A) Technical Bid
As per NIT
- (32.1) The amount and validity period of the performance guarantee is: Amount as BID SECURITY of the contract price Validity Period: -As per SBD
- (i) Performance security shall be valid until a date 45 days after the expiry of Defect Liability Period of 2 years after intended completion date.
- (ii) Additional Performance Security for unbalanced Bid shall be valid for 45 days plus intended completion period.

Date:
Signatory

Signature of Employer/ Authorized

Section 3 Qualification Information

(Following information's shall be furnished by the contractor on a non-judicial stamp paper of Rs. 100/- only)

Notes on Form of Qualification Information

The information to be filled in by bidders in the following pages will be used for Purposed of post-qualification as provided for in clause 4 of the Instructions to Bidders. This Information will not be incorporated in the Contract. Attach additional pages as necessary

1. Individual Bidders

1.1	Constitution or legal status of Bidder Place of registration: Principal place of business Power of attorney of signatory of Bid	[Attach copy] _____ _____ [Attach]
1.2	Total annual volume of civil engineering construction work executed and payments received in the last five years preceding the year in which bids are invited. (Attach certificate from Chartered Accountant)	(Rs in Lacs)

1.3.1	Work performed as prime Contractor (in the same name and style) on construction works of a similar nature and volume over the last five years. Attach certificate from the Engineer-in-charge
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Project Name	Name of Employer	Description of work	Value of contract	Contract No.	Date of Issue of work order	Stipulated Date of Completion	Actual Date of Completion	Remarks explaining reasons for Delay, if any

1.3.2. Information on Bid capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this

(A) Existing commitments and on-going construction works:

Description of Work	Place & State	Contract No & Date	Name & Address of Employer	Value of Contract (Rs. In lakhs)	Stipulated period of completion	Value of works remaining to be completed (Rs. Lakhs) *	Anticipated Date of completion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

* Enclose certificate(s) from Engineer(s)-in-charge for value of work remaining to be completed.

(B) Works for which bids already submitted:

Description of Work	Place & State	Name & Address of Employer	Estimated Value of Works (Rs. Lakhs)	Stipulated period of completion	Date when decision is expected	Remarks, if any
(1)	(2)	(3)	(4)	(5)	(6)	(7)

1.4. Availability of Major items of Contractor's Equipment proposed for carrying out the Works. List all information requested below. Refer also to Clause 4.2(d) and Clause 4.4 b (b) of the Instructions to Bidders.

Item of Equipment	Description, make, and age (Years), and capacity	Condition (new, good, poor) and number available	Owned, leased (from whom?), or to be purchased

1.5. Qualifications of technical personnel proposed for the Contract. Refer also to Clause 4.2(e) of the Instructions to Bidders and Clause 9.1 of Part-1 General Conditions of Contract

Position	Name	Qualification	Years of experience		
			Sewerage Works	Building Works	Other

1.6. Proposed sub-contractors and firms involved for construction. Refer to Clause 7 of Part I General Conditions of Contract.

Sections of the Works	Value of subcontract	Sub-contractor (name and address)	Experience in similar work

1.7. Note: The capability of the sub-Contractor will also be assessed (on the same lines as for the main Contractor) before according approval to him.

1.8. Financial reports for the last five years: balance sheets, profit and loss statements, auditors' reports, etc.

List below and attach copies.

1.9. Name, address, and telephone, telex, and facsimile numbers of banks that may provide references if contacted by the Employer.

1.10. a. Information on current litigation in which the Bidder is involved.

Name of Other party(s)	Cause of dispute	Litigation where (Court/arbitration)	Amount involved
1.11.			
1.12.			
1.13.			
1.14.			

1.11. Proposed Program (work method and schedule). Descriptions, drawings, and charts as necessary, to comply with the requirements of the bidding documents.

SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT

FACILITIES

BANK CERTIFICATE

This is to certify that M/S -----is a reputed company with a good financial standing.

If the contract for the work, namely, _____ is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs. _____ to meet their working capital requirements for executing the above contract.

Signature of Senior Bank Manager

.....

Name of the senior Bank Manager

.....

Address of the
Bank.....

Stamp of the Bank

Note: Certificate should be on the letterhead of the bank.

Under taking From bidders to Invest minimum 10% of the Value of the work.

FOR THE WORK: : Sewerage system in ABD area including operation and maintenance of 5 years under Smart city Mission

It is to be certified that I have Rs. In Cash, Rs.
..... in Bank and Rs..... by other sources with
proceed with the proposed work.

Date :-

Place :-

**Signature of
Contractor.**

Section 4

Part I General Conditions of Contract

A. General

4. Definitions

1.1. Terms, which are defined in the Contract Data, are not also defined in the Conditions of Contract but keep their defined meanings. Capital initials are used to identify defined terms.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

Compensation Events are those defined in Clause 40 hereunder.

The Completion Date is the date of completion of the Works as certified by the Engineer, in accordance with Clause 48.1.

The Contract is the Contract between the Employer and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in Clause 2.3.

The Contract Data defines the documents and other information, which comprise the Contract.

The Contractor is a person or corporate body whose Bid to carry out the Works, including routine maintenance, has been accepted by the Employer.

The Contractor's Bid is the completed bidding document submitted by the Contractor to the Employer.

The Contract Price is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

Days are calendar days; months are calendar months.

A Defect is any part of the Works not completed in accordance with the Contract.

The Defects Liability Certificate is the certificate issued by Engineer, after the Defect Liability Period has ended and upon correction of Defects by the Contractor.

The Defects Liability Period is Two years calculated from the Completion Date.

Drawings include calculations and other information provided or approved by the Engineer for the execution of the Contract.

The Employer is the party as defined in the Contract Data, who employs the Contractor to carry out the Works, including Routine maintenance,. The Employer may delegate any or all functions to a person or body nominated by him for specified Functions.

The Engineer is the person named in the Contract Data (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Engineer) who is responsible for supervising the execution of the Works and administering the Contract.

Equipments is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

The Initial Contract Price is the Contract Price listed in the Employer's Letter of Acceptance.

The Intended Completion Date is the date on which it is intended that the Contractor shall complete the Works.

The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised only by the Engineer by issuing an extension of time.

Materials are all supplies, including consumables, used by the Contractor for incorporation in the Works.

Plant is any integral part of the Works that shall have a mechanical, electrical, electronic, chemical, or biological function.

The Site is the area defined as such in the Contract Data.

Site Investigation Reports are those that were included in the bidding documents and are reports about the surface and subsurface conditions at the Site.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.

The Start Date is given in the Contract Data. It is the date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

A Sub-Contractor is a person or corporate body who has a Contract with the Contractor to carry out a part of the construction work in the Contract, which includes work on the Site.

Temporary Works are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

A. Variation is an instruction given by the Engineer, which varies the Works.

The Works, as defined in the Contract Data, are what the Contract requires the Contractor to construct, install, maintain, and turn over to the Employer. Routine maintenance is defined separately.

5. Interpretation

In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Engineer will provide instructions clarifying queries about these Conditions of Contract.

If sectional completion is specified in the Contract Data, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

The documents forming the Contract shall be interpreted in the following order of priority:

- (1) Agreement,
- (2) Notice to Proceed with the Work,

- (3) Letter of Acceptance,
- (4) Contractor's Bid
- (5) Contract Data,
- (6) Special Conditions of Contract Part II,
- (7) General Conditions of Contract Part I,
- (8) Specifications,
- (9) Drawings,
- (10) Bill of Quantities, and
- (11) Any other document listed in the Contract Data.

6. Language and Law.

The language of the Contract and the law governing the Contract are stated in the Contract Data.

7. Engineer's Decisions

Except where otherwise specifically stated, the Engineer will decide contractual matters between the Employer and the Contractor in the role representing the Employer. However, if the Engineer is required under the rules and regulations and orders of the Employer to obtain approval of some other authorities for specific actions, he will so obtain the approval.

Except as expressly stated in the Contract, the Engineer shall not have any authority to relieve the Contractor of any of his obligations under the contract.

8. Delegation

The Engineer, with the approval of the Employer, may delegate any of his duties and responsibilities to other people, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.

9. Communications

All Certificate, notices or instructions to be given to the contractor by Employer / Engineer shall be sent on the address or contact details given by the contractor in Section 6- Form of Bid. The address and contact details for communication with the Employer/ Engineer shall be as per the details given Contract Data to GCC. Communications between parties that are referred to in the conditions shall be in writing. The Notice sent by Facsimile (fax) or other electronic means shall be effective on confirmation of the transmission. The Notice sent by Registered post or Speed post shall be effective on delivery or at the expiry of the normal delivery period as undertaken by the postal service.

10. Subcontracting

7.1- The contractor may subcontract part of the construction work with the approval of the Employer in writing, up to 25% of the contract price but will not assign the Contract. Subcontracting shall not alter the contractor's obligations.

Beyond what has been stated in clauses 7.1, if the contractor proposes sub contracting any part of the work during execution of the works, because of some unforeseen circumstances to enable him to complete the work as per terms of the contract, the Employer will consider the following before according approval:

- a. The Contractor shall not sub-contract the whole of the works.
- b. The Contractor shall not sub-contract any part of the work without prior consent of the Employer. Any such consent shall not relieve the contractor from any liability or

obligation under the contract and he shall be responsible for the acts, defaults and neglects of any his sub-contractor, his agents or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agents and workmen.

The Engineer should satisfy himself before recommending to the Employer whether

- a. The circumstances warrant such sub-contracting: and
- b. The sub-contractor so proposed for the work possess the experience, qualification and equipment necessary for the job proposed to be entrusted to him in proportion of the Quantum of works to be sub-contracted.

11. Other Contractors

The contractor shall co-operate and share the site with other contractors. Public authority's utilities and the employer between the dates given in the schedule of other contractors, as referred to in the contract data. The contractor shall also provide facilities and services for them as described in the schedule. The employer may modify the schedule of other contractor, and shall notify the contractor of any such modification.

The contractor should take up the work in convenient reaches as decided by the Engineer to ensure there is least hindrance to the smooth flow of traffic including movement of vehicles and equipment of other contractors till the completion of the works.

12. Personnel

The Contractor shall employ for the construction work and routine maintenance the technical personnel named in the Contract Data or other technical persons approved by the Engineer. The Engineer will approve any proposed replacement of technical personnel only if their relevant qualifications and abilities are substantially equal to or better than those of the personnel stated in the Contract Data.

If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the Works in the Contract.

The Contractor shall not employ any retired Gazetted officer who has worked in the Engineering Department of the State Government and has either not completed two years after the date of retirement or has not obtained State Government's permission to employment with the Contractor.

13. Employer's and Contractor's Risks

The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks that this Contract states are Contractor's risks

14. Employer's Risks

The Employer is responsible for the excepted risks which are (a) in so far as they directly affect the execution of the Works in the Employer's country, the risks of war, invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war, riot commotion or disorder (unless restricted to the Contractor's employees), natural calamities and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive, or (b) a cause due solely to the design of the Works, other than the Contractor's design.

15. Contractor's Risks

All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other

than the excepted risks, referred to in clause 11.1, are the responsibility of the Contractor.

16. Insurance

The Contractor at his cost shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the date of completion, in the amounts and deductibles stated in the Contract Data for the following events which are due to the Contractor's risks:

- a) loss of or damage to the Works, Plant and Materials;
- b) loss of or damage to equipment;
- c) loss of or damage to property (except the Works, Plant, Materials, and equipment) in connection with the Contract; and
- d) Personal injury or death.

Insurance policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's approval before the completion date/ Start Date. All such insurance shall provide for compensation to be payable in Indian Rupees to rectify the loss or damage incurred.

(a) The Contractor at his cost shall also provide, in the joint names of the Employer and the Contractor, insurance cover from the date of completion to the end of defect liability period, in the amounts and deductibles stated in the Contract Data for the following events which are due to the Contractor's risks:

(a) Personal injury or death.

(b) Insurance policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's approval before the completion date/ start date. All such insurance shall provide for compensation to be payable in Indian Rupees.

Alterations to the terms of insurance shall not be made without the approval of the Engineer.

Both parties shall comply with any conditions of the insurance policies.

17. Site Investigation Reports

The Contractor, in preparing the Bid, may rely on any Site Investigation Reports referred to in the Contract Data, supplemented by any other information available to him, before submitting the bid.

18. Queries about the Contract Data

The Engineer will clarify queries on the Contract Data.

19. Contractor to Construct the Works

The Contractor shall construct, and install and maintain the Works in accordance with the Specifications and Drawings.

The contractor shall construct the works with intermediate technology, i.e., by manual means with medium input of machinery required to ensure the quality of works as per specifications. The contractor shall deploy the equipment and machinery as given in Contract Data.

1. The Works to Be Completed by the Intended Completion Date

The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Programme submitted by the Contractor, as

updated with the approval of the Engineer, and complete them by the Intended Completion Date.

2. Approval by the Engineer

The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Engineer, who is to approve them.

The Contractor shall be responsible for design of Temporary Works.

The Engineer's approval shall not alter the Contractor's responsibility for design of the Temporary Works.

The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.

All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Engineer before their use.

3. Safety

The Contractor shall be responsible for the safety of all activities on the Site.

4. Discoveries

Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Employer. The Contractor shall notify the Engineer of such discoveries and carry out the Engineer's instructions for dealing with them.

24. Possession of the Site

The Employer shall handover complete or part possession of the site to the Contractor 7 days in advance of construction program. At the start of the work, the employer shall handover the possession of at-least 75% of the site.

25. Access to the Site

The Contractor shall allow access to the Site and to any place where work in connection with the Contract is being carried out, or is intended to be carried out to the engineer and any person/persons/agency authorized by:

- a. The Engineer
- b. The Employer
- c. The Ministry of Rural Development, Government of India.
- d. National Rural Roads Development Agency, New Delhi

26. Instructions

The Contractor shall carry out all instructions of the Engineer, which comply with the applicable laws where the Site is located.

27. Dispute Redressal System

If any dispute or difference of any kind what-so-ever shall arises in connection with or arising out of this Contract or the execution of Works or maintenance of the Works there under, whether before its commencement or during the progress of Works or after the termination, abandonment or breach of the Contract, it shall, in the first instance, be referred for settlement to the competent authority, described along with their powers in the Contract Data, above the rank of the Engineer, The competent authority shall, within a period of forty-five days after being requested in writing by the Contractor to do so, convey his decision to the Contractor. Such decision in respect of every matter so referred shall, subject to review as hereinafter provided, be final and binding upon the Contractor. In case the Works is already in progress, the Contractor shall proceed with the execution of the Works, including maintenance thereof,

pending receipt of the decision of the competent authority as aforesaid, with all due diligence.

Either party will have the right of appeal, against the decision of the competent authority, to the arbitration if the amount appealed exceeds rupees one lakh.

28. Procedure for Resolution of Disputes

28.0.1. The Competent Authority mentioned in clause 24.1 shall give a decision in writing within 45 days of receipt of a notification of a dispute.

28.0.2. Either party may refer a decision of the Competent Authority to Arbitration within 28 days of the Competent Authority's written decision. Arbitration shall be under the Arbitration and Conciliation Act 1996. If neither party refers the dispute to Arbitration within the above 28 days, the Competent Authority's decision will be final and binding.

28.0.3. The Arbitration shall be conducted in accordance with the following procedure, in case Initial Contract Price is more than Rs. 5 Crore or the Contractor is a Foreign Contractor, who has bid under ICB:-

a) In case of a decision of the Competent Authority in a dispute or difference arising between the Employer and a Contractor relating to any matter arising out of or connected with this Agreement, the matter will be referred to an Arbitral Tribunal. The Arbitral Tribunal shall consist of three Arbitrators, one each to be appointed by the Employer and the contractor. The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties and shall act as presiding Arbitrator. In case of failure of the two Arbitrators appointed by the parties to reach upon a consensus within a period of 30 days from the appointment of the Arbitrator appointed subsequently, the presiding Arbitrator shall be appointed by the Chairman of the Executive Committee of the Indian Roads Congress.

b) If one of the parties fails to appoint its arbitrator in pursuance of sub-clause (a) above within 30 days after receipt of the notice of the appointment of its arbitrator by the other party, then the Chairman of the Executive Committee of the Indian Roads Congress shall appoint the arbitrator.

A certified copy of the order of the Chairman of the Executive Committee of the Indian Roads Congress, making such an appointment shall be furnished to each of the parties.

c) The decision of the majority of arbitrators shall be final and binding upon both parties. The cost and expenses of Arbitration proceedings will be paid as determined by the Arbitral Tribunal. However, the expenses incurred by each party in connection with the preparation, presentation etc. of its proceedings as also the fees and expenses paid to the arbitrator appointed by such party or on its behalf shall be borne by each party itself.

Where the Initial Contract Price as mentioned in the Acceptance Letter is Rs. 5 Crore and below, disputes and differences in which an Adjudicator has given a decision shall be referred to a sole Arbitrator. The sole Arbitrator would be appointed by the agreement between the parties; failing such agreement within 15 days of the reference to arbitration, by the appointing authority, namely the Chairman of the Executive Committee of the Indian Road Congress.

Arbitration proceedings shall be held at Agra (U.P.) , India, and the language of the arbitration proceedings and that of all documents and communications between the parties shall be English.

Performance under the contract shall continue even after reference to the arbitration and payments due to the contractor by the Employer shall not be withheld, unless they are the subject matter of the arbitration proceedings.

B. TIME CONTROL

29. Programme

Within the time stated in the Contract Data, the Contractor shall submit to the Engineer for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works, along with monthly cash flow forecasts for the construction of works.

The Contractor shall submit the list of equipment and machinery being brought to site, the list of key personnel being deployed, the list of machinery/ equipments being placed in field laboratory and the location of field laboratory along with the Program. The Engineer shall cause these details to be verified at each appropriate stage of the program.

An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining Works, including any changes to the sequence of the activities.

The Contractor shall submit to the Engineer for approval an updated Program at intervals of *60 Days* no longer than the period stated in the Contract Data. If the Contractor does not submit an updated Program within this period, the Engineer may withhold the amount stated in the Contract Data from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted.

The Engineer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Engineer again at any time. A revised Program shall show the effect of Variations and Compensation Events.

30. Extension of the Intended Completion Date

The Engineer shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining Works, which would cause the Contractor to incur additional cost

The Engineer shall decide whether and by how much time to extend the Intended Completion Date within 21 days of the Contractor asking the Engineer for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

31. Delays Ordered by the Engineer

The Superintending Engineer may instruct the Contractor to delay the start or progress of any activity within the Works. Delay/delays totaling more than 30 days will require prior written approval of the Employer.

32. Management Meetings

The Engineer may require the Contractor to attend a management meeting. The business of a management meeting shall be to review the plans for the Works.

29.1 The Engineer shall record the business of management meetings and provide copies of the record to those attending the meeting. The responsibility of the parties for actions to be taken shall be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all those who attended the meeting.

C. Quality Control

33. Identifying Defects

The Engineer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's

responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect.

34. Tests

For Carrying out mandatory tests as prescribed in the specification. The Contractor shall establish field laboratory at the location decided by Engineer. The field laboratory will have minimum equipment as specified in the Contract Data. The contractor shall be solely responsible for :

- a. Carrying out the mandatory tests prescribed in the Specifications, and
- b. For the correctness of the test results, whether preformed in his laboratory or elsewhere.

If the Engineer instructs the Contractor to carry out a test not specified in the Specification/ Rural Roads Manual to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples.

35. Correction of Defects noticed during the Defect Liability Period for two year.

- 35.0.1. The Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion of work. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.
- 35.0.2. Every time notice of Defect/Defects is given, the Contractor shall correct the notified Defect/Defects within the duration of time specified by the Engineer's notice.

The RFI system will be followed for execution of work.

36. Uncorrected Defects

If the Contractor has not corrected a Defect pertaining to the Defect Liability Period under clause 32.1.1 and of these Conditions of Contract, to the satisfaction of the Engineer, within the time specified in the Engineer's notice, the Engineer will assess the cost of having the Defect corrected, and the Contractor will pay this amount, on correction of the Defect.

D. Cost Control

37. Bill of Quantities

The Bill of Quantities shall contain items for the construction, installation, testing, and commissioning, maintaining works, and lump sum figures for yearly routine maintenance for each of the five years separately, to be done by the Contractor.

The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the Bill of Quantities for each item for the construction of roads. The payment to the Contractor is performance based for routine maintenance of roads.

38. Variations

The Engineer shall, having regard to the scope of the Works and the sanctioned estimated cost, have power to order, in writing, Variations within the scope of the Works he considers necessary or advisable during the progress of the Works. Such Variations shall form part of the Contract and the Contractor shall carry them out and include them in updated Programs produced by the Contractor. Oral orders of the Engineer for Variations, unless followed by written confirmation, shall not be taken into account.

39. Payments for Variations

If rates for variation items are specified in Bill of Quantity, the contractor shall carry out such work at the same rate. This shall apply for variation only up to the limit prescribed in the contract data. If the variation exceeds this limit, the rates shall be derived under the provision of clause 36.3 for quantities (higher or lower) exceeding the deviation limit.

If the rates for Variation are not specified in the Bill of Quantities, the Engineer shall derive the rate from similar items in the Bill of Quantities.

If the rate for Variation item cannot be determined in the manner specified in Clause 36.1 or 36.2, the Contractor shall, within 14 days of the issue of order of variation work, inform the Engineer the rate which he proposes to claim, supported by analysis of the rates. The Engineer shall assess the quotation and determine the rate based on prevailing market rates within one month of the submission of the claim by the Contractor. As far as possible, the rate analysis shall be based on the standard data book and the current schedule of rates of the district public works division. The decision of the Engineer on the rate so determined shall be final and binding on the Contractor.

40. Cash Flow Forecasts

When the Program is updated, the Contractor shall provide the Engineer with an updated cash flow forecast.

41. Payment Certificates

The payment to the contractor will be as follows for construction work:

- a) The Contractor shall submit to the Engineer fortnightly/ monthly statements of the value of the work executed less the cumulative amount certified previously supported with detailed measurement of the items of work executed in measurement books authorized by UP. P.W.D.
- b) The Engineer shall check the Contractor's fortnightly/monthly statement within 14 days and certify the amount to be paid to the Contractor.
- c) The value of work executed shall be determined, based on measurements by the Engineer.
- d) The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed.
- e) The value of work executed shall also include the valuation of Variations and Compensation Events.
- f) The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.
- g) The Payment of final bill shall be governed by the provisions of clause 50 of GCC.

42. Payments

Payments shall be adjusted for deductions for advance payments security deposit, other recoveries in terms of the Contract and taxes at source, as applicable under the law. The Engineer shall pay the Contractor the amounts he had certified within 15 days of the date of each certificate. The Employer may appoint another authority, as specified in the Contract Data (or any other competent person appointed by the Employer and notified to the contractor) to make payment certified by the Engineer.

Items of the Works for which no rate or price has been entered in the Bill of Quantities, will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

43. Compensation Events

The following shall be Compensation Events unless they are caused by the Contractor

- a) The Engineer orders a delay or delays exceeding a total of 30 days.
- b) The effects on the Contractor of any of the Employer's Risks.

If a Compensation Event would prevent the Works being completed before the Intended Completion Date, the Intended Completion Date shall be extended. The Engineer shall decide whether and by how much the Intended Completion Date shall be extended.

44. Tax

The rates quoted by the Contractor shall be deemed to be inclusive of the sales and other levies, duties, royalties, cess, toll, taxes of Central and State Governments, local bodies and authorities that the Contractor will have to pay for the performance of this Contract. The Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law.

45. Currencies

All payments will be made in Indian Rupees.

46. Security Deposit/ Retention and Release of Performance Security and Security Deposit/ Retention.

The Employer shall retain security deposit of 5% of the amount from each payment due to the Contractor until completion of the whole of the construction Work. No. security deposit/ retention shall be retained from the payments for Routine maintenance of Works.

On the completion of the whole of the construction Work half the total amount retained as Security Deposit is repaid to the contractor and half when the defect liability period has passed and the Engineer has certified that all defects notified by the Engineer to the contractor before the end of his period have been corrected.

The additional performance security for unbalanced bids as detailed in Clause 51 of Conditions of Contract is repaid to the contractor when the construction work is complete.

The performance security equal to the five percent of the contract price in Clause 51 of Conditions of contract is repaid to the contractor when the period of two years finished or defect liability period is over and the Engineer has certified that the contractor has satisfactorily carried out the Works.

If the contractor so desires then the Security Deposit can be converted into any interest bearing security of schedule commercial bank in the name of the Employer or National Saving Certificates duly pledged in favor of the Employer for Defect Liability Period.

47. Liquidated Damages

The Contractor shall pay liquidated damages to the Employer at the rate per week or part thereof stated in the Contract Data for the period that the Completion Date is later than the Intended Completion Date. Liquidated damages at the same rate shall be withheld if the Contractor fails to achieve the milestones prescribed in the Contract Data. However, in case the Contractor achieves next milestone the amount of the liquidated damages already withheld shall be restored to the Contractor by adjustment in the next payment certificate. The total amount of liquidated damages

shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's other liabilities.

If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate.

48. Advance Payment

The Employer will make the following advance payment to the contractor against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a Commercial bank acceptable to the Employer in amounts equal to the advance payment:

- a) Mobilization advance up to 5 percent of the contract price.
- b) Equipment advance up to ninety percent of the cost of the new equipment brought to the site, subjects to a maximum of 10 percent of the contract price.

The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest will not be charged on advance payment.

The Contractor is to use the advance payment only to pay for equipment, plant and mobilization expenses required specifically for execution of works. The Contractor shall demonstrate the advance payment as been used in this way by supplying copies of invoices or other documents to the Engineer.

The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor for the construction work, following the schedule of completed percentage of the work on payment basis. No account shall be taken of the advance payment or the repayment in assessing valuation of work done. Variations, price adjustments, Compensation events or liquidated damages.

49. Securities

The Performance Security equal to five percent of the contract price and additional security for unbalanced bids shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in the form given in the Contract Data and by a scheduled commercial bank. The Performance Security shall be valid until a date 45 days from the date of expiry of Defect Liability Period and the additional security for unbalanced bids shall be valid until a date 45 days from the date of issue of the certificate of completion.

50. Cost of Repairs

Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at his cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

51. Completion of Construction and Maintenance

The contractor shall request the Engineer to issue a certificate of completion of the construction of the works, and the Engineer will do so upon deciding that the works is completed.

52. Taking Over

The Employer shall take over the works within seven days of the Engineer issuing a certificate of completion of works.

53. Final Account

The contractor shall supply the Engineer with a detailed account of the total amount that the Contractor considers payable for works under the contract within 21 days of issue of certificate of completion of construction of works. The Engineer shall issue

a defect liability certificate and certify any payment that is due to the correct and complete. If the account is not correct or complete, the engineer shall issue within 42 days a schedule that states the scope of the corrections or additions that are necessary. If the account is still unsatisfactory after it has been resubmitted, the Engineer shall decide on the amount payable to the contractor and issue a payment certificate within 28 days of receiving the Contractor's revised account. The payment of final bill for construction of works will be made within 14 days thereafter.

In case the account is not received within 21 days of issue of Certificate of Completion as provided in clause 50. I above, the engineer shall proceed to finalize the account and issue a payment certificate within 28 days. The payment of final bill for construction of works will be made within 14 days thereafter.

54. Operating and Maintenance Manuals

If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the Contract Data.

If the Contractor does not supply the Drawings and/or manuals by the dates stated in the Contract Data, or they do not receive the Engineer's approval, the Engineer shall withhold the amount stated in the Contract Data from payments due to the Contractor.

55. Termination

The Employer may terminate the Contract if the Contractor causes a fundamental breach of the Contract.

Fundamental breaches of Contract shall include, but shall not be limited to, the following:

- a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Engineer;
- b) the Contractor is declared as bankrupt or goes into liquidation other than for approved reconstruction or amalgamation;
- c) the Engineer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer;
- d) the Contractor does not maintain a Security, which is required;
- e) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as defined in clause 44.1;
- f) the Contractor fails to provide insurance cover as required under clause 13;
- g) if the Contractor, in the judgment of the Employer, has engaged in the corrupt or fraudulent practice in competing for or in executing the Contract. For the purpose of this clause, "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value to influence the action of a public official in the procurement process or in Contract execution. "Fraudulent Practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid process at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.
- h) if the Contractor has not completed at least thirty percent of the value of construction Work required to be completed after half of the completion period has elapsed;
- i) if the Contractor fails to set up a field laboratory with the prescribed equipment, within the period specified in the Contract Data; and

j) Any other fundamental breaches as specified in the Contract Data.

k) if the Contractor fails to deploy machinery and equipment or personnel as specified in the contract Data at the Appropriate time.

Notwithstanding the above, the Employer may terminate the Contract for convenience.

If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

56. Payment upon Termination

If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer shall issue a certificate for the value of the work done and Materials ordered less liquidated damages, if any less 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 Data. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be recovered from the security deposit, and performance security. If any amount is still left un-recovered it will be a debt payable to the Employer.

If the Contract is terminated at the Employer's convenience, 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.

57. Property

All Materials on the Site, Plant, equipment, Temporary Works, and Works shall be deemed to be the property of the Employer for use for completing balance construction work if the Contract is terminated because of the Contractor's default, till the Works is completed after which it will be transferred to the Contractor and credit, if any, given for its use.

58. Releases from Performance

If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of the Employer or the Contractor, the Engineer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

F. Other Conditions of Contract

59. Labour

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and at such intervals as the Engineer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Engineer may require.

60. COMPLIANCE WITH LABOUR REGULATIONS

During continuance of the Contract, the Contractor and his sub Contractors shall abide at all times by all existing labor enactments and rules made there under, regulations, notifications and bye laws of the State or Central Government or local

authority and any other labor law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labor law in future either by the State or the Central Government or the local authority. Salient features of some of the major labor laws that are applicable to construction industry are given in Appendix to Part I General Condition of Contract. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the Contractor including his amount of performance security. The Employer/Engineer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

61. Drawings and Photographs of the Works

The contractor shall do photography/video photography of the site firstly before the start of the work, secondly mid-way in the execution of different stages of work and lastly after the completion of the work. No separate payment will be made to the contractor for this.

The Contractor shall not disclose details of Drawings furnished to him and works on which he is engaged without the prior approval of the Engineer in writing. No photograph of the works or any part thereof or plant employed thereon, except those permitted under clause 58.1, shall be taken or permitted by the Contractor to be taken by any of his employees or any employees of his sub-Contractors without the prior approval of the Engineer in writing. No photographs/ Video photography shall be published or otherwise circulated without the approval of the Engineer in writing.

62. The Apprentices Act 1961

The Contractor shall duly comply with the provisions of the Apprentices Act 1961 (III of 1961), the rules made there under and the orders that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so he shall be subject to all liabilities and penalties provided by the said Act and said Rules.

63. Criminals are prohibited from bidding

Any bidders having **criminal record** is not allowed to participate in the bidding process. Any person who is having criminal cases against him or involved in the **organized crime or gangster activities or Mafia or Goonda or Anti social activity** are strictly prohibited to participate in the bidding process. If it is established that any bidder has **criminal record, his bid shall be automatically cancelled.**

The bidder has to produced character certificate, Solvency certificate, self declared affidavit (on the prescribed Performa which is attached with the bid document) etc., issued by the competent authority in original with bid document.

64. Any bidder who is an Advocate and Registered with any State Bar Council Shall not be allowed to participate in the bidding. If it is established that the contractor is registered with the state bar council, his bid shall be automatically cancelled.

Section- 4.

Conditions of Contract

Part – II Special Conditions of Contract

1. All the works shall be carried out as per MORTH specifications/PWD detailed specification and instruction of Engineer-in-charge of ASCL.
2. The quantities are liable to vary on either side to any extent as per actual requirement of work for which no claim whatsoever by the contractor shall be entertained.
3. Job mix for all granular and bituminous works will have to be got prepared from reputed institute as directed by Engineer-in-charge and submitted for approval by competent authority. The entire ingredient required for job mix will be collected and sealed in presence of Engineer-in-charge and sent for preparation of job mix. If during execution of work there is change in grading of stone Aggregate, fresh job mix is to be got prepared.
4. Payment of all bituminous works- will be made on the basis of least quantity Arrived as by the following method:-
 - (I) Volume of bituminous work will be calculated by taking levels before and after the execution of particular activity at regular grids as prescribed by MORTH.
 - (II) Mix in each tipper will be taken at contractors cost and divided by the actual average field density of the stretch of each day of work and deemed volume will be arrived at. However, the contractor must note that density of any point should not be less than the permissible limit with respect to job mix.
5. Any recovery imposed by Technical Audit cell or by higher authority will be deducted from contractors running final bills during execution of works and will be adjusted from performance security if final bill is processed during defect liability period.
6. All the defects appeared' during execution of work will have to be rectified as directed by Engineer in charge within shortest possible time. During defect liability period contractor will be deploy sufficient technical staff as mention in contract document for, proper maintenance of work. If contractor fails to attend the defects. Within reasonable time period, the same will be attended by department and all expenses so incurred will be adjusted from performance security of contractors.
7. The contractor will adopt CNOON/PERT to complete the project in time. A detailed program and weekly working program will have to be submitted by contractor regularly.
8. Contractor shall procure Bitumen from Indian Oil Corporation, Hindustan Petroleum and shall produce the original C.R.C. issued by the company at the time of claiming the payment for bitumen and get reconciled against consumption in each running 'bill. If bitumen brought by the contractor is less than the calculated quantity arrived at by the measured quantity of works, the difference in such quality will be deducted from contractor's bill.
9. For earth work, each borrow pit will have get to be approved from competent authority by furnishing all physical/chemical characteristic of earth of each borrow pit before start of work.

10.MAINTENANCE DURING DEFECT LIABILITY PERIOD

The Defect Liability for this work is 12 months. During this period, it shall be the responsibility of the contractor to clean the area and furniture, tree/shrub cutting, etc at an acceptable serviceability level as directed by the Engineer in charge.

During the operation and maintenance period 60 months contractor shall provide a supervisor level staff for attending to all the O&M activities during the O&M Period.

The monthly report on the Operation and Maintenance shall be submitted to the Engineer and Security deposit for O&M as per the BOQ shall be released to the contractor based on appearance of defect year to year till entire of Operation and maintenance. and assessment made by Engineer in Charge of ASCL

11. Project Management Consultancy:

OBJECTIVE The objective of this Consultancy (the "Objective") is to assist the ASCL in implementation of the Project till the successful completion and handing over of all works to the ASCL and comprehensively supervise the works and activities carried out by the Contractors Engineer's Representative" under the respective contract(s) in a manner that would ensure:

- a. Total compliance of technical specifications and various other requirements contained in the respective contracts by the Contractor
- b. High standards of quality assurance system in the Consultancy as well as the works and activities of the Contractor
- c. Comprehensive and documented reporting to the ASCL of Consultant's own activities, progress of the Project(s) and compliances/ non-compliances by the Contractor
- d. Proper verification of measurements and bills submitted by the contractor so that payments made by the ASCL against these bills truly reflect the actual work done at site complying with the requirements of the respective contract(s);
- e. proper interface and coordination among the ASCL, contractor other contractors and local bodies/ state government; and
- f. Full documentation of the completed works including applications for various approvals.

The objectives of the PMC is not limited to the above, CEO of ASCL have discretion implement other objectives or the completion of the project.

12. Security Deposit

In the event of the contractor failing or neglecting to complete rectification work within the period up to which the contractor has agreed to maintain the work in good order, then, subject to provisions of clause 28 and 31 hereof the amount of security deposit retained by ASCL shall be forfeited without any notice.

13. Compensation for delay

The time allowed to carry out the work as entered in the **Contract** shall be strictly observed by the contractor and shall be reckoned from the date on which the order to commence work is given to the Contractor. The work shall through the stipulated period of the contract be proceeded with, all due diligence (time being deemed to be of the essence of the contract on the part of the Contractor) and the Contractor shall pay as compensation and amount equal to one percent or such smaller amount as the Chief Executive Officer ASCL (whose decision in writing shall be final) may

decide of the amount of estimated cost of the whole work as shown by the tenderer of everyday the work remains un commenced or unfinished after the proper dates.

And further to ensure good progress during execution of the work, the contractor shall be bound, in all cases in which the time allowed for any work exceeds one month to complete.

¼ of the working 1/3 of the time

¼ of the working ½ of the time

¼ ¾ of the working

¼ ¾ of the time

and full work should be completed in (04 Calendar months)

In the event of the Contractor failing to comply with these conditions he shall be liable to pay as compensation, an amount an equal to one percent or such smaller amounts as the Chief Executive Officer ASCL(whose decision in shall be final) may decide of the said estimated cost of the whole work for everyday that the due quantity of work remains incomplete provided always that the total amount of compensation to be paid under the provisions of this clause shall not exceed 10 percent of the estimated cost of the work as shown in the tender. Chief Executive Officer, ASCL, should be the final authority in the respect.

14. Additional Action when whole of security Deposit is forfeited

In any case in which under any clause of this contract the Contractor shall have rendered himself liable to pay compensation amounting to the whole of his security deposit whether paid in one sum or deducted by the instalments or in the case of abandonment of the work owing to serious illness or death of the Contractor or any other cause the Project Engineer, on behalf of the Corporation, shall have the power to adopt any of the following courses, as he may deem best suited to the interest of the Corporation.

- (a) To rescind the contract (for which rescission notice in writing to the Contractor under the hand of Project Engineer shall be conclusive evidence) and in that case the security deposit of the Contractor shall stand forfeited and be absolutely at the disposal of the Corporation.
- (b) To carry out the work or any part of the work departmentally debiting the Contractor with the cost of the work, expenditure incurred on the tools and plant, and charges on additional supervisory staff including the cost of the work—charged establishment employed for getting the un-executed part of the work completed and crediting him with the value of the work done departmentally in all respect in the same manner and at the same rates as if it had been carried out by the Contractor under terms of his contract. The certificate of the Project Engineer as to the costs and other allied expense so incurred and as to the value of the work so done departmentally shall be final and conclusive against the Contractor
- (c) i) To order that the work of the Contractor be measured up and to take such part thereof as shall be un-executed out of his hands, and to give it to another Contractor to complete, in which case all expenses incurred on advertisement for fixing a new contracting agency ,additional supervisory staff including the cost of the work charged establishment and the cost of the work executed by the new Contractor agency will be debited to the Contractor and the value of the work done or executed through the new Contractor in all respects and in the same manner and at the same rates as if it had been carried out by the Contractor under the terms of his contract. The certificate of the Project Engineer as to the costs and other allied expense so incurred and as to the value of the work so done departmentally shall be final and conclusive against the contractor.

ii) In case the contract shall be rescinded under clause (a) above the Contractor shall not be entitled to recover or be paid, any sum for any work thereof actually performed by him under this contract unless and until the Project Engineer shall have certified in writing the performance of the such work and the amount payable to him in respect thereof and he shall only be entitled to be paid the amount so certified. In the event of either of courses referred to clause (b) or (c) being adopted and the cost of the work executed departmentally or through new contractor and other allied expense exceeding the value of such work credited to the Contractor the amount of excess shall be deducted from any money due to the Contractor, by Corporation under the contractor or otherwise howsoever or from his security deposit or the sale proceeds thereof provided; however that Contractor shall have no claim against Corporation even if the certified value of the work done departmentally or through a new Contractor exceeds the certified cost of such work and allied expenses, provided always that whichever of the three courses mentioned in clause (a), (b) or (c) is adopted by the Chief Executive Officer ASCL, 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 advance on account of or with a view to the execution of the work or the performance of the contract.

15. Action when the progress of any particular portion of the work is unsatisfactory
If the progress of any particular portion of the work is unsatisfactory, the Chief Executive Officer ASCL shall notwithstanding that the general progress of the work is in accordance with the conditions mentioned in clause 2 be entitled to take action under clause 3 (b) after giving the Contractor 10 days' notice in working. The contractor will have no claim for compensation, for any loss sustained by him owing to such action.

16. Contractor remains liable to pay compensation if action not taken under clause 14 and 15

In any case in which any of the powers conferred upon the Project Engineer by clause 3 and 4 shall have become exercisable and the same shall not have been exercised the non-exercise thereof shall not constitute a waiving of any of the condition here of the such power shall notwithstanding be exercisable in the event of any future case of default by the Contractor for which under any clause hereof he is declared liable to pay compensation amounting to the whole of his security deposit and the liability of the Contractor for past and future compensation shall remain unaffected,. In the event of the Project Engineer taking action under sub-clause (a) or (c) of clause 3, he may, if he so desires, take possession of all or any tools and plant, materials and stores in or upon the work of the site thereof belonging to the Contractor, or procured by him and intended to be used for the execution of the work or any part thereof, paying or allowing for the same in account at the contract rates, or in the case of contract rates not being applicable at current market rates to be certified by the Project Engineer whose certificate thereof shall be final. In the alternative, the Project Engineer may, after giving notice in writing to the Contractor or his clerk of any work, foreman or other authorized agent required him to remove such tools and plant, materials, or stores from 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 Project Engineer may remove them at the Contractor's expenses or sell them by auction or private sale on account of the Contractor and at his risk in all respects, and the certificate of Project Engineer as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the Contractor

17. Extension of time limit

If the Contractor shall desire an extension of the time for completion of work on the ground of his having been unavoidably hindered in its execution or on any other ground he shall apply in writing to the Project Engineer 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 as aforesaid or on which the clause for asking for extension occurred, whichever is earlier and the Project Engineer, or in the opinion of Project Engineer as the case may be if in his opinion, there were reasonable ground for granting an extension, grant such extension as he thinks necessary or proper, the decision of the Chief Executive Officer ASCL in this matter shall be final.

18. Final Certificate

On the completion of the work the Contractor shall be furnished with a certificate by the Project Engineer (hereinafter called the Engineer-in-Charge) of such completion; but no such certificate shall be given nor shall the work be considered to be complete until the Contractor shall have removed from the premises on which the work shall have been executed, all scaffolding, surplus materials and rubbish, and shall have cleaned off, the dirt from all wood work, doors, windows, wall, floor or other parts of any building in or upon which the work has been executed, or of which he may have had possession for the purpose of executing the work, nor until the work shall have been measured by the Engineer-in –Charge or where the measurements have been taken by his subordinates until they have received approval of the Engineer-in- Change, the said measurements being binding and conclusive against Contractor. If the contractor shall fail to comply with the requirements of this clause as to the removal of scaffolding surplus materials and rubbish and cleaning of dirt on or before the date fixed for the completion of the work the Engineer-in- Charge may at the expense of the Contractor, removal such scaffolding, surplus material and rubbish, and dispose of the same as he thinks fit and clean off as such dirt as aforesaid and the Contractor shall from with pay the amount of the all expenses so incurred, but shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof

19. Payment on intermediate certificate to be regarded as advances

No payment shall be made for any work, estimated to cost less than rupees one thousand till after the whole of 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 than approved and passed by the Engineer-in – Change, 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 payment by way of advance against the final payment only and not as payment for work actually done and completed and shall not preclude the Engineer-in-Charge from requiring any bad, unsound imperfect or unskillful work to be removed or taken away and reconstructed, or re-erected nor shall any such payment be considered as an admission of the due performance of the contract or any part thereof in any respect or the occurring of any claim nor shall it conclude, determine or effect in any other way powers of the Engineer-in-Charge as to the final settlement and adjustment of the accounts 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 date fixed for 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

20. Payment on reduced rates on account of items of work not accepted as completion discretion of Engineer-in- Charge

The rates of several items of work estimated to cost more than Rs. 1000/- agreed to within, shall be valid only when the item concerned is accepted as having been completed fully in accordance with the sanctioned specifications. In case where the item of work are not accepted as so completed by the Engineer-in Charge may make payment on account of such item at such reduced rates as he may consider reasonable in the preparation of final or on account bills.

21. Bill to be submitted

A bill shall be submitted by the Contractor in each month on or before the date fixed by the Engineer- in- Charge for all work executed in the previous month and the 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 10 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 counter signature to the measurement list shall be sufficient warrant, and the Engineer-in-Charge may prepare a bill from such a list which shall be binding on the contractor in all respects.

22. Bill to be on printed forms

The contractor shall submit all bills on the printed forms to be had in the application at the office of the Engineer- in-Charge. The charges to be made in the bill shall always be entered at the rates specified in the tender or in the case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the tender at the rates hereinafter provided for such work.

23. Stores supplied by ASCL

If the specification or estimate of the work provides for the use of any special description of materials to be supplied from the store of the Engineering departmental store or if it is required that the contractor shall use certain stores to be provided by the Engineer in charge or General manager (such materials and stores and the prices to be charged therefore as hereinafter mentioned being so far as practicable for the convenience of the contractor but not so far as in any way to control the meaning or effect to this contract specified in the schedule or memorandum hereto annexed) the contractor shall be supplied with such materials and stored as may be required from time to time to be used only by him for the purpose of the contract only, and the value of the full quantity of the materials and stores so supplied shall be set off or deducted from any sums then due, or thereafter to become due to contractor under the contract, or otherwise, or from the security deposit or the proceeds of the sale thereof if the security deposit is held in pledged 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 Corporation and shall on no account be removed from the site of the work, and shall at all times be open for inspection by the engineer in charge. Any such materials unused and in perfectly good conditions at the time of completion or determination of the contract shall be returned by the engineering 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 consent of the Engineer in charge and shall have no claim for compensation on account of any such material supplied to him as foresaid but remaining unused by him or any wastage in or damage to any such materials

All stores of controlled materials such as cement, steel etc., supplied to the contractor by the ASCL should be kept by the contractor under lock and key and will be accessible for inspection by the Project Engineer or his agents all the time

24. Work to be executed in accordance to specifications, drawings, orders etc.

The contractor shall execute whole and every part of the work in the most substantial and workman like manner, and both as regards materials and every other respect in strict accordance with specifications. The contractor shall also conform exactly, fully, and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Engineer-in-Charge and lodged in his office and to which the contractor shall be entitled to have access for the purpose of inspection at such office, or at the site of the work during office hours. The contractor will be entitled to receive three sets of contract drawings and working drawing as well as one certified copy of the accepted tender along with work order free of cost. Further copies of the contract drawings and working drawings if required by him, shall be supplied at the rate of Rs.200/- per set of contract drawings and Rs.100/- per working drawing except where otherwise specified

25. Alterations in specifications and designs not invalidate

The Engineer-in-Charge shall have the power to make any alterations in or additions to original specifications, drawings, designs, and the 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 work in accordance with any instructions in this connection which may be given to him in the writing signed by the Engineer- in-Charge and such alterations 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 the 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 if the additional and altered work includes any class of work for which no rate is specified in the contract, then such work or class shall be carried out at the rates entered in the Schedule of rates of the Government or the Corporation or at the rates mutually agreed upon between the Engineer-in -Charge or altered work for which no rate is entered in the rates agreed upon then the contractor shall within seven days of the date of receipt by him 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 rate he shall by notice in writing be at liberty to cancel his order to carry out such class of work and arrange to carry out in such manner as he may consider advisable provided always that if the contractor shall commence work or incurred any expenditure in regard thereto before the rates shall have been determined as lastly herein before mentioned, then in such case he shall only be entitled to be paid in respect of the work carried out or expenditure incurred by him prior to the date of 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 a dispute, the decision of the Chief Engineer will 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 alterations above referred to shall be within the scope of such designs, drawings and specifications appended to the tender.

The time limit for the completion of the work shall be extended in the proportion that the increase in its cost occasioned by alterations, or additions bears to the cost of the original contract work, and the certificate of the Engineer- in-Charge as to such proportion shall be conclusive

26. Extension of time in consequence of additions or alterations

- 1) If at any time after the execution of the contract documents the Engineer shall for any reason whatsoever (other than default on the part of the contractor for which the Corporation is entitled to rescind the contract) desires that the whole or the part of the work specified in the tender should be suspended for any period or that the whole or part of the work should not be carried out, at all he shall give to the contractor a notice in writing of such desire and upon the receipt of such notice the contractor shall forthwith suspend or stop the work wholly or in part as required, after having due regard to the appropriate stage at which the work should be stopped or suspended so as not to cause any damage or injury to the work already done or endanger the safety thereof provided that the design of the Engineer as to the stage at which the work or any part of it could be or could have been safely stopped or suspended shall be final and conclusive against the contractor. The contractor shall have no claim to any payment or compensation whatsoever by reason of or suspension, stoppage or curtailment except to the extent specified therein after.

No claim to any payment or compensation for alteration in or restriction of work

- 2) Where the total suspension of work ordered as aforesaid continued for a continuous period exceeding 90 days the contractor shall be at liberty to withdraw from the contractual obligations under the contract so far as it pertains to the unexecuted part of the work by giving a 10 days prior notice in writing to the Engineer, within 30 days of the expiry of the said period of 90 days, of such intention and requiring the Engineer to record the final measurements of the work already done to pay the final bill. Upon giving such notice the contractor shall be deemed to have been discharged from his obligation to complete the remaining un-executed work under his contract. On receipt of such notice the Engineer shall proceed to complete the measurement and make such payment as may be finally due to the contractor within the period of 90 days from the receipt of such notice in respect of the work already done by the contractor. Such payment shall not in any manner prejudice the right of the contractor to any further compensation under the remaining provisions of this clause.

No claim to compensation on account of loss due to delay in supply of material by ASCL

- 3) Where the Engineer required the contractor to suspend the work for a period in excess of 30 days at any time or 60 days in the aggregate, the contractor shall be entitled to apply to the Engineer within 30 days of the resumption of the work after such suspension for payment of compensation to the extent of pecuniary loss suffered by him in respect of working machinery remained idle on the site or on the account of his having and to pay the salary or wages of labor engaged by him during

the said period of suspension provided always that the contract shall be not entitled to any claim in respect of any working machinery, salary or wages for the first 30 days whether consecutive or in the aggregate or such suspension in respect of any suspension whatsoever occasioned by unsatisfactory work or any other default on his part. The decision of the Engineer in this regard shall be final and conclusive against the contractor.

(4) In the event of-

- (i) Any total stoppage of work on notice from the Engineer under Sub clause (1) in that behalf.
- (ii) Withdrawal from the contractor from the contractual obligation completes the remaining un-expected work under the sub-clause (2) on account of continued suspension of work for a period exceeding 90days

No claim to compensation on account of loss due to delay in supply of material by Corporation Curtailment in the quantity of item or items originally tendered on account of any alteration, omission or substitution in the specification, drawings, designs, or instructions under clause 15(1) where such curtailment exceeds 25 % in quantity and the value of quantity curtailed beyond 25 % at the rates for the items specified in the tender is more than Rs.50000/-..It shall be open to the contractor, within 90 days from the service of (i) the notice of stoppage of work or (ii) the notice of withdrawal from the contractual obligations under the contract on account of continued suspension of work or (iii) notice under clause 15(1) resulting in such curtailment, to produce to the Engineer satisfactory documentary evidence that he had purchased or agreed to purchase material for use in the contracted work, before receipt by him of the notice of stoppage, suspension or curtailment and require the Corporation to take over on payment such material at the rates determined by the Engineer, provided, however such rates shall in no case exceed the rates at which the same was required by the contractor. The contractor shall thereafter take over the materials so offered, provided the quantities offered, are not in excess of the requirements of the unexecuted work as specified in the accepted tender and are of quality and specifications approved by the Engineer

The contractor shall not be entitled to claim any compensation from the Corporation for the loss suffered by him on account of delay by Corporation in the supply of materials entered in Schedule „A“ where such delay is caused by-

- (i) Difficulties related to the supply of railway wagons,
- (ii) Force Majeure,
- (iii) Act of God,
- (iv) Act of enemies of the State or any other reasonable cause beyond the control of Corporation.

In the case of such delay in the supply of materials, Corporation shall grant such extension of time for the completion of the works as shall appear to the Project Engineer to be reasonable in accordance with the circumstances of the case. The contractor shall accept the decision of the Project Engineer as to the extension of time as final

27. Time limit for unforeseen claims

Under no circumstances whatever shall the contractor be entitled to any compensation from the Corporation on any account unless the contractor shall have submitted a claim in writing to the Engineer- in- Charge within one month of the case of such claim occurring

28. Action and compensation payable in case of bad work

If any time before the security deposit or any part thereof is refunded to the contractor, it shall appear to the Engineer-in- Charge or his subordinate in charge of work, that any work has been executed with

unsound, imperfect or unskillful workmanship or with the materials of 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 any have been inadvertently passed, certified and paid for 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 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 intimation aforesaid, the contractor shall be liable to pay compensation at the rate of 1 % on the amount of the estimate for every day not exceeding 10 days during which the failure so continues and in the case of any such failure the Engineer- in-Charge may rectify and remove, and re-execute the work or remove and replace the material or articles 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 no such inferior work or materials as described above maybe accepted or made use of it shall be within his discretion to accept the same at such reduced rates as he may fix therefore

29. Work to be open for Contractor or responsible agent to be present

All work 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 at all other times at which his subordinates to visit the work shall have been given to the contractor, either himself be present to receive orders and instructions or have responsible agent duly authorized in writing present for that purpose. Orders given to the contractors duly authorized agent shall be considered to have the same force and affect as if they had been given to the contractor himself.

30. Notice to be given before work is covered up

The Contractor shall give not less than 5 days' notice in writing to the Engineer- in- Charge or his subordinate in charge of the work before measurement any work in order that the same may be measured and correct dimensions thereof taken before the same is so covered up or place beyond the reach of measurement and shall not cover up or place beyond the reach of measurement any work without the consent in writing of Engineer-in-Charge or his subordinate in charge of the work 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 contractors expense and in default thereof no payment or allowance shall be made for such work or for the materials with which the same was executed

31. Contractor liable for damage done

If during the period of 12 months from the date of completion as certified by the Engineer- in-Charge pursuant to Clause 7 of the contract for 12 months after commissioning the work, whichever is earlier in the opinion of the Project Engineer, said work is defective in any manner whatsoever, the contractor shall forthwith on receipt of notice in that behalf from the Project Engineer, duly commence execution and completely carry out at his cost in every respect or the work that may be necessary for rectifying and setting right the defects specified therein including dismantling and

reconstruction of unsafe portion strictly in accordance with and in the manner prescribed and under the supervision of the Project Engineer. In the event of the contractor failing or neglecting to commence execution of the said rectification work within the period prescribed thereof in the said notice and/or to complete the same as aforesaid as required by the said notice, the Project Engineer shall get the same executed and carried out departmentally or by any other agency at the risk on account and at the cost of the contractor. The contractor shall forthwith on demand pay to the ASCL the amount of such cost, charges and expenses sustained or incurred by the ASCL of which the certificate of the Project Engineer shall be final and binding on the contractor. Such cost, charges and expenses shall be deemed to be arrears of land revenue and in the event of the contractor failing or neglecting to pay the same on demand as aforesaid without prejudice to any other rights and aforesaid remedies of the corporation the same maybe recovered from the contractor as arrears of land revenue. The ASCL shall also be entitled to deduct the same from any amount, which may then be payable or which may thereafter become payable by the ASCL to the contractor either in respect of the said work or any other work whatsoever or from the amount of security deposit retained by Corporation

32. **Contractor to supply, Plant, Ladder etc.**

The contractor shall supply at his own cost all materials (except such special material, if any as many in accordance with the contract, be supplied from the Engineering Departmental Stores), plant tools appliances implements, ladders, cordage, tackle scaffolding and temporary works requisite or proper for the proper execution of the work, whether, in the original, altered or substituted from and whether including in the specification or other documents forming part of the contract or referred to in these conditions or not and which may be necessary for the purpose of satisfying or complying with the requirement of the Engineer-in-Charge as to any matter as to which these conditions, he is entitled to be satisfied, or which he is entitled to require together with the 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 setting out works and counting, weighing and assisting in the measurement or examination at any time and from time to time of the work or the material, failing which the same may be provided by the Engineer-in-Charge at the expenses of the contractor and the expenses may be deducted from any money due to the contractor under the contract or from his security deposit or the proceeds of sale thereof, or of a sufficient portion thereof. The contractor shall provide all necessary fencing and lights required to protect the public from accidents, and shall also be bound to bare the expenses of defense of every suit, action or other legal proceedings, that may be brought by any person for injuries sustained obeying to neglect of the above precautions, and to pay any damages and costs which may be avoided in any such suit actions or proceedings to any such person, or which may with consent of the contractor to be paid for compromising any claim by any such person.

33. **List of machinery in contractor's possession and which they propose to use on the work should be submitted along with the tender**

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 from 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: and
 - ii) As far as possible by competent workers possessing adequate experience in this kind of work
- c) All scaffolds and appliances connected therewith and ladders shall
 - i) Be sound of material,
 - ii) Be of adequate strength having regards to the loads and strains to which they will be subjects, and
 - iii) Be maintained in proper condition
- d) Scaffolds shall be so constructed that no 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 lifting gear on scaffolds special precautions 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 in specified.
 - i) Working platform, gangways, stairways shall
 - ii) Be so constructed that no part of thereof can sag unduly or unequally.
 - iii) 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
- i) Be kept free from any unnecessary obstruction
- j) In case of working platform, gangway, working places and stairways at a height exceeding three Members. Every working platform and every gangway shall be closely boarded unless other adequate measures are taken to ensure safety.
 - i) Every working platform and gangway shall have adequate width and
 - ii) Every working platform, gangway, working place and Stairway shall be suitable fenced.
- k) Every opening in the floor of a building or in a working platform shall accept for the time and to the extent required to allow the excess of persons for the transport for shifting of materials to be provided with suitable means to prevent the fall of persons or materials
- l) When persons are employed on roof where there is a danger of falling from a height exceeding 3 meters. Suitable precautions 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 scaffolds or other working places
- n) Safe means of access shall be provided to all working platforms and other working places

The contractor(s) will have to make payments to the laborers as per minimum wages Act.

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

 - (a) Hoisting machine and tackle, including the 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 mean of suspension shall be of suitable quality and adequate strength and free from patent defect.
- (c) Hoisting machines and tackle shall be examined and adequately tested after erection on the site and before used and be re examined in position at intervals to be prescribed by the Corporation.
- (d) Every chain, ring, hook, shackle swivel and pulley block used in hoisting and lowering materials or as a mean of suspension shall be periodically examined.
- (e) Every crane driver or hoisting appliance operator shall be properly qualified.
- (f) No person who is below the age of 18 years shall be control of any hoisting machine, including any scaffold which, or give signals to the operator.
- (g) In case of every hoisting machine and of every chain, ring, hook, shackle, swivel pulley block used in hoisting or lowering or as a mean of suspension, the safe working load shall be as ascertained by adequate means.
- (h) Every hoisting machine and all gear referred to in preceding regulation shall be plainly marked with the safe working load.
- (i) In the case of a hoisting machine having a variable safe working load each safe working load and the condition under which it is applicable shall be clearly indicated.
- (j) No part of any hoisting machine or of any geared referred to in regulation (g) above shall be loaded beyond the safe working load except for the purpose of testing.
- (k) Motors, gearing transmissions, electric wiring and other dangerous part of hoisting appliances shall be provided with efficient safeguards.
- (l) Hoisting appliances shall be provided with such means as will reduce to minimum, and the risk of the accidental descent of a load Adequate precautions shall be taken to reduce to a minimum the risk of any part of a suspended load becoming accidentally displaced

34. Measure for prevention of fire

The contractor shall not set fire to any standing jungle, trees, bush woods or grass without a written permit from the Project Engineer.

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

The contractor shall make his own arrangements for drinking water for the labors employed by him.

35. Liability of contractor for any damage done in or outside work

Compensation for all damages done intentionally or unintentionally by the contractor's labor whether in or beyond the limits of Corporation property including any damage caused by the spreading of fire mentioned in Clause 22 shall be estimated by the Engineer- in- Charge or such other officer as he may appoint and the estimate of the Engineer in charge subject to the decision of the Chief Executive Officer on appeal shall be final 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 Corporation to the contractor under this contract or otherwise. The contractor shall bear the expenses of defending any section or other legal proceedings that may be brought by any persons for injury sustained by him owing to neglect of precautions to prevent the spread of

fire and he shall pay any damages and cause that may be awarded by the court in consequences

36. Employment of female labor

The employment of female labors on works in neighborhood of soldier's barracks should be avoided as far as possible. The contractor shall employ the labor with the nearest employment exchange

37. Work of Sunday

No work shall be done on a Sunday without the sanction in written of the Engineer -in-Charge

38. Work not to sublet

The contract shall not be assigned or sublet without the written approval of the Engineer- in- Charge and if the contractor shall assign or sublet his contract, or attempt to do so, or become insolvent or commence any proceeding to get himself adjudicated and insolvent or make any composition with his creditors, or attempt to do so or if bribe, gratuity, gift, loan, perquisites, reward or advantage pecuniary or otherwise, shall either directly or indirectly be given, promise or offered by the contractor or any of his servants or agents to any public officer or person in the employ of corporation in any way relating to his office or employment, or if in any such officer or person shall become in anyway directly or indirectly interested in the contract the Engineer-in -Charge may there upon by notice in written rescind the contract and the security deposit of the contractor shall thereupon stand forfeited and be absolutely at the disposal of Corporation and the same consequences shall ensure as if the contract had been rescinded under Clause 3 hereof and in addition the contractor shall not be entitled to recover or be paid for any work therefore actually performed under the contract

39. Sum payable by way of compensation to be considered reasonable compensation without reference to actual loss

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

40. Changes in constitution of firm to

In case of tender by partners, any changes in the constitution of a firm shall be forthwith notified by the contractor to the Engineer- in- Charge for his information

41. Direction and control of Chief Executive Officer ASCL

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

(1) Except where otherwise specified in the contract and subject to the powers delegated to him by Corporation the decision of the Project Engineer for the time being shall be final, conclusive, and binding all parties to the contract upon all questions relating to the meaning of all specifications, designs, drawings and instructions hereinbefore mentioned and as to the quality of workmanship or materials used on the work, or as to any other question, claim, right matter, or thing whatsoever, if any way arising out of, or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions, or otherwise concerning the works or the execution, or failure to execute the same, whether arising during the progress of the work, or after the completion or abandonment thereof.

(2) The contractor may within thirty days of receipt by him of any order passed by the Project Engineer as aforesaid appeal against it to the ASCL concerned with the contract,

work or Project provided that-

The accepted value of that contract exceeds Rs. 10.00 lakhs (Rs. Ten lakhs Amount of claim is not less than Rs. 1.00 lakh (Rs. One lakh)

If the contractor is not satisfied with the order passed by the Chief Executive Officer, ASCL as aforesaid, the contractor may within thirty days of receipt by him of any such order Appeal against it to the Commissioner, and the Decision given by the Commissioner will be final.

42. Lump sums in estimates

When the estimate on which a tender is made includes lump sums in respect of parts of the work the contractor shall be entitled to payment in respect of the items of work involved or the part of work in question at the same rates as are payable under this contract of each item, or if the part of work in question is not in the option 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 and the certificate in writing of the Engineer- in-Charge shall be final and conclusive against the contractor with regard to any sum or sums payable to him under the provision of this clause

43. Actions where no specifications

In the case of any class of work for which there is no such specification as is mentioned in rule 1 such work shall be carried out in accordance with the standard specifications of Public Works Department, and in the event of there being no specification, then in case the work shall be carried out in all respects in accordance with all instructions and requirements of the Engineer- in-Charge

44. Definition of work

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

The percentage referred to in the tender shall be deducted from/ added to the gross of the bill before deducting the value of any stock issued

All quarry fees, royalties and ground rent for stacking materials if any should be paid by the contractor

The contractor shall be responsible for and shall pay any compensation to his workmen payable under the Workmen's Compensation Act 1923 (VIII of 1923) (hereinafter called the said Act) for injuries caused to the workmen. If such compensation is payable paid by corporation as principal under sub section (1) of section 12 of the said Act on behalf of the contractor under subsection (2) of the said section. Such compensation shall be recovered in the manner laid down in the Clause 1 above the contractor shall be responsible for and shall at the expenses of providing medical aid to any workmen who may suffer a bodily injury as a result of an accident. If Corporation the same shall be recoverable from the contractor forthwith and be incurs such expenses deducted without prejudice to any other remedy of Corporation from any amount due or that may be due to the contractor. The contractor shall provide all necessary personal safety equipment's and first aid apparatus available for use of persons employed on site and shall maintain the same condition suitable 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 by the contractor shall take adequate steps to ensure proper use of the equipment by those concerned.
- b) When the work is carried in the proximity to any place where there is a risk or drawing all necessary equipment shall be provided and kept ready

for use and all necessary steps shall be taken for the prompt rescue of any person in danger.

c) Adequate provisions shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

The contractor shall duly comply with the provision of "the Apprentices Act" (Ill of 1961) the rules made there under and the orders that may be issued from time to time under the Act the said Rules

45. Claim for quantities entered in the tender

(1) Quantities in respect of the several items shown in the tender rare approximate and no revision in the tendered rate shall be permitted in respect of any of the items so long as subject to any special provision contained in the specifications prescribing a different percentage of permissible variation the quantity of the item does not exceed the contract quantity by more than 50% and so long as the value of the excess quantity beyond this limit as the rate of the item specified in the tender is not more than Rs 5,00,000/- (Rs Five Lakh only).

(2) The contractor shall if ordered in writing by the Engineer to do so, also carry out any quantities in excess of the limit mentioned in sub-clause (1) hereof on the same conditions as in accordance with the specifications in the tender and at the rates as mentioned below:

a) if tender rate is above, rate will be at par as per Current PWD SOR

b) If tender rate is below, rate will be as per tender quoted rate on Current PWD SOR. For the purpose of operation of this clause, the total cost shall be taken as derived from the PWD SOR.

(3) Claims arising out of reduction in the tendered quantity of any item beyond 50 % will be governed by the provision of clause 15 only when the amount of such reduction beyond 50 % at the rate of the item specified in the tender is more than Rs.5,00,000/- (Rs Five Lakh only). This reduction is exclusively of the reduction mentioned in clause No 2, 1, 4 of the work and site condition.

There is no change in the rate if excess is less than or equal to 50%. Also, there is no change in the rate if quantity of work done is more than 50 % of the tendered quantity or the value of the excess work at tendered rates does not exceed Rs. 5,00,000/- (Rs Five Lacks only)

46. Employment of famine labor etc

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

47. Claim for compensation for delay in starting the

No compensation shall be allowed for any delay caused in the starting of the work on account of acquisition of land or in the case of clearance works on account of any delay in according to sanction of estimates

48. Claim for compensation for delay in execution

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

49. Entering upon or commencing any portion of work

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

50. Minimum age of persons employed, the employment of donkeys and for other animals and payment of fair wages

- (i) No contractor shall employ any person who is under age of 18 Years.
- (ii) No contractor shall employ donkeys or other animals with breeching of string or thin rope the breeching must be at least three inches wide and should be of tape (Nawar).
- (iii) No animals suffering from sores lameness or emaciation or which is immature shall be employed on the work.
- (iv) The Engineer-in-Charge or his agent is authorized to remove from the work any person or animal found working which does not satisfy these conditions and no responsibility shall be accepted by ASCL for any delay caused in the completion of work by such removal.
- (v) The contractor shall pay fair and reasonable wages to the workmen employed by him in the contract under taken by him. In the event of any dispute arising between the contractor and his workmen on the grounds that the wages paid are not fair and reasonable, the dispute shall be referred without delay to the Project Engineer who shall decide the same. The decision of the Project Engineer shall be conclusive and binding on the contractor but such decisions shall not in any way affect the conditions of contract regarding the payment to be made by corporation at the sanctioned tender rates.
- (vi) The contractor shall provide drinking water facilities to the workers similar amenities shall be provided to the workers engaged on large work in urban areas.
- (vii) Contractor to take precaution against accidents which take place on account of labor using loose garments while working near machinery

51. Method of payment

Payments to contractors shall be made by cheque drawn on any bank within the ASCL limits convenient not exceeding Rs 10 /- will be paid in cash.

52. Employment of scarcity labor

If ASCL declares a state of scarcity or famine to exist in any village situated within 10 miles of the work, the contractor shall employ upon such parts of work, as are suitable for unskilled labor, any person certified to him by the Project Engineer, or be any person to whom the Project Engineer may have delegated this duty in writing to be in need of relief and shall be bound to pay to such person wages not below the minimum which government may have fixed in this behalf. Any disputes which may arise in connection with the implementation of this clause shall be decided by the Project Engineer whose decision shall be final and binding on the contractor.

The contractor shall employ at least 80 percent of the total number of unskilled labor to be employed by him on the said work from out of the persons ordinarily residing in the district in which site of the said work is located. Provided, however; that if the required number of unskilled labor from that district is not available, the contractor shall in the first instance employ such number of persons as is available and thereafter may with previous permission in writing of the Project Engineer-in-charge of the said work, obtain the rest of the requirement of unskilled labor from outside district Wages to be paid to the skilled and unskilled laborers engaged by the Contractor. The contractor shall pay the laborer's skilled and unskilled according to the wages prescribed by the Minimum Wages Act of 1948 applicable to the area in which the work of the contract is located.

The contractor shall comply with the provisions of the Apprentices Act 1961 and the rules and Orders issued there under from time to time, if he fails to do so, his failure will be a breach of the contract and the Project Engineer, may in his discretion, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provision of Act. The contractor shall pay the laborer's skilled and unskilled according to wages prescribed by Minimum Wages Act applicable to the area in which the work lies

The contractor shall duly comply with all the provisions of the Contract Labor (Regulation and Abolition) Act, 1970 (37 of 1970) as amended from time to time and all other relevant status and statutory provision concerning payment of wages particularly to workmen employed by the contractor and working on the site of the work. In particular, the contractor shall pay wages to each worker employed by him on the site of the work. If the contractor fails or neglect to pay wages at the said rates or makes short payment and the ASCL makes such payment of wages in full or part thereof less paid by the contractor, as the case may be, the amount so paid by the contractor to such workers shall be deemed to be arrears of land revenue and the corporation shall be entitled to recover the same as such from the contractor or deduct same from the amount payable by the corporation to the contractor hereunder or from any other amount payable by the ASCL to the contractor hereunder or from any other amounts Payable to him by the Corporation.

If the project is shelved by the Corporation before commencement, the contractor will have no right to claim any loses or compensation due to the same and for whatsoever reasons.

All disputes and differences of any kind whatever arising out of or in connection with the contract or the carrying out of the work (whether during progress of the works or after their completion and whether before or after the determination, abandonment or breach of the contract) shall be referred to and settled by Project Engineer. But if the contractor be dissatisfied with the decision of the Chief Executive Officer ASCL or as to withholding by the Project Engineer of any certificate of the Project Engineer or as to withholding by the Project Engineer of any certificate to which the contractor may within 60 days after receiving notice of such decision give a return notice to the other party requiring that / may claim to entitled them and in any such case the contractor such matters in disputes be referred to in an appeal before a Committee as mentioned below. Such return notice shall specify the manner which are in disputes and such disputes or difference of which such notice has been given and no other shall be and is hereby referred to Committee consisting of the Chief Executive Officer ASCL, the decision taken by the committee will be final and binding on both the parties Such reference except as to the withholding of any certificate to which the contractor to be entitled shall not be opened or entered upon until after the completion or alleged completion of the works or until after the practical cessation of the works arising from any cause unless with the written consent of the Project Engineer. Provided always that the Corporation shall not withhold the payment of an interim certificate nor the contractor in any way delay the carrying out of the works by reason of any such matters, question or dispute being referred to the Committee but shall, proceed with the work with all the diligence and shall, until the decision of the Committee abide by the decision of the Project Engineer and no award of the Committee shall relievier the contractor of his obligations to adhere strictly to Project Engineer's instructions with regard to the actual carrying out of the works. The Owner and the contractor hereby also agree that the said reference to

the Committee under this clause shall be a condition precedent to any right of action under the Contract.

Contractor shall take out necessary Insurance Policy / policies for all workmen, labor employed on site so as to provide adequate Insurance cover for execution of the awarded contract work from National Insurance Co Ltd. Insurance Policy/policies taken out from any other company will not be accepted. He shall submit the receipt of premium to ASCL before work commencement

ADDITIONAL GENERAL CONDITIONS AND SPECIFICATIONS

NOTE: These are to apply as additional specifications and conditions, unless otherwise already provided for contradictorily else-where in this contract.

CONTRACTOR TO INFORM HIM SELFFULLY:

The Contractor shall be deemed to have carefully examined the work and site conditions including labor, the general and the special conditions, specifications, schedules and drawings and shall be deemed to have visited the site of the work and to have fully informed himself regarding the local conditions and carried out his own investigations to arrive at rates quoted in the tender. In this regard, he will be given necessary information to the best of knowledge of Department but without any guarantee about it.

ERRORS, OMISSION AND DISCREPANCIES:

a) In case of errors, omissions and /or disagreements between written and scaled dimensions on the drawing or between drawing and specifications etc. the following order of preference shall apply.

- (i) Between actual scaled and written dimensions or descriptions on a drawing the latter shall be adopted.
- (ii) Between the written or shown description of dimensions in the drawing and corresponding one in the specifications, the latter shall apply.
- (iii) Between the quantities shown in schedule of quantities and those arrived at from the drawings, the latter shall apply.
- (iv) Between the written description of the item in the schedule of quantities and the detailed description in the specifications of the same items, the latter shall apply.

b) In case of difference between the rates written in figures and words, the rate adopted by the contractor for working out the total amount of the item will be taken as correct. In order cases correct rates would be that, which is lower.

In all cases of omissions and / or doubts or discrepancies in the dimensions or descriptions of any item or specifications, a reference shall be made to the Project Engineer, ASCL whose elucidation, elaboration or decision shall be considered as authentic. The contractor shall be held responsible for any errors that may occur in the work through lack of such reference and precaution.

WORKING METHODS AND PROGRESS SCHEDULES:

(a) Contractor shall submit within times stipulated by the Engineer, in writing the details of actual methods that would be adopted by the contractor for the execution of any items as required by Engineer , at each of the location, supported by necessary detailed drawings and sketches including those of the Plant and Machinery that would be used ,their locations, arrangement for conveying and handling materials etc. and obtain prior approval of the Engineer-in-charge well in advance of starting of such item of work. The Engineer-in-charge reserves the right to suggest modifications or make complete changes in the method proposed

by the contractor, whether accepted previously or not, at any stage of work, to obtain the desired accuracy, quantity and progress of the work which shall be binding on the contractor, and no claim on account of such change in method of execution will be entertained by corporation so long as specifications of the item remain unaltered.

PROGRESS SCHEDULE

(b) The Contractor shall furnish within the period stipulated in writing by the Engineer-in-charge, of the order to start the work, a progress schedule in quadruplicate indicating the date of actual start, the monthly progress 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, plant and machinery. The Schedule is to be such as is practicable of achievement towards the completion of the whole work in the time limit, the particular items, if any on the due dates specified in the contract and shall have the approval of the Engineer-in-Charge. No revised schedule shall be operative without such acceptance in writing. The Engineer is further empowered to ask for more detailed schedule or schedules say; week by week for any item or items, in case of urgency of work as will be directed by him and the contractor shall supply the same as and when asked for.

(c) The contractor shall furnish sufficient plant, equipment and labor as may be necessary to maintain the progress of schedule. The working and shift hours restricted to one shift a day for operations to be done under the corporation supervision shall be such as may be approved by the Engineer-in-charge. They shall not be varied without the prior approval of the Engineer. Night work which requires supervision shall not be permitted except when specifically allowed by Engineer each time, if requested by the contractor. The contractor shall provide necessary lighting arrangements etc. for night work as directed by Engineers without extra cost.

(d) Further, the contractor shall submit the progress report of work in prescribed forms charts etc. at periodical intervals, as may be specified by the Engineer-in-charge. Schedule shall be in forms of progress charts, forms, progress statement and /or reports as may be approved by the Engineer.

(e) The contractor shall maintain Performa, charts, details regarding machinery equipment, labor, materials, personnel etc. as may be specified by the Engineer and submit periodical returns thereof as may be specified by the Engineer-in-charge.

AGENT AND WORK ORDER BOOK

The Contractor shall himself manage the work or engage an authorized all-time agent on the work capable of managing and guiding the work and understanding the specifications and contract condition. A qualified and experienced, Engineer shall be provided by the contractor as his agent for technical matters in case the Engineer-in-charge considers this as essential for the work and so directs contracts. He will take orders as will be given by the Project Engineer or his representatives and shall be responsible for carrying them out. This agent shall not be changed without prior intimation to the Project Engineer and his representatives on the work site. The contractor shall supply to the Engineer the details of all supervisory and other staff employed by the contractor and notify changes when made, and satisfy the unquestionable right to ask for change in the quality and numbers of contractor's supervisory staff and to order removal from work of any of such staff. The contractor shall comply with such orders and effect replacements to the satisfaction of the Engineer.

A work order book shall be maintained on site and it shall be the property of corporation and the Contractor shall promptly sign orders given therein by Project Engineer or his representative and his superior offices, and comply with them. The compliance shall be reported by the contractor to the Engineer in good time so that it can be checked. The blank work order book with machine numbered pages will be provided by the corporation free of charge for this purpose. The contractor will be allowed to copy out instructions therein from time to time.

INITIAL MEASUREMENTS FOR RECORD:

Where, for proper measurement of the work, it is necessary to have an initial set of levels or other measurement taken, the same as recorded in the authorized field book or measurement book of corporation by the Engineer or his authorized representative will be signed by the contractor who will be entitled to have a true copy of the same made at his cost. Any failure on the part of the contractor to get such levels etc. recorded before starting the work will render him liable to accept the decision of the Engineer as to the basis of taking measurement. Like-wise the contractor will not cover any work which will render its subsequent measurements difficult or impossible without first getting the same jointly measured by himself and the authorized representative of the Project Engineer. The record of such measurements on the corporation side will be signed by the contractor and he will be entitled to have a true copy of the same made at his cost.

HANDLING OVER THE WORK

All the work and materials before finally taken over by Corporation will be entire liability of the Contractor for guarding, maintaining and making good any damages of any magnitude. Interim payments made for such work will not alter this position. The handling over by the contractor and taking over by the Project Engineer or his authorized representative will be always in writing, copies of which will go to the Project Engineer or his authorized representative and the contractor. It is, however understood that before taking over such work, Corporation will not put it into regular use as distinct from causal or incidental one, except as specifically mentioned elsewhere in this contract, or as mutually agreed to.

ASSISTANCE IN PROCURING PRIORITIES, PERMITSETC

The Engineer, on a written request by the contractor, will if in his opinion, the request is reasonable and in the interest of work and its progress, assist the contractor in securing, the priorities for deliveries, transport permits for controlled materials etc. where such are needed. The Corporation, will not, however be responsible for the non-availability of such facilities or delay in this behalf and no claims on account of such failures or delays shall be allowed by the Corporation.

The Contractor shall have to make his own arrangement for machinery required for the work. However, such machinery conveniently available with the Corporation may be spared as the ruled in force on recovery of necessary Security Deposit and rent agreement in the prescribed form. Such an agreement shall be independent of this contract and the supply of machinery shall not form a ground for any claim or extension of time limit for this work.

SAMPLES AND TESTING OF MATERIALS

- (i) All materials to be used on work shall be got approved in advance from the Engineer-in-charge and shall pass the test and or analysis required by him, which will be (a) as specified in the specification for the item concerned and or as specified by the Indian Road Congress Standard Specification (b) Code of Practice for Road and Bridges or (c) I.S.I. Specifications (Whichever and wherever applicable) or (d) such recognized Specifications accepted to Engineer-in-Charge as equivalent thereto or in absence of such recognized Specifications (e) such requirement test and or analysis as may be specified by the Engineer-in-Charge in order of precedence given above.
- (ii) The contractor shall at his risk and cost make all arrangements and /or shall provide for all such facilities as the Engineer-in-charge may require for collecting preparing required number of samples for tests or for analysis at such item and to such places may be directed by the Engineer and bear all charges and cost of testing. Such samples shall also be deposited with the Engineer-in-Charge.
- (iii) The contractor shall if and when required submit at his cost the samples of materials to be tested or analysis and if, so directed, shall not make use of or incorporate in the work any materials represented by the samples until the required tests or analysis have been made and the materials, finally accepted by the Engineer-in-charge.
- (iv) The contractor shall not be eligible for any claim or compensation either arising out of any delay in the work or due to any corrective measures required to be taken on account of and as a result of testing of the materials.
- (v) The contractor or his authorized representative will be allowed to remain present in the departmental authorised laboratory while testing samples furnished by him. However, the results of all tests carried out in the such laboratory in the presence or absence of the contractor or his authorized representative will be binding on the contractor.
- (vi) Cost of routine day to day quality control testing charges for tests required as per specifications will be borne by contractor by sending the same to the concerned laboratories or by establishing laboratory at site.

CO-ORDINATION:

When several agencies for different sub work of the Project are to work simultaneously on the timely completion of the whole Project smoothly, the scheduled dated for completion specified in each contract shall therefore be strictly adhered to. Each contractor may make his independent arrangement for water, power, housing etc. if they so desired. On the other hand, the contractor is at liberty to mutual agreement in this behalf and makes joint arrangements with the approval of the Engineer. No single contractor shall take or cause to be taken any steps or action that may cause disruption discontent, or disturbance of work labor or arrangement etc. of other contractor in the Project localities. Any action by any contractor which the Engineer in his unquestioned discretion may consider as infringement of the above code would be considered as a breach of the contract conditions and shall be dealt with as such.

In case of any dispute, disagreement between the contractor, the Engineer's decision regarding the co-ordination, co-operation and facilities to be provided by any of the contractors shall be final and binding on the contractors concerned and such a decision or decisions shall not vitiate any contract nor absolve the contractor(s) of his/their obligations under the contract nor consider for the grant for any claim or compensation.

PAYMENT:

The Contractor must understand that the rates quoted are for completed work and include all costs due to labor, scaffolding, machinery, power, royalties, taxes etc. and should also

include all expenses to cover the of night work if and when required and no claim for additional payment beyond the prices or rates quoted will be entertained. The mode of measurements has been indicated in the specifications, if there is any ambiguity or doubt in this respect the decision of Project Engineer will be final.

PATENTED DEVICE

Whenever the contractor desires to use any designed devices, materials or process covered by the letter of patent or copy right, the right for such use shall be secured by suitable legal arrangement and agreement with patent owner and the copy of their agreement shall be filled with the Engineer-in-charge if so desired by the letter.

TEMPORARY QUARTERS:

(i) The contractor shall at his own expense maintain sufficient experienced supervisory staff etc. required for the work and shall make his own arrangement, provide housing for them with all necessary arrangements, including fire preventive measures etc. as directed by the Engineer-in-charge.

SAFETY MEASURES AND AMENITIES:

SAFETY MEASURES:

The contractor shall take all necessary precautions for the safety of the workers and preserving their health while working in such job as require special protection and precautions. The following are some of the requirements listed, though not exhaustive. The contractor shall also comply with the directions issued by the Engineer in this behalf from time to time and at all times.

- (1) Providing protective foot wear to workers, in situations like mixing and placing of mortar of concrete in quarries and places where the work is under too much of wet conditions as also for movements over surfaces infected with oyster growth etc.
- (2) Providing protective head gear to workers, working in quarries etc. to protect them against accidental fall of materials from above. To provide Reflective Jackets, Helmets to site staff.
- (3) Taking necessary steps towards training the workers concerned in the use of machinery before, they are allowed to handle it independently and taking all necessary precautions in and around the areas where machines, hoists, and similar units are working.
- (4) Avoiding bare lives-wires etc. as would electrocute workers.
- (5) Making all platforms, staging and temporary structures sufficiently strong so as not to cause inconvenience and risk to the workmen and supervisory staff.
- (6) Providing sufficient first aid trained staff and equipment to be available quickly at the work site to render immediate first aid treatment in case of accidents due to suffocation, drowning and other injuries.
- (7) Where the workers are required to work near machine and are liable to accident they should not be allowed to wear loose cloths like dhoti, zabba, etc.

DAMAGE BY FLOODS OR ACCIDENTS:

The contractor shall take all precautions against damage by floods or like or from accident etc. no compensation will be allowed to the contractor on this account or for correcting and repairing ant such damage to the work during construction. The contractor shall be liable to make good at his cost any plant or material belonging to the Corporation, lost or damaged by floods or from any other cause which is in his charge.

RELATION WITH PUBLIC AUTHORITIES:

The Contractor shall comply with all rules, regulations, bye-laws and direction given from time to time also by any local public authority in connection with this work and shall himself pay fees or charges which are leviable on him without any extra cost to the Department.

POLICE PROTECTION:

For the Special Protection of camp, the contractor's works, the Department will help the contractor as far as possible to arrange for such protections with the concerned authorities if so required by the Contractor in writing. The full cost of such protection shall be borne by the Contractor.

INDEMNITY:

The Contractor shall indemnify the ASCL against all actions, suits, claims and demands brought or made against him in respect of anything done or committed to be done by the Contractor on execution of or in connection with this contract and against any loss or damage to the corporation in consequence of any action or suit being brought against the Contractor for anything done or committed to be done in the execution of this contract.

MEDICAL AND SANITARY ARRANGEMENTS TO BE PROVIDED FOR LABOUR EMPLOYED IN THE CONSTRUCTION BY THE CONTRACTOR

- a) The Contractor shall provide an adequate supply of potable water for use of laborers on work and in Camps.
- b) The contractor shall construct trench or semi-permanent latrines for the use of the laborers. Separate latrines shall be provided for men and women.
- c) The Contractor shall build sufficient number of huts on a suitable plot of land for use of the laborers according to the following specifications.
 - i. Huts of bamboo and tin sheets may be constructed.
 - ii. A good site not liable to submergence shall be selected on high ground remote from jungle but well provided with trees, shall be chosen wherever it is available. The neighborhood of tank, jungle, grass or woods should be particularly avoided. Camps should not be established close to large cuttings of earthwork.
 - iii. The lines of huts shall have open spaces of at least ten meters between rows. When a good natural site cannot be procured, particular attention should be given to the drainage.
 - iv. There should be no overcrowding. Floor space at the rate of 30 sq.ft.per head shall be provided. Care should be taken to see that the huts are kept clean and in good order.
 - v. The contractor must find his own land and if he wants Corporation Land, he should apply for it and pay assessment for it, if made available by Corporation.
 - vi. The Contractor shall construct a sufficient number of bathing places. Washing places should also be provided for the purpose of washing clothes.
- 2. The Contractor shall make sufficient arrangements for draining away the surface and salvage water as well as water from the bathing and washing places and shall dispose off the wastewater in such a way as not to cause any nuisance.
 - d) The Contractor shall engage a medical officer with a traveling dispensary for a camp containing 500 or more persons if there is no government or other private

dispensary situated within 8kms from the camp. In case of emergency the contractor shall arrange at his cost for transport for quick medical help to his sick worker.

e) The Contractor shall provide the necessary staff for effecting a satisfactory drainage system and cleanliness of the camp to the satisfaction of the Engineer. At least one sweeper per 200 persons should be engaged.

f) The Assistant Director of Public Health shall be consulted before opening a labor camp and his instruction on matters such as water supply, sanitary conveniences, the camp site accommodation and food supply shall be followed the Contractor.

g) The Contractor shall make arrangements for all anti-malaria measures to be provided for the labor employed on the work. The anti-malaria measure shall be provided as directed by the Assistant Director of Public Health.

3. QUARRIES:

The quarrying operations if required and permitted by the Engineer-in-charge shall be carried out by the contractor with proper equipment such as Compressors, jack hammers, Drill bits, Explosives etc. and sufficient number of workmen shall be employed so as to get the required out-turn.

The Contractor shall carry out the works in quarries conformity with all the rules and regulations already laid down or may be laid down from time to time by Corporation due to non-compliance of any rules or regulations or due to damages by the contractor shall be the responsibility of the contractor. The Engineer-in-charge or his representative shall be given full facilities by the contractor for inspection at all times of the working of the quarry, records maintained, the stocks of the explosives and detonators etc., so as to enable him to check that the working records and storage are all in accordance with the relevant rule. The Engineer-in-charge or his representative shall at any time be allowed to inspect the works, buildings and equipment at the quarters.

The Contractor shall maintain at his own cost, the books, registers etc., required to be maintained under the relevant rules and regulations and as directed by the Engineer-in-charge. These books shall be open for inspection at times by the Engineer-in-charge or his representative and the contractor shall furnish the copies or extracts of books or register as and when required.

All quarrying operations shall be carried out by the contractor in organized and expeditious manner, systematically and with proper planning. The contractor shall engage licensed blaster and adopt electric blasting and/or any other approved method which would ensure complete safety to all men engaged in the quarry and its surroundings. The contractor shall himself provide suitable magazines and arrange to procure and store explosives, etc. as required under the rules at his own cost the designs and the locations of the magazine shall be got approved in advance from the Chief Inspector of Explosives and the rules and regulations in this connection as laid down by the Chief Inspector of Explosives from time to time shall be strictly adhered to by the Contractor. It is generally experienced that it takes time to obtain the necessary license for blasting storage of material from the concerned authorities. The contractor must therefore take timely advance action for procuring all such licenses so that the work progress may not be hampered.

The approaches to the quarrying place from the existing public roads shall have to be arranged by the contractor at his own cost, and the approaches shall be maintained by the contractor at his own cost till the work is over.

The quarrying operations shall be carried out by the contractor to the entire satisfaction of the Engineer-in-charge and the development of the quarry shall be made efficiently so as to

avoid wastage of stones. Only such stones as are of the required quality shall be used on the work. Any stone which is in the opinion of the Engineer-in-Charge, not in accordance with the specifications or of required quality will be rejected at any time, at the quarry or at the site of work. The rejected stones shall not be used on the work and such rejected materials shall be removed to the place shown at the contractor's cost.

Since all stones quarried from Government quarry (if made available) by the contractor including the excavated overburden are the property of the government, no stones or earth shall be supplied by the contractor to any other agencies or works, and are not allowed to be taken away for any other works all such surplus quarried materials not required for work under this contract shall be the property of the Government and shall be handed over by the contractor to Government free of cost at quarry site duly heaped at the spots indicated by the engineer-in-charge. The contractor will be entitled to the refund of the royalty if any paid by him for such quantity handed over to Government for which necessary certificate will be issued by Project Engineer as per usual procedure. If, however, the Government does not require such surplus material, the contractor may be allowed to dispose of or use material elsewhere with prior written permission of Engineer-in-Charge. Leaving off a quarry face or opening of a new quarry face shall be done only on the approval of the Engineer-in-charge. Quarrying permission will have to be directly obtained by the contractor, from the Collector of the district concerned for which purpose the Corporation will render necessary assistance. All quarry fees, Royalty charges, ground rent for staking material, etc. if any two be paid, shall be paid directly by the contractor as per rules in force. The contractor will be permitted to erect at his own risk and cost at the quarry site if suitable vacant space in government area is available for the purpose, his own structures for stores, offices, etc. at place approved by the Engineer-in-charge. On completion of the work, the contractor shall remove all the structures erected by him and restore the site to its original condition. The contractor shall not use any land in the quarry either for cultivation or for any other purpose except that required for breaking or stacking or transporting stones.

TRAFFIC REGULATION

Unless separately provided for in the contract, the contractor shall have to make all necessary arrangement for regulating traffic, day to night during the period of construction to the entire satisfaction of the Engineer. This includes the construction and maintenance of diversions if necessary. The contractor shall have to provide necessary caution boards, barricades, flags, lights and watchmen etc. so as to comply with the latest Motor Vehicles rules and regulations and for traffic safety and he shall be responsible for all claims from accidents which may arise due to his negligence whether in regulating the traffic or in stacking material on the roads or due to any other reasons.

MISCELLANEOUS

Rate shall be exclusive of G.S.T. as applicable.

For providing electric wiring or water lines etc. shall be provided if necessary through walls, slabs, beams etc. and later on refilled up with bricks or stone chippings, cement mortar without any extra cost.

In case it becomes necessary for the due fulfillment of Contract for the Contractor to occupy land outside the Department limits, the Contractor will have to make his own arrangement with the land owners and to pay such rents if any are payable as mutually agreed between them. The Department will afford the Contractor all the reasonable assistance to enable him to obtain ASCL land for such purpose on usual terms and conditions as per the rules of the ASCL

Special provision in detailed specifications or wording of any item shall gain precedence over corresponding contradictory provision (if any) in the Standard Specifications or PWD Hand Book, where reference to such specifications is given without reproducing the details in Contract.

Suitable separating barricades and enclosures shall be provided to separate material brought by the Contractor and material issued by ASCL to the Contractor. Same applies for the material obtained from different sources of supply.

It is presumed that the Contractor has gone carefully through the Standard Specifications of PWD Hand Books and the Schedule of Rate of the Division and studied the site conditions before arriving at rates quoted by him. Decision of the Engineer-in-charge shall be final as regards interpretation of specifications.

The stacking and storage of construction material at site shall be in such a manner as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality, properties and fitness for the work. Suitable precautions shall be taken by the Contractor to protect the material against atmospheric action, fire and other hazards. The materials likely to be carried away by wind shall be stored in suitable stores or with suitable barricades and where there is likelihood of subsidence of soil, such heavy material shall be stored on approved platforms.

The Contractor shall be responsible for making good the damages done to the existing Property during construction by his men.

If it is found necessary from safety point of view to test any part of the structure, the test shall be carried out by the Contractor with the help of the Department at this worn cost.

The Contractor shall provide, maintain, furnish and remove on completion temporary shed for office on work site for the use of Project Engineer's representative.

Defective work is liable to be rejected at any stage. The Contractor, on no account can refuse to rectify the defects merely on reasons that further work has been carried out. No extra payment shall be made for rectification.

General directions or detailed description of work, materials and items coverage of rates given in the specification are not necessarily repeated in the Bill of Quantities. Reference is, however, drawn to the appropriate section clause (s) of the General Specifications in accordance with which the work is to be carried out.

In the absence of specific directions to the contrary, the rates and prices inserted in the items are to be considered as the full inclusive rates and prices for the finished work described there under and are to cover all labor, materials, wastage, temporary work, plant overhead charges and profits, as well as the general liabilities, obligations and risk arising out of the General Conditions of the Contract.

The quantities set down against the items in the Schedule B are only estimated quantities of each kind of work included in the Contract and are not to be taken as a guarantee that the quantities scheduled will be carried out or required or that they will not be exceeded.

All measurements will be made in accordance with the methods indicated in the specifications and read in conjunction with the General Conditions of Contract.

The details shown on drawings and all other information pertaining to the work shall be treated as indicative and provisional only and are liable to variation as found necessary while preparing working drawing which will be supplied by the ASCL during execution. The Contractor shall not, on account of such variation be entitled to any increase over the ones mentioned in the contract which are on quantity basis.

Section 5

Specifications

All the works shall be carried out as per specification for sewerage work as per separately given with the tender document and Detailed PWD/ Jal Nigam Specification & latest E-in-C circulars.

Section 5 (Cont'd)

Drawings

List of Drawings: -

Drawings to be followed for actual execution of work should bear the stamp "Good for construction".

1. Any revision of working drawings should be indicated by pre-fixing R1, R2..... etc. after original reference number. Reasons for each revision should be clearly noted in the drawing.
2. Complete set of drawings should be issued along with other tender documents so as to form part of the agreement.
3. Drawings are not available with the bidding documents downloaded from the website and may be obtained from the office of the ASCL Agra as indicated in the NIT

Section– 6.

Form of Bid

Notes on Form of Bid

The Bidder shall fill in and submit this Bid form with the Bid.

----- (Date)

To

The **CEO,**

Agra Smart City Limited,

Agra.

Description of the work: Providing Sewerage system to ABD area including 5 years operation and maintenance under Smart city Mission

1. I/We offer to execute the works described above and remedy any defects there in conformity with the conditions of contract, specifications, drawings, bill of quantities and addenda for
 - (a.) For Item rate in the Bill of quantity, as referred to in clause 13 of ITB.
2. We undertake to commence the works on receiving the notice to proceed with work in accordance with the contract documents.
3. This Bid your written acceptance of if shall constitute a binding contract between us. We understand that you are bound to accept the lowest or any Bid you receive.

We hereby confirm that this bid complies with the Bid validity and earnest money required by the bidding documents and specified in the Appendix to ITB.

Authorized Signature :- _____

Name and title of Signatory:-_____

Name of bidder :- _____

Authorized Address of Communication:- _____

Telephone No(s): (Office) :- _____

Mobile No :- _____

Facsimile (FAX) No :- _____

Electronic Mail Identification (E-mail ID) :- _____

Section 7

Bill of Quantities Preamble

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, Conditions of Contract Specifications and Drawings.
2. For the construction of works, the quantities given in the Bill of Quantities are estimated, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at the rates and prices tendered in the Bill of Quantities in the case of item rate tenders.
3. The rates and prices tendered in the priced Bill of Quantities shall, except in so far as it is otherwise provided under the Contract, include all constructional plant, labour, supervision, materials, erection, maintenance, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out in the Contract.
4. Arithmetic errors will be corrected by the Employer pursuant to Clause 27 of the instructions to Bidders.

Section 8

Letter of Acceptance and Other Forms

OFFICE OF THE CEO, AGRA SMART CITY LIMITED, AGRA

NO.....
DATED.....

LETTER OF ACCEPTANCE

To,

M/s.....

.....

.....

This is to notify you that on behalf of the Employer, **CEO, Agra Smart City Limited, Agra** has accepted your Bid dated for execution of the for the Contract Price of Rs..... Rs.....only) is hereby accepted by our Agency.

You are hereby requested to furnish Performance Security, in the form detailed in Cl.32 of ITB for an amount of Rs..... (Rs.....) Within 10 days of the receipt of this letter of acceptance valid up to 45 days from the date of expiry of Defects Liability Period (i.e. up to) and sign the contract, failing which action as stated in Cl. 32.3 of ITB will be taken.

Yours faithfully,

**CEO, Agra Smart City Limited,
Agra**

OFFICE OF THE CEO, AGRA SMART CITY LIMITED, AGRA

Issue of Notice to proceed with the work

LETTER NO.....

DATED.....

To,

.....
.....
.....

Dear Sirs:

Pursuant to your furnishing the requisite performance security as stipulated in ITB Clause 32.1 and signing of the contract for the construction offor Dist. Agra you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents & complete it by

Yours faithfully,

**CEO, Agra Smart City Limited,
Agra**

(c) Standard Form of Agreement

Notes on Standard Form of Agreement

The Agreement should incorporate any corrections or modifications to the Bid resulting from corrections of errors (Instructions to Bidders, Clause 26).

Standard Form: Agreement

Agreement

This agreement, made the day of of Between **CEO, Agra Smart City Limited, Agra** (Hereinafter called “the Employer”) of the one part, and

.....
.....
.....

[Name and address of Contractor] (Hereinafter called “the Contractor” of the other part). Whereas the Employer is desirous that the Contractor execute the Work of

District- Agra (Hereinafter called “the Works”) and the Employer has accepted the Bid by the Contractor for the Execution and completion of such Works and the remedying of any defects therein at a cost of Rupees.....

(Rs.....only)

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price

or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

4. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:
 - i) Letter of Acceptance:
 - ii) Notice to proceed with the works:
 - iii) Contractor"s Bid:
 - iv) Contract Data:
 - v) Special Conditions of contract and General Conditions of Contract:
 - vi) Specifications:
 - vii) Drawings:
 - viii) Bill of Quantities: and
 - ix) Any other document listed in the Contract Data as forming part of the contract.

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written. was hereunto affixed in the presence of: Signed, Sealed and Delivered by the said To

Binding Signature of Contractor

Binding Signature of Employer
authorized representative

(d) Form of unconditional Bank guarantee for advance payment

BANK GUARANTEE FOR ADVANCE PAYMENT

To,

CEO, Agra Smart City Limited,

Agra Nagar Nigam,

Agra

Gentlemen:

In accordance with the provisions of the General Conditions of contract, clause 45 (“Advance Payment”) of the above-mentioned

Contract, *[name and address of Contractor]*
(Hereinafter called “the Contractor”) shall deposit with
[Name of Employer] a bank guarantee to guarantee his proper and faithful performance
under the said Clause of the Contract in an amount of
*[Amount of guarantee]*¹*[in words]*. We, the
.....*[bank or financial institution]*, as instructed by the
Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not
as Surety merely, the payment to..... *[name of Employer]*
on his first demand without whatsoever right of objection on our part and without his first
claim to the Contractor, in the amount not exceeding
.....*[amount of guarantee]*
..... We further agree that no change or addition to or other
modification of the terms of the Contract or of Works to be performed there under or of any
of the Contractor documents which may be release us from any liability under this
guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall remain valid and in full effect from the date of the advance payment
under the Contract until _____ *[name of Employer]*
receives full repayment of the same amount from the Contractor.

Yours truly,

Signature and seal: _____

Name of Bank/Financial Institution: _____

Address: _____

Date: _____

1. An amount shall be inserted by the bank or financial institution representing the amount of the Advance Payment, and Denominated in Indian Rupees.

(e) Form of unconditional Bank guarantee “Performance Bank Guarantee”).

PERFORMANCE BANK GUARANTEE

To,

CEO, Agra Smart City Ltd.

Agra Nagar Nigam,

Agra

WREREAS [*Name and Address of Contractor*]
(Hereinafter called “the Contractor”) has undertaken, in pursuance of Contract No. Datedto execute[*Name of Contract and brief description of Works*] herein after called “The Contract”

AND WHEREAS it has been stipulated by you in the said contract that the contractor shall furnish you with a bank guarantee by a Nationalized Bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract,

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you on behalf of the Contractor, up to a total of[*amount of guarantee*][*in words*], such sum being payable in the types and proportions of currencies in which the Contract price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of [*Amount of guarantee*] as aforesaid without your needing to prove or to show grounds or reasons for a demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contactor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in anyway release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This Guarantee shall be valid until a date 45 days after the expiry of defect liability period of 5 years after intended completion date.

Signature and seal of the guarantor

Name of Bank

Address

Date

QUALIFICATION INFORMATION

The information to be filled in by the Bidder in the following pages will be used for Purposes of post qualification as provided for In Clause 4 of the Instructions to Bidders. This information will not be incorporated in the Contract.

1. For Individual bidders

1.1 Constitution or legal status of bidder

[Attach Copy]

Place of registration:

Principal place of business:

1.2 Power of attorney of signatory of Bid

Total value of Civil Engineering/ Construction/ Sewerage system work executed and payments received in the last five years** (in Rs. million)		

[Attach]

1.3.1. Work performed as prime contractor (in the same name) on works of a similar nature over the last five years **

Project Name	Name Of The Employer*	Description Of Work	Contact No.	Value Of Contract (Rs. Million)	Date Of Issue Of Work Order	Stipulated Period Of Completion	Actual Date Of Completion*	Remarks Explaining Reasons For Delay And Work Completed

1.3.2 Quantities of work executed as prime contractor (in the same name and style) in the last five years:

* Attach certificate (s) from the Engineer - In - Charge

@ The item of work for which data is requested should tally with specified in ITB clause 4.5A(c)

** Immediately preceding the financial year in which bids are received

Attach certificate from chartered Accountant

1.4 Information on bid capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this bid

(a) Existing Commitments and on-going works:

Descripti on Of Work	Place & State	Contra ct No. & Date	Name And Addres s Of Employ er	Value Of Contra ct (Rs. In Million)	Stipulate d Period Of Completi on	Value Of Works* Remaining To Be Completed (Rs. In Million)	Anticipate d Date Of Completi on

(b) Works for which bids already submitted

Descripti on Of Work	Place & State	Name And Addres s Of Employ er	Estimat ed Value Of Works (Rs. In Million)	Stipulate d Period Of Completi on	Date When decision is expected	Remar ks, If Any

* Attach certificate (s) from the Engineer - In – Charge

1.5 The following items of Contractor's equipment are essential for carrying out the works. The bidder should list all the information requested below. Refer also to sub clause 4.3 (d) of the instructions to bidders.

Item Of Equipm ent	Requirem ent Nos.	Availability Proposal			Remarks (From Whom to be purchased
		Owned/Relea sed/ To be procured	Nos/Capac ity	Year (Model)/Conditio n	

@ As Per Annex 1 of section 1 - Instruction to bidders

1.6 Qualification and experience of key personnel proposed for administration and execution of the contract attach biographical data. Refer also to sub clause 4.3 (e) and 4.5 (B) (b) of instructions to bidders and sub clause 9.1 of the conditions of contract

Position	Name	Qualification	Experience (years) in general	Experience In The Proposed Position
Project Manager				
Construction Engineer				
Material and Quality control Engineer				

1.7 Proposed subcontracts and firms involved. [Refer ITB Clause 4.3 (j)]

Sections Of The Works	Value of Sub Contract	Sub-Contractor (Name And Address)	Experience In Similar Work

1.8 Financial reports for the last five years: balance sheets, profit and loss statements, auditors' reports (in case of companies/corporation), etc. List them below and attach copies.

1.9 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit. etc. List them below and attach copies of support documents {sample format attached}.

1.10 Name, address, and telephone, telex, and fax numbers of the Bidders' bankers who may provide references if contacted by the Employer.

1.11 Information on litigation history in which the bidder is involved.

Other Party (ies)	Employer	Cause of Dispute	Amount Involved	Remarks/Present Status

1.12 Statement of compliance under the requirement of Sub Clause 3.2 of the instruction to bidders.

.....

1.13 Proposed work method and schedule. The bidder should attach description, drawings and charts as necessary to company with the requirement of the bidding documents. [Refer ITB Clause 4.1 and 4.3 (k)].

2. Joint Ventures - Deleted

3. Additional Requirements

3.1 Bidders should provide any additional information required to fulfill the requirements of clause 4 of the instruction to bidders, if Applicable

Check List of Bidder.

Sl. No.	Document/Certificate	References	
		Chapter	Clause
1	2	3	4
1	T – 6	I T B A	3.2, 3.3, 3.5
2	T – 4	- do -	3.4
3	T – 5	- do -	3.4
4	Following information shall be furnished by the contractor on Non- Judicial Stamp paper with Bid.		
a.	Construction or legal status Bidder, Place of registration Principal place of business, Power of attorney.	Section - 3	1.1
b.	Total annual volume of civil Engineering constructions work executed and payments received in the last five years preceding the year in which bids are invited. (Attach certificate from chartered Accountant)	Section – 3	1.2
c.	Work performed as prime contractor (in the same name and style) on construction works of a similar nature and volume over the last five year. Attach certificate from the Engineer-In-Charge.	Section - 3	1.3.1
d.	Existing commitments and on-going constructions works.	Section – 3	1.3.2. A
e.	Works for which bids already submitted.	Section – 3	1.3.2. B.
f.	Availability of major items of contractor"s Equipment proposed for carrying out the works. List all information requested below, Refer also to Clause 4.2 (d) and Clause 4.4 b (b) of the instructions to Bidders.	Section – 3 I T B	1.4, 4.4 (b) (i)
g.	Qualifications of technical personnel proposed for the contract. Refer also to clause 4.2 (e) of the instructions to bidders and clause 9.1 of part-1	Section – 3 I T B	1.5, 4.4.3 (b) (ii)

	General Conditions of Contract.		
h.	Financial reports for the last five years: balance sheets, profit and loss statement, auditor, reports, etc. List below and attach copies.	Section – 3 I T B	1.6., 1.7
i.	Evidence of access to financial resources to meet the qualification: cash in hand, lines of credit, etc. list below and attach copies of support documents. (Sample format attached)	Section – 3	1.8
j.	Name, address and Telephone, telex, and facsimile numbers of banks that may provide reference if contacted by the Employer.	Section – 3	1.9
k.	Information on current litigation in which the bidders is involved.	Section – 3	1.9 A
5	Undertaking from bidder for minimum investment.	I T B	4.2 (g)
6	Authority to seek reference from the Bidders"s bankers	I T B	4.2 (i)
7	Each bidders must produce the current income-tax clearance certificate. An affidavit that the information furnished with the bid documents is correct in all respects and, Such other certificates as defined in the Appendix to ITB. Failure to produce the certificates shall make the bid non-responsive.	I T B	4.4 B (a)
8	Bid Security	I T B	16
9	The minimum amount of liquid assets and/or credit facilities net other contractual commitments of the successful bidder shall be 10% of the contract value.	Appendix to I T B	4.4.B (b) (iii)
10	The bidder must produce an affidavit stating the names of retired gazetted officer (if any) in his employment who retired within the last two years with the following ranks from the departments listed below.	- do -	4.4 B (c) (ii)
11	Calculation of Bid capacity of Bidder.	Appendix to I T B	4.6
12	The proposed methodology and programmed of construction, backed will equipment and material planning and deployment, duly supported with broad calculations and quality management PI an proposed to be adopted, justifying their capability of execution and completion of the work as per technical specific actions and within the stipulated period of completion.	I T B	4.2.L
13	Any documents which are not mentioned in any list shall be as per standard Bid of Document.	-	-

TECHNICAL SPECIFICATIONS

ANNEXURE (A) GENERAL SPECIFICATIONS

CHAPTER	DESCRIPTION	PAGE NO.
	INTERPRETATION	3
	PROJECT DESCRIPTION	4
1	General	6
2	Submittals	31
3	Site preparation	33
4	Dismantling	36
5	Earth work	37
6	Brick work	52
7	Concrete work	59
8	Form work	82
9	Reinforcement	87
10	Plastering	95

ANNEXURE (B)-SEWERAGE WORKS

CHAPTER	DESCRIPTION	PAGE NO.
11	Laying And Jointing Of Reinforced Concrete Pipes	105
12	Laying And Jointing Of Di Pipes	107
13	Double Wall Corrugated (Dwc) HDPE Pipes	119
14	Appurtenances	128
15	Fixing Of Valves	138

ANNEXURE (C)-ELECTRICAL

ANNEXURE – (A)

(General Specifications)

INTERPRETATION

In this contract the following words shall be understood as having the meanings herein assigned to them.

- a. 'Contractor' means the person or persons or firm or company contracting for the work specified, including his or their executors or administrators of legal representatives or successors :
- b. 'Engineer' means Corporation Engineer (or) his representative or any other Engineer appointed from time to time by the Board to act as such in connection with these Works. Whenever any Work is specified to be done or material supplied to the satisfaction of the Engineer, it shall be taken as including his properly authorized assistants and duly authorized representatives.
- c. 'Works' means works to be constructed, completed and maintained in accordance with contract.
- d. TORRENT – Power supply agency
- e. IS - Indian Standards
- f. ISS - Indian Standard Specifications

I. PROJECT DESCRIPTION

This project contemplates **Sewerage system in ABD area in Agra Municipal Corporation under Agra smart city project.**

Proposal for ABD

- Total sewage generation of Tajganj Sewerage Zone including ABD is 25.99MLD for 2020, 37.62 MLD for 2035 & 54.87 MLD for 2050.
- Laying of about 55 Km of HDPE DWC pipe, diameter varying from 150mm to 300mm for missing link for Zones Kohlai, Dandupura, Mehwati & Central and new sewer lines for Mayapura & Kalalkheria village.
- Laying of about 10 Kms of RCC NP3 pipe of dia varying from 150mm to 400 mm for missing link for Zones Kohlai, Dandupura, Mehwati & Central and new sewer lines for Mayapura & Kalalkheria village.
- Construction of sewer appurtenances like 580 Nos. of chambers, and 2200 Nos. of manholes.
- Sewage lifting stations with electrical and pumping machineries 1 No in zone Nagla Mewati, 1 No in zone Dhandupura and 1 No. in zone Kalalkheria & Mayapura villages

- Intermediate sewage pumping station (IPS) with electrical and pumping machineries for zone Kalalkheria & Mayapura village
- Sewage pumping main are proposed for a length of about 5.60 Km from Kolhai IPS and Kalalkheria & Mayapura IPS to proposed Jal Nigam 100 MLD capacity STP under Namami Gange project at existing 78 MLD existing STP campus.
- About 14500 Nos. of House Sewer Connection (HSC) with chamber are proposed in the ABD.
- Road restoration is not part of this proposal
- Trenchless crossing for SH/NH/Railway/waterways wherever open excavation is not feasible.
- Laying & commissioning of vacuum sewer system for missing links in Kohlai zone with 5 years O & M
- Operation & Maintenance for 5 years after commissioning of the project
- The electricity and fuel costs are included in O & M cost estimation. However it will be paid as per actual consumption

Rehabilitation of existing sewer system

- The existing sewer system needs minor repair works, raising of manholes to top of road level, replacement of damaged manhole covers, cleaning of choked manholes, cleaning of choked sewer lines etc.
- The cost estimated for rehabilitation and cleaning of existing sewer system is arrived as per field observations. However contractor shall study the requirements as per the site conditions within ABD area and arrive budget on his own.
- Sewer cleaning equipment like suction cum jetting machines, mechanically operated manhole desalting hydraulic vehicle mounted equipment shall be purchased by the contractor and utilized for rehabilitation and O & M period and handover the machineries in good condition certified by the manufacturer for 1 year warranty and hand over to ASCL.

CHAPTER 1 - GENERAL

1.1 MATERIALS:

- a. The term "Materials" shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the works.
- b. All materials shall be new and of the kinds and qualities described in the contract and shall be at least equal to approved samples.
- c. Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the works under this contract.

1.2 SAMPLES AND TESTS OF MATERIALS:

- a. The Contractor shall submit samples of such materials as may be required by the Engineer and shall carry out the specified tests directed by the Engineer at the Site, at the supplier's premises or at a laboratory approved by the Engineer.
- b. Samples shall be submitted and tests shall be carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer.
- c. The Contractor shall give the Engineer minimum fifteen days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by the Engineer. The Engineer or his nominee shall attend the test at the appointed place within fifteen days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by the Engineer to carry out such a test on a mutually agreed upon date in his presence. The Contractor shall in any case submit to the Engineer within seven days of every test such number of certified copies (not exceeding six) of the test readings as the Engineer may require.
- d. Approval by the Engineer for placing orders for materials or for samples or tests shall not prejudice any of the Engineer's powers under the Contract particularly under the provisions of Conditions of Contract.
- e. The provisions of this clause shall also apply to materials supplied under any nominated sub-contract.

1.3 STANDARDS:

- a. The special attention of the Contractor is drawn to the relevant sections and clauses of the National Building Code of India (latest revision) and latest I.S. Specifications (latest editions as amended) and should follow all the specifications and conditions strictly.
- b. Materials and workmanship shall comply with the relevant Indian Standards or any other National standards equivalent or higher than Indian standard (with amendments) current on the date of submission of tender only.

c. Where the relevant standard provides for the furnishing of a certificate to the Employer, at his request, stating that the materials supplied comply in all respects with the standards, the Contractor shall obtain the certificate and forward it to the Engineer.

d. The specifications, standard and codes listed below are made a part of this specification. All standards, tentative specifications, specifications, code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

e. If no standard is indicated, the relevant Indian Standard, if any, shall apply, Indian standards are published by:

Bureau of Indian Standards, Manak Bhavan,9, Bahadur Shah Zafar Marg,
NEW DELHI – 110 002.

f. In case of discrepancy between the specification and the Standards referred to herein, the Specification shall govern.

I. General works

i) Materials – Applicable Indian Standards:

IS: 455 – 1989 Specification for Portland slag cement

IS: 1489 – 1991 Specification for Portland pozzolana cement

IS: 6909 – 1990 Specification for super sulphated cement

IS: 8041 – 1990 Specification for rapid hardening Portland cement

IS: 8043 – 1991 Specification for hydrophobic Portland cement

IS: 8112 – 1989 Specification for 43 grade ordinary Portland cement

IS: 12269 – 1987 Specification for 53 grade ordinary Portland cement

IS: 383 – 1970 Specification for coarse and fine aggregates from natural sources for concrete.

IS: 432 – 1982 Specification for mild (part I & II) steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.

IS: 1786 – 1985 Specification for high strength deformed steel bars and wires for concrete reinforcement

IS: 4990 - 1993 Specification for plywood for concrete shuttering work.

IS: 1726 – 1991 Specification for Cast Iron Manhole Covers and Frames.

IS: 883 – 1994 Code of practice for design of structural timber in building.

IS: 1077 – 1992 Common Burnt Clay Building Bricks – Specification.

ii) Tests

- IS: 516 - 1959 Method of test for strength of concrete
- IS: 1199 – 1959 Method of sampling and analysis of concrete
- IS: 2386 – 1963 Method of test for (Part I & VIII) aggregate for Concrete
- IS: 5640 – 1970 Method of test for determining aggregate impact value of soft coarse aggregates
- IS: 2720 Methods of test for soils (Parts I & XLI) (latest revisions)
- IS: 3025 – 1964 Method for sampling and test (physical and chemical) for water used in construction.
- iii) Code of practice
- IS: 456 – 2000 : Plain and Reinforced concrete – Code of Practice
- IS: 800 – 1984 Code of practice for general construction in steel
- IS: 2502 – 1963 Code of practice for bending and fixing of bars for concrete reinforcement
- IS: 3558 – 1983 Code of practice for use of immersion vibrators for consolidating concrete
- IS: 10005 – 1994 SI Units and Recommendations for the use of their Multiples and of certain other units.
- IS: 10262 – 1982 Recommended guidelines for concrete mix design
- iv) Construction Safety**
- IS: 3696 Safety code of scaffolds (Parts I & II) and ladders (latest revisions)
- IS: 2750 – 1964 Specification for steel scaffolding
- IS: 3764 – 1992 Code of safety for excavation work
- v) Steel**
- IS: 2751 – 1979 Code of practice for welding of M.S. Plain & Deformed Bars for reinforced concrete construction
- IS: 9417 – 1989 Recommendations for welding cold worked steel bars for reinforced concrete construction
- IS: 10790 - 1984 Methods of sampling of steel for pre-stressed and reinforced concrete part 2 Reinforcing steel.
- IS: 1566 – 1982 Specification for Hard-drawn steel wire fabric concrete reinforcement.

IS: 280 - 1978 Specification for Mild Steel Wire for General Engineering.

vi) Brickwork plastering

IS: 2116 – 1980 Specification for Sand for masonry mortars.

IS: 3495 – 1992 Methods of test of Burnt clay Building Bricks.
(Part 1 – 4)

vii) Sluice Valves

IS: 1364 Hexagon Head Bolts, Screws and Nuts of product Grade A and B (Part 1 – 6 latest revision)

IS: 638 – 1979 Specification for sheet rubber jointing and rubber insertion jointing.

IS: 2685 – 1971 Code of practice for selection, installation and maintenance of sluice valves.

IS: 14846 – 2000 Sluice valve for water works purposes (50 to 1200mm size) – Specification

II) Sewerage works

i) Materials – Applicable Indian Standards:

IS: 455 – 1989 Specification for Portland slag cement

IS: 1489 – 1991 Specification for Portland pozzolana cement

IS: 6909 – 1990 Specification for super sulphated cement

IS: 8041 – 1990 Specification for rapid hardening Portland cement

IS: 8043 – 1991 Specification for hydrophobic Portland cement

IS: 8112 – 1989 Specification for 43 grade ordinary Portland cement

IS: 12269 – 1987 Specification for 53 grade ordinary Portland cement

IS: 383 – 1970 Specification for coarse and fine aggregates from natural sources for concrete.

IS: 432 – 1982 Specification for mild (part I & II) steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.

- IS: 1786 – 1985 Specification for high strength deformed steel bars and wires for concrete reinforcement
- IS: 4990 - 1993 Specification for plywood for concrete shuttering work.
- IS: 1726 – 1991 Specification for Cast Iron Manhole Covers and Frames.
- IS: 883 – 1994 Code of practice for design of structural timber in building.
- IS: 1077 – 1992 Common Burnt Clay Building Bricks – Specification.

ii) Tests

- IS: 516 - 1959 Method of test for strength of concrete
- IS: 1199 – 1959 Method of sampling and analysis of concrete
- IS: 2386 – 1963 Method of test for (Part I & VIII) aggregate for Concrete
- IS: 5640 – 1970 Method of test for determining aggregate impact value of soft coarse aggregates
- IS: 2720 Methods of test for soils (Parts I & XLI) (latest revisions)
- IS: 3025 – 1964 Method for sampling and test (physical and chemical) for water used in construction.

iii) Code of practice

- IS: 456 – 2000 Plain and Reinforced concrete – Code of Practice
- IS: 800 – 1984 Code of practice for general construction in steel
- IS: 2502 – 1963 Code of practice for bending and fixing of bars for concrete reinforcement
- IS: 3558 – 1983 Code of practice for use of immersion vibrators for consolidating concrete
- IS: 10005 – 1994 SI Units and Recommendations for the use of their Multiples and of certain other units.
- IS: 10262 – 1982 Recommended guidelines for concrete mix design
- IS: 4111 Part 1 – 1986 Manholes (first revision)
- IS: 4111 Part 4 – 1986 Pumping stations and Pumping mains (rising main)

iv) Construction Safety

IS: 3696 Safety code of scaffolds (Parts I & II) and ladders (latest revisions)

IS: 2750 – 1964 Specification for steel scaffolding

IS: 3764 – 1992 Code of safety for excavation work

v) Steel

IS: 2751 – 1979 Code of practice for welding of M.S. Plain & Deformed Bars for reinforced concrete construction

IS: 9417 – 1989 Recommendations for welding cold worked steel bars for reinforced concrete construction

IS: 10790 - 1984 Methods of sampling of steel for pre-stressed and reinforced concrete part 2 Reinforcing steel.

IS: 1566 – 1982 Specification for Hard-drawn steel wire fabric concrete reinforcement.

IS: 280 - 1978 Specification for Mild Steel Wire for General Engineering.

vi) Brickwork plastering

IS: 2116 – 1980 Specification for Sand for masonry mortars.

IS: 3495 – 1992 Methods of test of Burnt clay Building Bricks.
(Part 1 – 4)

vii) Sanitary Appliances

IS: 1726 – 1974 Specification for cast iron manhole covers and frames - Part 1 to 8

IS: 5455 – 1969 Specification for cast iron steps for Manholes

IS: 5312 – 1984 Specification for swing check type reflux (nonreturn valves – Part 1 & 2

viii) Sluice Valves

IS: 1364 Hexagon Head Bolts, Screws and Nuts of product Grade A and B (Part 1 – 6 latest revision)

IS: 638 – 1979 Specification for sheet rubber jointing and rubber insertion jointing.

IS: 2685 – 1971 Code of practice for selection, installation and maintenance of sluice valves.

IS: 14846 – 2000 Sluice valve for water works purposes (50 to 1200mm size) – Specification

ix) Cast Iron Pipes

IS: 1536 – 2001 Centrifugally Cast (spun) Iron pressure pipes for water, gas and sewage - Specification

IS: 5382 - 1985 Specification for Rubber sealing rings for gas mains, water mains and sewers.

IS: 3400 Methods of test for vulcanized rubbers (Part 1 – 23 - latest revisions)

IS: 13655 – 1993 Guidelines for Heat Treatment of Cast Iron.

IS: 1500 – 2005 Methods for Brinell hardness test for metallic materials.

IS: 1536:2001 Centrifugally Cast (Spun) Iron Pressure Pipes for Water, gas and sewage – Specification.

IS: 1538:1993 Cast Iron Fittings for Pressure Pipes for Water, gas and Sewage - Specification.

IS: 2062 – 1999 Steel for General Structural purposes – Specification.

x) SW Pipes

IS: 651 - 1980 Salt glazed stoneware pipes and fittings (fourth revision)

IS: 4127 - 1983 Code of practice for laying glazed Stoneware Pipes (First revision).

xi) Manuals

UP Jal Nigham Practice

SPECIAL CONDITIONS

1.4 CONSTRUCTION WATER:

The Contractor shall make his own arrangement for the fresh water required for construction of civil works and testing of pipeline and hydraulic structures as well as for the potable water required for his labour camps.

1.5 CONSTRUCTION POWER:

The Contractor shall make his own arrangement for supply of electrical energy required at his sites and the works.

1.6 TEMPORARY FENCING:

The Contractor shall, at his own expense, erect and maintain in good condition temporary fences and gates along the boundaries of the areas assigned, if any, to him by the employer for the purpose of the execution of the works.

The Contractor shall, except when authorized by the Engineer, confine his men, materials and plant within the site of which he is given possession. The Contractor shall not use any part of the site for purposes not connected with the works unless prior written consent of the

Engineer has been obtained. Access shall be made to such areas only by way of approved gateways.

1.7 SANITARY FACILITIES:

The Contractor shall provide and maintain in clean and sanitary condition adequate W.C.'s and wash places, which may be required on the various parts of the site or use of his employees, to the satisfaction of the Engineer. The Contractor shall make all arrangements for the disposal of sewage or drainage in accordance with the directions of the Engineer.

1.8 RESTRICTED ENTRY TO SITE:

The Contractor shall get the prior permission of the Engineer before any person not directly connected with the works to visit the site.

1.9 EXISTING SERVICES:

Drains, pipes, cables, overhead electric wires and similar services encountered in the course of the works shall be guarded from injury by the Contractor at his own cost, so that they may continue in full and uninterrupted use to the satisfaction of the Employer and the Contractor shall not store materials or otherwise occupy any part of the 'site' in a manner likely to hinder the operation of such services. The Contractor must make good or bear the cost of making good, the damage done by him on any mains, pipes, cables or lines (whether above or below ground), whether shown or not shown in the drawings, without delay to the satisfaction of the Engineer and the Employer.

1.10 ELECTRIC POWER SUPPLY:

1. The Electrical Power required has to be obtained by the Contractor from the Torrent power supply.

2. The Contractor is forewarned that there can be interruptions in power supply for reasons beyond the control of the Torrent and therefore the contractor is advised to make his standby arrangement to provide and maintain all essential power supply for his work area at his expense. The contractor shall not be entitled to any compensation for any loss or damage to his machinery or any equipment or any consequential loss in progress of work and idle labour as a result of any interruptions in Power supply.

1.11 NOTICE TO TELEPHONE, RAILWAYS & ELECTRICITY SUPPLY UNDER TAKING:

Before commencing operations the contractor has to obtain permission from State/National Highways Department (if required) when he wants to cut any section of the road. the employer will give necessary assistance such as sending letters and attending meetings if required. The employer will also pay necessary charges towards restoration of roads State Highways and National Highways. Any delay in getting the permission from the State Highways Department, National Highways Department, Railway Department, Electricity Board, Telegraphs Department, Traffic Department attached to the police and other departments or companies for carrying out the work will be to the account of contractor.

The contractor before taking up operations, which involve cutting of roads, shifting utilities etc., during the progress of the work, shall give notice to the concerned authorities viz. State Highways Department, National Highways Department, Railway Department, Electricity Board, Telegraphs Department, Traffic Department attached to the police and other departments or companies (Airtel, Vodopone etc.) as may be affected by the work. The notice should identify the specific details so that the necessary diversion of traffic may be arranged and permissions obtained. The contractor shall co-operate with the department concerned and provide for necessary barricading of roads, protection to existing underground cables etc., met with during the excavation of trenches. The contractor shall provide at his own expenses watching and lighting arrangements during day and night and erect required notice board such as "Caution Road closed for Traffic" etc.,. He should also provide and

maintain at his own cost the necessary supports for underground cables etc., to afford best protection to them in consultation with the authorities in charge of the properties and to their best satisfaction. The contractor has to make necessary arrangements to get supply of electricity from Torrent for operating the machinery and equipment. The employer will pay the necessary service connection and S.D charges. The contractor should obtain all approvals for installation and commissioning of machinery and accessories offered by them from the respective inspecting authorities such as CEIG or CEFM etc., Fees if any, to be paid to the inspecting authorities will be reimbursed by the Employer.

1.12 PERMISSION FOR ROAD CUTS:

Wherever the Contractor considers that it is necessary to cut through an existing SH/NH road or crossing railway track or crossing rivers or canals he shall obtain necessary permission/approval from competent authority in advance before commencing the work by submitting necessary documents to the concerned officials for permission/approval. Contractor is held responsible for any delay in getting permission/approval. Trenchless crossing for NH/Railway/Waterways are to be carried out as per permission/instruction from Engineer-in-charge

In the event of cutting a road by the Contractor without the written permission from the Engineer, the Contractor shall be responsible for the cost of reinstating the road as undertaken by the State or National Highways Department.

1.13 TEMPORARY DIVERSION OF ROADS:

During the execution of the work the Contractor shall make at his cost all necessary provision for the temporary diversion of roads, cart-tracks, footpaths, drains, water courses, channels etc., if he fail to do so, the same shall be done by the Engineer and the cost thereof will be recovered from the Contractor.

1.14 BARRICADING:

The manhole / trench shall be barricaded on all four sides. The Contractor who has dug up the trench shall be responsible for any mishap, which may occur. Non-barricading of trenches by the Contractor shall be liable for a fine of Rs.500/- per day, per location from the interim payment certificates prepared in accordance with Sub Clause 60.2 of the conditions of particular application. Such deduction will not relieve the Contractor of any liability or duty under the Contract.

1.15 FILLING IN HOLES AND TRENCHES ETC.:

The Contractor immediately upon completion of the Works shall fill up holes and trenches which may have been made or dug, level the mounds, or heaps or earth that may have been raised or made, and clear away all rubbish which may have become superfluous or have been occasioned or made in the execution of the works, and the Contractor shall bear and pay all costs, charges etc.

1.16 ACCIDENTS:

It shall be the duty of the Contractor to arrange for the execution of the works in such a manner as to avoid the possibility of the accidents to persons or damage to the properties at any state of the progress of work. Nevertheless he shall be held wholly responsible for any injury or damage to persons and properties, which may occur irrespective of any precautions he may take during the execution of the works. The Contractor shall make good all claims and loss arising out of such accidents and indemnify the Employer from all such claims and expenses on account thereof.

1.17 WATER AND LIGHTING:

The Contractor shall pay all fees and provide water and light as required from Municipal mains or other sources and shall pay all charges, thereof (including storage tanks, meters

etc.) for the use of the works and workmen, unless otherwise arranged and decided on by writing with Engineer. The water used for the works shall be free from earthy vegetable or organic matter and from salts or other substances likely to interfere with the setting of mortar or otherwise prove harmful to the work and conform to relevant standards.

1.18 PAYMENT TO LABOURERS:

The Contractor should note, that in the event of emergency, he shall pay all labours every day and if this is not done, the Board shall make requisite payment and recover the cost from the Contractor. The Contractor shall not employ any labour below age of 15 years.

1.19 EQUIVALENCE OF STANDARDS AND CODES:

Whenever reference is made in the contract to the respective standards and codes in accordance with which plant, equipment or materials are to be furnished and work is to be performed or tested the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly set forth in the contract. Where such standards and codes are national in character, or relate to a particular country or region, other authoritative standards which ensure equal or higher quality than the standards and codes specified will be accepted subject to the prior review and written approval by the Engineer. Difference between the standards specified and the proposed authoritative standards must be fully described in writing by the Contractor and submitted to the Engineer well in advance for approval. If on the prior review, the Engineer determines that such proposed deviations do not ensure equal or higher quality; the Contractor shall comply with the standards set forth in the contract documents.

The Contractor should use only accepted makes of materials and plant and should construct the entire Works according to Specifications, Standards, data sheets, drawings etc. If no makes are specified then only manufacturers of Plant and materials corresponding to the state of the Art technology and / or confirming to the latest Indian / International standards shall be used. Providing materials of approved quality and confirming to the standards does not relieve the Contractor from being responsible for the successful performance of all system components.

1.20 SAFETY PROVISION:

1.20.1 General Requirements for Health and Safety:

The safety provision shall be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work spot, persons responsible for ensuring compliance with the safety provision shall be named therein by the Contractor.

To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the Contractor shall be open to inspection by the Engineer or his representative and the inspecting officer.

Notwithstanding the above provision Contractor is not exempted from the operation of any other Act or rules in force relating to safety provisions.

1.20.2 Protection of the Public:

No material on any of the sites shall be so stocked or placed as to cause danger or inconvenience to any person or to the public. The Contractor shall provide all necessary fencing and lights to protect public from accidents and shall be bound to bear expenses of defense of every suit, action or proceedings of law that may be brought by any person for injury sustaining, owing to neglect the above precautions and to any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

1.20.3 Scaffolding and Ladders:

The Contractor shall ensure that suitable scaffolds are being provided for workers for all the works, which cannot safely be done from the ground or from solid construction, except such short period work, as can be done safely from ladders.

When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1 (¼ horizontal to 1 vertical). IS code for scaffolding and ladders, IS: 3696 Part – I and Part II and its latest revision is to be followed. Every ladder shall be securely fixed. No portable single ladder shall be over 7m in length. Width between side rails in rung ladders shall in no case be less than 30cm. for ladders; this width shall be increased by at least 6mm for each additional 30cm length. Uniform steps spacing shall not exceed 30cm.

Scaffolding or staging more than 3.25 metres above the ground or floor swung or suspended from an overhead support or erection with stationary support shall have guard rail properly attached bolted, braced or otherwise secured atleast at 1 metre high above the floor or platform and the scaffolding of staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or the structure.

All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use.

1.20.4 Working Platforms:

Working platform, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if height of a platform or gangways or stairway is more than 3.25 meters above ground level, it shall be closely boarded having adequate width and be suitably fenced as described in 1.24.3 above. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of 1 meter. Safe means of access shall be provided to all working platforms and other working places.

1.20.5 Precautions when using Electrical Equipment's:

Adequate precautions shall be taken to prevent danger from electrical equipment. When workers are employed on electrical installations, which are already energized, insulating mats, wearing apparel such as gloves, sleeves and boots, as may be necessary shall be provided. Workers shall not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

1.21 DEMOLITION:

Before commencing any demolition work and also during the process of the work, safety code for demolition of building IS: 4130 of the latest revision shall be followed:

- a. All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- b. No electric cable or apparatus, which is liable to be a source of danger for a cable or apparatus used by operator, shall remain electrically charged.
- c. All practical steps shall be taken to prevent danger to persons employed from risk or fire or explosion or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

1.22 SAFETY EQUIPMENT:

1.22.1 General Requirements:

All necessary personal safety equipment as considered adequate by the Engineer shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

- a. Workers employed on mixing asphaltic materials, cement and lime mortars / concrete shall be provided with protective footwear, hand gloves and goggles
- b. Those engaged in handling any materials which is injurious to eyes shall be provided with protective goggles
- c. Stone breakers shall be provided with protective goggles and protective clothing
- d. When workers are employed in confined spaces (sewers, manholes etc.), which are in use, the Contractor shall ensure that manhole covers are opened and manholes are ventilated at least for an hour before workers are allowed to get into them. Manholes so opened shall be cordoned-off with suitable railing and warning signals of boards provided to prevent accident to public. Before entry by any worker the Contractor shall ensure that a gas detector is lowered into the confined space and the atmosphere is shown to be safe.
- e. The Contractor shall not employ men below the age of 15 and women on the work of painting with products containing lead in any form. Whenever men above the age of 18 are employed on the work of lead painting the following precautions shall be taken:
 - i) No paint containing lead or lead products shall be used except in the form of paste of ready-made paint.
 - ii) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paints dry rubbed and scaped.
 - iii) Contractor shall supply overalls to workmen and adequate facilities shall be provided to enable working painters to wash during and on cessation of working periods.

1.22.2 Working near water:

When the work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provisions made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

1.22.3 Hoisting Machines:

Use of hoisting machines and tacks including their attachments, anchorage and supports shall conform to the following:

- a)
 - i) These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good repair and in good working order.
 - ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.
 - b) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years shall be in-charge of an hoisting machine, including any scaffold winch or giving signals to operator.
 - c) In case of every hoisting machine and of every chain ring hook, shackle, swivel and pulley block used in hoisting machine or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred

to above shall be plainly marked with safe working load in case of hoisting with safe working load. In case of hoisting machine having a variable safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose to testing.

d) Engineer shall notify the safe working load of the machine in case of departmental machine. As regards Contractor's machine, the Contractor shall notify safe working load of each machine to the Engineer. Whenever he brings to the site of work and get it verified by the Engineer.

Motors, gearing, transmission, electrical wiring and other dangerous parts or hoisting appliance shall be provided with such means so as to reduce to the minimum risk and accident descend of load; adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced.

1.23 WORKING WITH EXPLOSIVES:

The Contractor shall obtain prior permission of the competent authority such as Chief of Fire services for the site, manner and method of storing explosives near the site of work. All handling of explosives including storage, transport shall be carried out under the rules approved by the "Explosive Department of the Government".

1.24 ENVIRONMENTAL PROTECTION WORK:

The Contractor have to take following measures during construction and commissioning of works for protection of environment as to avoid environmental impacts on air, water and land.

1.25.1 Site Clearance:

The site clearance shall be done with minimum damage to existing structures flora and fauna, electricity and telephone lines and other infrastructure service.

1.25.2 Earthwork and Excavation:

The Contractor shall inform the local authorities / government if any fossils, coins artifacts of value or antiquity, structures and other remains of geological or archaeological interests and excavation shall be stopped until identification of cultural relics by the authorized institution is complete.

The Contractor shall dispose off surplus / waste material at identified sites approved by the Engineer. The Contractor shall ensure that there is minimum hindrance to normal activities and business. The Contractor shall avoid damage to permanent structures and shall avoid loss of standing crops along the road.

1.25.3 Replanting of Trees and Bushes:

The Contractor shall carry out replantation on areas / on the periphery of construction sites to minimize visual impact and soil erosion. The Contractor shall pay special attention to the type of trees to be replanted to prevent fouling of water through falling leaves and bird droppings. A list showing the type of trees to be replanted shall be submitted to the Engineer for approval prior for undertaking any replantation.

1.25.4 Soil Erosion and Water Quality:

The Contractor shall ensure that earth and stone do not silt up existing irrigation / drainage systems. The Contractor shall take suitable measures to prevent direct discharge of polluted waters from construction activity into lakes / rivers / irrigation channels.

The Contractor shall minimize exposure of soil types susceptible to wind and water erosion. The Contractor shall control run-off and erosion through proper drainage channels and structures.

1.25.5 Soil Compaction:

The Contractor shall restrict traffic movements and use low ground pressure machines. The Contractor shall preserve topsoil to be replaced after completion of construction activity. The Contractor shall avoid wet soils as far as possible.

1.25.6 Social Disruption:

The Contractor shall minimize interruptions to utility services through proper planning and scheduling of activities. The Contractor shall provide temporary roads and diversions as may be necessary for smooth flow of traffic and people.

1.25.7 Dust / Air Pollution:

The Contractor shall provide effective dust control through sprinkling / washing of construction sites and access roads. The Contractor shall cover / water stockpiles and storage areas to prevent dust pollution. The Contractor shall cover trucks transporting construction materials to minimize spills. The Contractor shall have a preventive maintenance programme for construction equipment and vehicles to meet emission standards. Oil shall not be used to control dust.

1.25.8 Noise Pollution:

The Contractor shall normally undertake construction work during daytime only (between 7.30 to 18.00 hrs.) and when authorized to work beyond these hours adopt suitable noise control methods during such works. The Contractor shall maintain machines and trucks to keep them with low noise. The Contractor shall install sound barriers and plant tree as appropriate during construction. The Contractor shall monitor the level of noise near the construction site, factory sites and sensitive areas with the following frequency.

- a) During construction period: 12 times a year each time including day and night.
- b) During commissioning period: 4 times ad hoc monitoring

1.25.9 Construction Camps:

The Contractor shall take adequate measures such as provision of septic tank / pit latrines at construction site / camps. The Contractor shall provide crèches to working women labour. The Contractor shall provide drinking water conforming to IS: 10500 – 1991.

The Contractor shall provide garbage can at suitable fixed place and the garbage shall be disposed off regularly.

1.25.10 Aesthetic Improvement:

The Contractor shall through proper housekeeping enhance aesthetic appearance of construction sites. The Contractor shall dispose-off construction wastes at approved disposal sites. The Contractor shall repair pavements immediately following construction of pipeline and appurtenant structures.

The Contractor shall remove after completion of construction, all temporary structures and restore the project and surrounding areas nearest possible to the reconstruction condition.

1.25.11 Conservation of Ecological Resources:

The Contractor shall not use farmland and forest belts as materials borrow sites. The Contractor shall not select arable land as material borrow site. In case excavation in arable land is unavoidable, topsoil layer (30cms depth) shall be saved and returned after construction work is completed so as to minimize impacts on ecosystem, agriculture and animal husbandry. The Contractor shall educate construction workers to protect natural resources, wild plants and animals.

1.26 Use of Trade Names:

Wherever reference is made in the contract to specific manufacturers or trade names the Contractor shall be entitled to substitute Plant and materials supplied by other manufacturers or producers. Such substitution shall be to the approvals of the Engineer, which will not be

unreasonably withheld. At the request of the Engineer the Contractor shall provide information to establish that the substituted Plant and materials are equivalent or better than those referred to.

1.27 Direction by the Engineer:

The Contractor is responsible for all activities relating to the construction of the works. Any reference in this Specification to the Engineer directing or ordering, prescribing etc. the Contractor shall be deemed to mean "Contractor to propose a methodology of construction and to submit to the Engineer for approval". Any such approval by the Engineer shall not limit the Contractor's responsibilities relating to construction of the Works. Notwithstanding this clause the Engineer shall be entitled to instruct the Contractor whenever the Engineer considers it necessary to do so. Where such an instruction is considered by the Contractor to represent additional work he shall inform the Engineer of his opinion before undertaking the work. No claim for additional work on the basis of an instruction by the Engineer can be considered where the Contractor has failed to provide such prior notification.

1.28 Definition of the Engineer:

Any reference in the Contract Documents to the Engineer in charge, or Board Engineer, or Executive Engineer, or departmental officers, shall be taken to mean the Engineer.

CHAPTER 2 - SUBMITTALS

2.1 DESCRIPTION:

This section covers additional requirements for submission of schedules, samples, certificates, etc., and forms a part of all other sections in which submittals are required. It is subjected to General Conditions of Contract.

Requirements of submissions to be included:

1. PERT / CPM Progress Schedule
2. Samples of all materials pertaining to this work
3. Material lists and equipment
4. Factory test reports
5. Certificates
6. Laboratory test reports

2.2 REQUIREMENTS:

CPM Progress Schedule:

Within 30 days of award of the tender, the Contractor shall submit a critical path method analysis for construction progress control and make such revisions as are required for approval. He shall clearly indicate all construction activities, sub activities and mileposts on a time-oriented basis, with the critical path fully identified for all activities. He shall update and resubmit the charts monthly, flag all slippages and mileposts and attach a narrative description of the proposed corrective actions to the resubmitted charts. The Contractor shall include the following minimum information for each activity and critical path item:

- i. Date and initial submittal, as applicable.
- ii. Ordering dates for long lead time items.
- iii. Dates for materials on site.
- iv. Testing and clean up.
- v. Final completion and handing over.

2.3 SAMPLES:

The Contractor has to submit samples of all materials used for the work prior to start of the works and get the approval of the Engineer in charge. He shall label or tag each sample or set of samples, identifying the manufacturer's name and address, brand name, catalogue number, project title he intends use.

2.4 MATERIAL LISTS AND EQUIPMENT DATA:

The Contractor has to submit all material lists, equipment lists etc. well in advance before starting the work and get the approval of the Engineer in charge.

CHAPTER 3 - SITE PREPARATION

3.1 CLEARING SITE:

Preliminary work are required to be done before laying of pipes including pegging out, clearing and disposal of shrubs, grasses, bushes, hedges, boulders, debris from the route.

This shall also include the removal of stumps, etc. or parts thereof lying along the alignment of pipe. The Contractor should inform the Engineer in charge before removing shrubs, grasses, etc. well in advance. The alignment of the mains shall be so fixed as to avoid cutting of any trees.

3.2 REMOVAL OF TOP SOIL, SHRUBS AND OTHER VEGETATION:

All shrubs, vegetation and other plants shall be removed and cleared from the selected stretch of the site. All debris and unsuitable material upto a depth of 30cm between ground level or road level shall be removed. All debris and unsuitable material shall be carted away from the site as per the direction of Board Engineer up to a distance of 10 km.

3.3 UTILITIES PROTECTION:

All utility lines and structures, whether indicated on the drawings or not, which are to remain in service shall be protected by the contractor from any damage likely to result from his operations. Relocation wherever necessary will be done by the respective Service Departments on payment by deposit work separately. No extra payment will be made for minor relocation, which does not require dislocation from existing condition and shifting to other location. In such a condition, the service lines shall be pushed slightly to facilitate laying of main and brought back to original position after the work is completed wherever necessary. The service lines should be supported at bottom with planks, posts, etc. and tied with ropes properly. Any damage to any utility resulting from the Contractor's operations shall be repaired at the Contractor's expense.

3.4 PAVEMENT REMOVAL:

The Contractor must inform the other concerned departments well in advance before starting the work. The Contractor must provide and maintain proper and efficient traffic control system such as safety lamps, sign boards etc. operating day and night for the full duration of work. The CMWSSB shall not be responsible under any circumstances for any mishappenings therefore. For the purpose of payment for removal of pavement, steel tapes are to be used and the Engineer's representative and Contractor or his representative shall take the measurement jointly. The width of trenches shall be as per the specification drawing and only such widths shall be taken into account for computing quantities for payment. The Contractor has to pay restoration charges for width excavated in excess of prescribed width.

For other elements of work such as making cross connections, fixing other appurtenances etc. the Engineer shall prescribe the dimensions for removal of pavement from time to time.

3.5 MAINTENANCE OF TRAFFIC AND CLOSING OF STREETS:

The work shall be carried out in such a manner, which will cause the least interruption to traffic, and road / street may be closed in such a manner that it causes the least interruption to traffic. Where it is necessary for traffic to cross open trenches, suitable bridges shall be provided. Suitable signs indicating that a street is closed shall be placed and necessary detour signs for the proper maintenance of traffic shall be provided.

3.6 INTERRUPTION TO SERVICE:

No valve or other control of the existing services shall be operated without the permission of the authority.

3.7 WORK DURING NIGHTS:

No extra payment will be made for doing the work in the nights. The Contractor shall get prior approval from the Engineer in charge before starting the work during nights.

CHAPTER 4 - DISMANTLING

4.1 DISMANTLING OF EXISTING STRUCTURES:

The structure shall be dismantled carefully and materials removed without causing damage to the serviceable material to be salvaged, the part of the structure to be retained and any properties of structures nearby. Any avoidable damage to the articles to be salvaged and part of the structure shall be made good by the Contractor without extra claims. The Contractor shall be responsible for any injury to the lookers or the public.

Structure should be removed 45cm below Ground and portion which in any way comes within new construction shall be removed entirely. Contractor shall maintain register or the salvaged material, which shall have signature of the Engineer on entries made.

All the material obtained from the removed structure shall be the property of client. Serviceable materials shall be stacked neatly in such a manner as to avoid deterioration at site or at other places. Non-serviceable materials shall be disposed off by the Contractor without causing any inconvenience.

All rubbish shall be cleared off the site and the Ground let clean and clear and Rubbish and non-serviceable materials shall be carted away upto a distance of 10kms as per the direction of Board Engineer.

4.2 MEASUREMENT AND PAYMENT:

The measurements of work shall be exact length and width and height of the dismantled structure. It shall be priced per unit of the Cubic metre. Any excavation that may be necessary for dismantling the structure below 45cm from ground level shall be paid under the item of Excavation and shall include labour for refilling, watering and ramming, spreading on site if required and for disposal of surplus earth.

CHAPTER 5 - EARTH WORK

5.1 DESCRIPTION:

The work specified in this section includes the provision of all labour, machinery, construction equipment and other appliances required to perform all earthwork specified or required, in a sound, workmanlike manner.

5.2 GENERAL:

Excavation shall be required to be done for the following works:

- a) Excavation for underground pipelines.
- b) Excavations for valve chambers, Thrust blocks and Special structure

No separate payment shall be made for removal of shrubs, which are less than 100mm in diameter at breast height, grass, small bushes and stumps. The alignment of the main shall be so fixed as to avoid cutting of any trees.

No extra payment shall be made to the Contractor for working in a confined space.

5.3 CLASSIFICATION:

The excavation work shall be classified into the following categories by inspection of faces of cutting:

- i) Loamy, clayey soils like black cotton soils, red earth, hard gravel, mixture of gravel and soft disintegrated rock like shale, ordinary gravel, stony earth and earth mixed with fair sized boulders, except rock requiring blasting, chiseling, wedging etc.
- ii) Hard rock and boulders to be removed by benching, chipping, chiseling, wedging, barring and by controlled blasting wherever permissible.

5.4 TRENCH EXCAVATION:

General:

Trench excavation means excavation of trenches into which the pipe is to be laid. Before commencing trench excavation, the route of the trenches shall be pegged out accurately and the natural ground levels and the alignment shall be agreed with the Engineer in charge. The Contractor shall dig probing pits or appropriate size and depth including cutting the road at every 100m interval or as directed by Engineer in charge. The quantity of excavation beyond the normal dimensions will be paid under relevant items of excavations in various strata.

Stripping Surface Materials:

Before the surface of any part of the site is disturbed or the works there on are started, the Contractor shall take and record levels in the presence of the Engineer or his representative. Before commencing the excavation, the surface materials shall be carefully stripped and set aside for reuse as directed by the Engineer.

5.5 WIDTH OF TRENCH:

The width of the trench at bottom between the faces of sheeting shall be Nominal diameter of the pipe plus 300mm clearance on either side of the pipe. Trenches shall be of such extra width, when required as will permit the convenient placing of timber supports, strutting and planking and handling of specials.

The width of trenches measured at the crown of the pipe shall permit adequate working space. The trenches shall be widened at sockets and other structures as may be found necessary. Payment for excavation shall be made on quantity basis as per width given in the Table.

Care should be taken to avoid excessive trench width and thereby increasing the load on the pipes.

5.6 DEPTH OF EXCAVATION OF TRENCHES:

The depths for the trenches will be calculated from the surface to the bed of the pipes and in case when a layer of bedding is to be placed below the pipeline, the depth to the bottom of the bedding will be paid.

The trench shall be so dug that the pipeline may be laid to the required gradient and to the required depth, mentioned in the Table below. A minimum cover of 1.2m is to be provided above the crown level of pipe upto the Ground level / Road level.

TABLE SHOWING DETAILS OF TRENCH SIZE

Diameter (mm)	Trench width (m)
100	0.70
150	0.75
200	0.80
250	0.85
300	0.90
350	0.95
400	1.00
450	1.05
500	1.10
600	1.20
700	1.30
750	1.35
800	1.40
900	1.50
1000	1.60
1100	1.70
1200	1.80
1300	1.90
1400	2.00
1500	2.10
1600	2.20

5.7 MAXIMUM LENGTH OF OPEN TRENCH:

Except by special permission of the Engineer, only that length of trench excavation shall be permitted in advance of the pipe jointing, such that laying and jointing of pipes can reasonably be expected to be completed and the trench refilled not later than 3 days after excavation of the trench. The Contractor will not be permitted to keep trenches open for unduly long periods, creating public hazards. The Engineer's decision in this respect shall be final.

5.8 WIDENING TRENCH AT JOINTS, ETC.

Any widening or deepening of the trench, whether in ordinary soil or rock, necessary to accommodate curves, joints or bends as shown on the drawings or ordered by the Engineer shall be carried out by the Contractor, after taking all the necessary safety measures.

5.9 OVER-EXCAVATION OF TRENCH BOTTOMS:

All excavation carried below the grades shown on drawings or bottom of the bedding shall be refilled with sand / concrete at the Contractor's expense.

5.10 EXCAVATED MATERIAL:

The material from the excavation shall be deposited on either side of the trench leaving clear berm on one side at least 40cm wide or at such further distance from the edges of the trench as may be necessary to prevent the weight of materials from causing the side of the trench to slip or fall, or at such a distance and such a manner as to avoid any wall or structure or causing inconvenience to the public or other persons or otherwise as the Engineer may direct, till it is carted away.

The excavated soil should be so placed and handled as not to inconvenience the usual traffic, till it is carted away. The Contractor should also provide necessary bridging over the excavated trenches for the house-holders and pedestrians to cross over and vehicular crossings if and where required at no extra cost; if the Engineer decides that there is no hindrance to traffic due to not carting away the excavated earth, he will give instructions to that effect. The Contractor shall be responsible for making all arrangements for the disposal of surplus excavated material upto a distance of 10kms.

5.11 PIPE BEDDING:

i) Sand Bedding:

Where specified, the river sand bedding the required thickness and level shall be provided below pipe prior to laying the pipe in trenches. It shall be compacted with a light hand hammer. Any reduction in compaction shall be made up by adding sand during ramming. For the purpose of bedding under this item, only screened fine sand of grain size not larger than 2mm shall be used. The sand shall be clean, uncoated and free from clay lumps, injurious amount of dust, soft particles, organic matter, loam or other deleterious substances.

If the sand supplied is unclean, it shall be washed. In no case shall sand containing more than 3.5% by dry volume or 5% by wet volume of clay, loam or silt be accepted. Tests specified for determining silt in sand and organic impurities described in IS: 383 shall apply. Sieved and washed sand shall be stored on the works in such a manner as to prevent intrusion of any foreign matter, including coarser particle of sand or any clay or metal or

chips. Tests as indicated above shall be performed if called for by the Engineer at the expense of the Contractor.

ii) Concrete Bedding:

This type of bedding is as per the drawing appended with the tender document and is to be provided at locations shown in the drawings or as specified by the Engineer. A concrete bedding using M15 grade is to be adopted. The concrete work related to this specification is detailed in the specifications of concrete and allied works.

5.12 EXCAVATION FOR APPURTENANCES:

Excavation in trenches for foundation of valve chambers, pedestals etc. shall be as per the plan or as directed by the Engineer. The dimensions of the excavation shall be measured as the projection in plan of the outermost edges of the structure.

5.13 KEEP EXCAVATION CLEAR OF WATER:

Where ground water is encountered or anticipated, the Contractor shall provide sufficient pumps to handle the ingress of water and must provide and maintain in working order. Standby pumping units are to be made available and employed in the event of mechanical failure. The Contractor must also arrange for night and day operation of the pumps wherever necessary to ensure that the work proceeds at all times.

5.14 DEWATERING IN AREAS OF HIGH WATER TABLE:

The Contractor shall perform dewatering as required so that all works of the contract are installed on dry areas and excavations, including without limitation the construction of all structures and underground piping. The Contractor shall ensure that dewatering is carried out only to a depth sufficient for the required excavation. The Contractor shall also ensure that, at all times, during construction, no groundwater shall come into contact with any concrete surface or reinforcement and that any structure shall be capable of withstanding any hydrostatic pressure to which it may be subjected during construction and until completed.

The Contractor shall be deemed to have included in the tender price for maintaining all works in a dry condition during construction. Any water removed from excavations shall wherever practicable, be pumped directly to the natural drainage channel or to storm sewers if approved via an efficient system of discharge lines. No water may be discharged into the sewerage system or onto open spaces.

The Contractor shall include for the diversion of all water courses encountered in the work until the scheme is completed and put into operation.

Notwithstanding any previous approval, the Contractor shall be fully responsible for maintaining dry excavations.

Where deemed necessary by the Engineer, working drawings and data shall be submitted for review or approval showing the intended plan for dewatering operations. Details of locations and capacities of dewatering wells, well points, pumps, sumps, collection and discharge lines, standby units, water disposal methods, monitoring and settlement shall be included. These shall be submitted not less than 30 days prior to start of dewatering operations.

The static water level shall be drawn down to a minimum of 300mm below the bottom of the excavation so as to maintain the undisturbed state of the foundation soils and allow the placement of any fill or backfill to the required density. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

5.15 UNSOUND FOUNDATIONS, SOFT SPOTS:

When the specified levels of trench or structure are reached, the Engineer will inspect the ground exposed and if he considers that any part of the ground is by its nature unsuitable, he may direct the Contractor to excavate further and the further excavation shall be filled with concrete M-10 or river sand. Should the bottom of any trench or structure excavation, while acceptable to the Engineer at the time of his inspection subsequently become unacceptable due to exposure to weather conditions or due to flooding or have become puddled, soft or loose during the progress of the works, the Contractor shall remove such damaged, softened or loosened material and excavate further by hand. In this case, the cost of the extra excavation and of the additional foundation materials required will be the Contractor's responsibility if necessitated by his negligence.

The omission by the Engineer to give an instruction under this Clause shall not relieve the Contractor from any responsibility for defect in the works due to the construction being placed upon an unsuitable formation if prior to the construction of the work the Contractor shall have failed to call the attention of the Engineer thereto in writing.

If in the opinion of the Engineer, a formation is unsound as a result of the Contractor failing to keep the excavation free from water, the Engineer will order the removal and disposal of the unsound material and filling of the resulting void. The Contractor shall execute the work as directed and shall have no claim against the Board for any costs thus incurred.

5.16 CAUTION CUM INFORMATION BOARDS:

Before commencing an excavation, "Caution-Cum-Information" board shall be installed at site by the Contractor. Such board shall remain at site as long as the trench remains open. The board shall be installed at both the ends of the trench atleast 100m before the approach to the area, if the trench is less than 600m in length. Additional boards at every 300m shall be installed, if the length of the trench exceeds 600m. If the streetlight is inadequate, lettering with fluorescent paint shall be used for these boards. The boards shall also contain

information regarding dates of commencement and completion of the work, name and phone number of the Engineer in charge of the work. See also Clause 5.19. The size of lettering shall be adequate to be read by passing vehicles.

5.17 BARRICADING:

To prevent persons from injury and to avoid damage to the property, adequate barricades, construction sign, torches, red lanterns and guards as required shall be provided and maintained during the progress of the construction work and until it is safe for traffic to use the roadways. The manhole trench shall be barricaded on all four sides. Barricading for laying pipe lines consists of fixing casuarina posts 8 - 10cm dia. and 1.52m high at 1.53m centre to centre tied with coir ropes in two rows or by any other method as approved by the Engineer. Barricading also includes watching during night, fixing danger flags, danger lights / reflector and painting in different colours. The Contractor who has dug up the trench shall be responsible for any mishap, which may occur.

5.18 FENCING, WATCHING, LIGHTING:

The parts of the fencing shall be of timber, securely fixed in the ground not more than 2.50m apart, they shall not be less than 10cm in dia. or not less than 1.25m above the surface of the ground. There shall be no two rails, one near the top of the posts and the other about 0.50m above the ground and each shall be of 5cm to 10cm in diameter and sufficiently long to run from post to post to which they shall be tied with strong ropes. The method of projecting rails beyond the posts and tying together where they meet will not be allowed on any account. All along the edges of the excavated trenches, a bund of earth about 1m high shall be formed when so required by the Engineer for further protection. Proper provision shall be made for lighting at night and watchmen shall be kept to see that this is properly done and maintained. In addition to the normal lighting arrangements, the Contractor shall provide, whenever such work is in progress, battery operated blinking lights (6 volts) in the beginning and end of a trench with a view to provide suitable indication to the vehicular traffic. The Contractor shall also provide and display special boards printed with fluorescent prints indicating the progress of work along the road. In the event of the Contractor not complying with the provisions of the clause, it may be carried out by the Engineer and the cost recovered from the Contractor besides claiming liquidity damages from the Contractor. In all such cases the work may be carried out by Board. The Contractor shall be held responsible for all claims for compensation as a result of accident or injury to persons / non-provision of red flags.

The Contractor shall at his own cost provide all notice boards before opening of roads as directed by the Engineer.

Arrangements shall be made by the Contractor to obtain permission from CMC and traffic authorities for working and to direct traffic when work is in progress. No separate payment shall be paid for this item of work.

5.19 REFILLING TRENCHES:

- a) With a view to restrict the length of open trenches, on completion of the pipe laying operations, refilling of trenches shall be started immediately by the Contractor. Pipe laying and testing shall follow closely upon the progress of trench excavation and the Contractor shall not be permitted more than 500 metres of trench excavation to remain open while awaiting testing of the pipe line.
- b) Care shall be taken while back filling, not to injure or disturb the pipe. Filling shall be carried out simultaneously on both the sides of the pipes so that unequal pressure does not occur.
- c) Walking or working on the completed pipelines shall not be permitted unless the trench has been filled to a height of at least 30cm over the top of the pipe except as may be necessary for tamping etc., during back filling work.
- d) Filling-in shall be done in layers not exceeding 150mm in thickness accompanied by adequate watering, ramming etc. so as to get good compaction upto 300mm above the top of the pipe. Above this level, sea sand shall be placed in layers of 200mm watered and compacted by tamping.
- e) The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place.
- f) Before and during the backfilling of the trench, precautions shall be taken against the floatation of the pipeline due to the entry of large quantities of water into the trench causing an uplift of the empty or the partly filled pipeline.

5.20 MEASUREMENT AND PAYMENT:

The payment of excavation shall be made on quantity basis as per the actual dimensions of the trench excavated limited to the width as per specification drawings.

a) Trench Excavation:

The length of the trench excavation shall be measured along the center line of pipe at various depths stated in the Bill of Quantities, the total length being segregated into stretches according to the various depths of excavation contained in the Bill of Quantities to fall into the specified categories. Within each stretch, the depth applicable shall be within the range specified in Bill of Quantities.

The depth of excavation shall be measured from the top of the trench at the center before excavation upto the bottom of the bedding under the pipe. If no bedding is provided, the measurement shall be to the top level of the bottom of the pipeline. The width of the trench shall be measured on the basis of the specification drawing. No additional payment shall be made for the deepening and widening at sockets specials, hunching or surrounds beyond the dimensions mentioned in the specification drawing. For excess width excavated the road cutting charges to be paid by the Contractor.

The measurement of depth and width of trench shall be taken at every 20 metres along the alignment and at every change in direction and diameter of the pipe.

b) **Structure:**

Measurement for structure excavation shall be made as per the projection in plan of the outermost edges of the structure as per the plan at the bottom.

c) **Rock excavation:**

The depth of rock excavation measured for payment shall not exceed the corresponding depth in ordinary excavation plus 150mm both for structure and trench excavations.

The maximum trench widths measured for payment in rock excavations will be as per specification drawing.

In all above cases, no payment will be made for additional selected fill, lean concrete, bedding cradling or hunching concrete that may be specified or ordered by the Engineer as a consequence of excavating beyond the limits specified in the contract documents or ordered by the Engineer.

d) **Disposal of excavated material:**

All the excavated material shall be carted away and the contractor shall be paid in the following manner for disposal of the same. An item is provided in the bill of quantities and it includes loading, unloading, transporting to a site upto a distance of 10kms as directed by the Engineer.

e) For excess width of excavation than specified, no payment will be made and the Contractor has to bear the cost of restoration.

5.21 PERMANENT REINSTATEMENT:

a. Highways:

Restoration and re-instatement of Highways head and sidewalk surface shall be done by Highway Department and ASCL Board will pay the cost.

b. Municipal Roads:

The reinstatement of the NH/SH/Municipal roads, i.e. Asphalt, concrete and WBM roads and side walk surfaces shall be carried out by road project by the ASCL, Unless otherwise instructed by Engineer-in-charge ASCL will not pay the cost.

c. Private properties:

However, any damages to the private properties such as compound wall, fencing, etc. during the execution or immediately afterwards due to contractor carelessness, the same has to be restored by the Contractor to the original shape at Contractor's own cost.

5.22 SHORING AND STRUTTING:

Open cuttings and trenches shall be suitably shored, sheeted and braced, if required by the Engineer or by site conditions or to meet local laws, for protecting life, property of the work.

Adequate shoring and strutting shall be provided by the Contractors at their own cost. Warped or deformed timber shall not be used. The shoring shall project at least 150mm above ground level and shall extend to a suitable depth below the bottom of the trench. Wherever necessary, the planks or struts shall be driven by compressed air pile drivers. The planks shall be fixed close enough to avoid any running in of sand earth through the joints. The shoring material shall not be of sizes less than those specified below, unless steel sheet piling is used or unless approved by the Engineer in writing.

- a) Planks : 38mm thick
- b) Walling pieces : 100 cm x 100 cm
- c) Struts : 15 cm x 20 cm

For walling pieces round timber shall not be allowed. In a vertical plane, there shall be at least three struts or more as directed by the Engineer. They shall rest on walling pieces. The spacing of the struts shall be as per the requirement of the design. At the bottom, extra struts shall have to be provided if ordered by the Engineer. The rates for excavation do not include the cost of shoring, which shall be paid for separately as per relevant item of the Bill of Quantities. The Contractors shall be held responsible for providing secure shoring, and for adopting every other precaution, which may be necessary for protecting nearby structures, which are likely to be damaged as a result of excavation. The Contractors shall design the shoring required for actual site conditions and shall provide shoring accordingly. The design shall be submitted to the Engineer on demand. The shoring shall be so designed that lowering of pipe of normal length or any other pipe laying operation does not necessitate the removal of any strut or any other member of shoring. If the Engineer requires the adoption of any special measures or precautions, the Contractor will comply with the same immediately. If any part of a nearby structure is cut out or removed for facility of work, the same shall be made good on completion of the work by the Contractors at their cost.

In the event of the Contractors not complying with the provisions of this contract in respect of shoring the Engineering may, with or without notice to the Contractors, put up shoring or improve shoring already put up or adopt such other measures as he may deem necessary, the cost of which shall be recovered from the Contractors. Such action on the part of the Engineer, shall not, however absolve the Contractors of their responsibilities under this contract.

No part of the shoring shall, at any time, be removed by the Contractors without obtaining permission from the Engineer. While taking out shoring planks, the hollows formed shall be simultaneously filled in with soft earth and shall be well compacted as directed.

No payment will be made if the Contractors leave shoring material in the trench on his own or merely to suit their own convenience. The work of providing shoring shall be measured and paid for on the basis of areas of planks provided upto ground level and no separate payment will be made for providing and fixing of walling pieces, struts, dog spikes etc. the cost of which shall be deemed to have been covered by the rate for shoring.

The planks shall project at least 150mm above the ground level. For the purpose of payment, however, measurements shall be taken up to ground level only and no payment will be made for planking above ground level.

5.23 QUALITY CONTROL TEST:

Trenches other than in roads and paved areas shall be backfilled as specified in Clause 5.20.

CHAPTER 6 - BRICK WORK

6.1 BRICK WORK:

6.1.1 Masonry Mortars:

Proportioning:

Mix proportion of cement sand mortar shall be as indicated. The mixes specified are by volume. 50 kg. of cement shall be taken as equal to 0.035 cum. to determine bulk. The quantity of water to be added to cement sand mortar shall be such that working consistency is obtained. Excess water shall be avoided.

Preparation of Cement Mortar:

Mixing shall be done preferably in a mechanical mixer. If done by hand, mixing operation shall be carried out on a clean watertight platform. Cement and sand shall be mixed dry in the required proportion to obtain a uniform colour. The required quantity of water shall then be added and the mortar hoed back and forth for 5 to 10 minutes with additions of water to a workable consistency. In the case of mechanical mixing, the mortar shall be mixed for at least three minutes after addition of water. Cement mortar shall be freshly mixed for immediately use. Any mortar, which has commenced to set, shall be discarded and removed from the site.

Time of use of Mortar:

Mortars with cement as an ingredient shall be used as early as possible after mixing, preferably within half an hour from the time water is added to the mix or at the latest within one hour of its mixing.

Workability of Masonry Mortar:

The working consistency of the mortar is usually judged by the work during application. The water used shall be enough to maintain the fluidity of the mortar during application, but at the same time it shall not be excessive leading to segregation of aggregates from the cement.

6.1.2 Brick Masonry:

a. Manufacture:

Common burnt clay building bricks shall conform to the requirements of IS: 1077 and shall be of quality not less than class 20 with moisture absorption rate not exceeding 15 percent as defined in IS:1077. The bricks shall be chamber burnt and shall have sharp corners and smooth faces and shall not be damaged in any manner and sizes shall conform to the works sizes specified with tolerances as given in 6.2 IS: 1077.

b. Samples:

The Contractor shall deliver samples of each type of brick to the Engineer, and no orders shall be placed without the written approval of the Engineer. All the bricks used in the works shall be of the same standard as the approved samples. The samples shall be preserved on site, and subsequent deliveries shall be checked for uniformity of shape, colour and texture against the samples. If in the opinion of the Engineer any deliveries vary from the standard of the samples, such bricks shall be rejected and removed from the site. Samples of bricks shall be tested in accordance with IS: 3495 by the Contractor.

c. Uniformity:

The bricks selected for exposed pointed brickwork walls shall be of uniform colour, deep cherry red or copper colour, and uniform texture. Only such bricks as are permitted by the Engineer shall be used.

6.2 SETTING OUT:

All brickworks shall be set out and built to the respective dimensions, thickness and heights as indicated.

6.3 SCAFFOLDING:

Scaffolding shall be strong to withstand all dead, live and impact loads, which are likely to come on them. Scaffolding shall be provided to allow easy approach to every part of the work overhand work shall not be allowed.

For exposed brick facing double scaffolding having two sets of vertical supports shall be provided. For brickwork, which is to be plastered over, single scaffolding may be provided. In single scaffolding one end of the putlogs shall rest in the hole provided in the header course of brick masonry. Not more than one header for each putlog shall be left out. Such holes shall not be allowed in the case of pillars of narrow masonry portions between openings, which are less than one metre in width or are immediately under or near the structural member supported by the walls. The holes left shall be made good on removal of scaffolding to match with the face work / surrounding area.

Timber or bamboo scaffolds shall be erected in accordance with the provisions contained in IS: 3696 (Part I) - 1987. Safety code for scaffolds and ladders, Part I - Scaffolds, to ensure safety of workmen and others. Steel scaffolding shall be erected in accordance with the provisions contained in IS: 2750-1964. Specifications for steel scaffolding and relevant provisions of IS: 3696 (Part I) - 1987 for safety code for scaffolds (Parts I & II) and ladders shall be followed.

6.4 SOAKING OF BRICKS:

Bricks shall be soaked in water before use for a period of the water to just penetrate the whole depth of the bricks. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. The bricks required for masonry work using mud mortar shall not be soaked. When bricks are soaked, they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on clean place, where they are not again spoiled by dirt, earth, etc.

6.5 LAYING:

All loose materials, dirt and set lumps of mortar which may be laying over the surface on which brickwork is to be freshly started, shall be removed with a wire brush and surface wetted slightly. Bricks shall be laid on a full bed of mortar. When laying, the bricks shall be properly bedded and slightly pressed with handle of trowel so that the mortar can get into all the pores of the brick surface to ensure proper adhesion. All the joints shall be properly flushed and packed with mortar so that no hollow spaces are left. Care shall be taken to see that the required quantity of water is added to the mortar at the mixing platform to obtain required consistency. Addition of water during laying of the course shall not be permitted. In the case of walls two bricks thick and over, the joints shall be grouted at every course in addition to bedding and flushing with mortar.

Bricks shall be laid with frog up. However if the top course is exposed, bricks shall be laid with frog down. Care shall be taken to fill the frogs with mortar before embedding the bricks in position.

All quoins shall be accurately constructed and the height of courses checked with story rods as the work proceeds. Acute and obtuse quoins shall be bonded, where practicable, in the same way square quoins; obtuse quoins shall be formed with squint showing a three quarter brick on one face and quarter brick on the other.

6.6 BOND:

All brickwork shall be built in English Bond, unless otherwise indicated. Half brick walls shall be built in stretcher bond. Header bond shall be used for walls curved on plan for better alignment. Header bond shall also be used in foundation footings, stretchers may be used when the thickness of wall renders use of headers impracticable. Where the thickness of footings is uniform for a number of course of the footings shall be headers.

Half or cut bricks shall not be used except where necessary to complete the bond.

Overlap in stretcher bond is usually half brick and is obtained by commencing each alternate course with a half brick. The overlap in header bond which is usually half the width of the brick is obtained by introducing a three quarter brick in each alternate course at quoins. In general, the cross joints in any course of brickwork shall not be nearer than a quarter of brick length from those in the course below or above it.

6.7 UNIFORMITY:

The brickwork shall be built in uniform layers; corners and other advanced work shall be raked back. No part of a wall during its construction shall be raised more than one metre above the general construction level, to avoid unequal settlement. Parts of walls left at different levels shall be properly raked back. Tothing may be done where future extension is contemplated but shall not be used as an alternative to taking back.

For half brick partition to be keyed into main walls, indents shall be left in the main walls.

6.8 THICKNESS OF JOINTS:

The thickness of joints shall be 10mm + 3 or – 3mm, unless otherwise specified. Thickness of joints shall be kept uniform. Slight difference to thickness of bricks shall be adjusted within joint thickness. Where brickwork is to match the existing work, the joints shall be of the same thickness as in the existing work.

6.9 STRIKING JOINTS:

Where no pointing, plastering or other finish is indicated, the green mortar shall be neatly struck flush. Where pointing, plastering or other finish is indicated, the joints shall be squarely raked out to a depth not less than 10mm for plastering and 15mm for pointing.

6.10 CURING:

The brickwork shall be constantly kept wet for atleast 7 days.

6.11 FACING:

In case of walls one brick thick and under, at least one face shall be kept even and in proper plane, while the other face may be slightly rough. In case of walls more than one brick thick, both the face shall be kept even and in proper plane.

For exposed brickwork selected bricks of the specified class and sub-class shall be used for the face work, where however, use of facing bricks is indicated, brick walls shall be faced with facing bricks. No rubbing down of brickwork shall be allowed.

Brick walls shall be plastered pointed or otherwise finished, as indicated. Joints of external faces of brick walls in foundation upto 15cm below ground level and of internal faces of brick walls in foundation and plinth below sub-floor level shall be struck flush when the mortar is green, as the work proceeds.

6.12 CLEANING:

Face of brickwork shall be cleaned on the same day it is laid and all mortar droppings removed.

6.13 CONSTRUCTION DETAILS:

Holes for Pipes etc.

All necessary holes for pipes, air flues, ventilators, etc. shall be cut or formed as work proceeds and grouted in cement and sand mortar 1:3 of cement concrete 1:2:4 as required and made good.

CHAPTER 7 - CONCRETE WORKS

7.1 CONCRETE:

General:

- a. The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix whether reinforced or otherwise, shall conform to the applicable portions of this Specification.
- b. The Engineer shall have the right to inspect the source/s of materials, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer's approval obtained, prior to starting of concrete work.

7.2 MATERIALS FOR STANDARD CONCRETE:

The ingredients to be used in the manufacture of concrete shall consist solely of Portland cement, clean sand, natural coarse aggregate, clean water, and admixtures, if Specifically called for and conditions at site warrant its use.

- a. **Cement:** Cement shall conform to IS: 12269 – 1987.
- b. **Aggregates:** Aggregates shall comply with the requirements of IS: 383 – 1970.

i. General

- a) "Aggregate" in general designates both fine and coarse inert materials used in the manufacture of concrete.
- b) "Coarse Aggregate" is aggregate most of which is not passed through on 4.75mm IS sieve.
- c) "Fine aggregate" is aggregate most of which is passed through on 4.75mm IS sieve.
- d) All fine and coarse aggregate proposed for use in the works shall be subject to the Engineer's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer.
- e) Aggregates shall, except as noted above, consist of natural sands, crushed stone from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, durable against weathering of limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the "mix design" and preliminary tests on concrete specified later.
- f) Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used without the special permission of the Engineer.

ii. Fine Aggregate:

a) General:

Fine aggregate shall consist of natural or crushed sand conforming to IS: 383. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt or other deleterious substances, which can be injurious to the setting qualities / strength / durability of concrete.

(i) **Machine-made Sand:** Machine-made sand will be acceptable, provided the constituent rock-gravel composition shall be sound, hard, dense, non-organic, uncoated and durable against weathering.

(ii) **Screening and Washing:** Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fraction.

(iii) **Foreign material limitations:** The percentage of deleterious substances in sand delivered to the mixer shall not exceed the following:

Percent by weight:

		Uncrushed	Crushed
(A)	Material finer than 75 micron I.S. Sieve	3.00	15.00
(B)	Shale	1.00	--
(C)	Coal and lignite	1.00	1.00
(D)	Clay lumps	--	--
(E)	Total of all above substances including items (A) to (D) for uncrushed sand and items (C) and (D) for crushed sand	5.00	1.00

b) Gradation:

(I) Unless otherwise directed or approved by the Engineer, the grading of sand shall be within the limits indicated under here:

IS Sieve	Percentage passing for			
	Grading	Grading	Grading	Grading
Designation	Zone – I	Zone – II	Zone – III	Zone AVE
10mm	100	100	100	100
4.75mm	90 – 100	90 – 100	90 – 100	95– 100
2.36mm	60 – 95	75 – 100	85 – 100	95 – 100

1.18mm	30 – 70	55 – 90	75 – 100	90 – 100
600micron	15 – 34	35 – 59	60 – 79	80 – 100
300micron	5 – 20	8 – 30	12 – 40	15 – 50
150micron	0 – 10	0 – 10	0 – 10	0 - 15

(II) Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron I.S. sieve, by total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron I.S. sieve or to percentage passing any other sieve size on the coarser limit of Grading Zone I or the finer limit of Grading Zone AVE. Fine aggregates conforming to Grading Zone AVE shall be used. Mix designs and preliminary tests shall show its suitability for producing concrete of specified strength and workability.

c) Fineness Modulus:

The sand shall have a fineness modulus of not less than 2.2 or more than 4.2. The fineness modulus is determined by adding the cumulative percentages retained on the following I.S. sieve sizes (4.75mm, 2.36mm, 1.18mm, 600micron, 300micron and 150micron) and dividing the sum by 100.

(III) Coarse Aggregate:

a) Coarse aggregate for concrete, except as noted above, shall conform to IS: 383. This shall consist of crushed stone and shall be hard, strong, durable clean and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.

b) Screening and Washing:

Crushed rock shall be screened and or washed for the removal of dirt or dust coating, if so requested by the Engineer.

c) Grading:

Coarse aggregate shall be either in single size or graded, in both cases the grading shall be within the following limits.

IS Sieve Designation	Percentage passing for single sized aggregate of normal size					Percentage passing for graded aggregate of normal size			
	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
63 mm	100	--	--	--	--	100	--	--	-
40 mm	85.00	100	--	--	--	95.00	--	--	-
20 mm	020	85.00	100	--	--	37.00	95.00	100	-
16 mm	--	--	85.00	100	--	--	--	90.00	-
12.5 mm	--	--	--	85.00	100	--	--	--	90.00
10 mm	05	020	030	045	85.00	1035	235	370	4085

d. **Water:** Water for mixing concrete, mortar or grout shall conform to IS:456 – 2000. If required to do so by the Engineer, the Contractor shall take samples of the water and test them for quality.

7.3 TRANSPORTING AND DEPOSITING CONCRETE:

Mixing plant shall be located as close as possible to the point of placement. Concrete shall be placed within 30 minutes after mixing and shall be transported from the mixer to its final placement as rapidly as practicable, taking care to see that no segregation or loss of ingredients take place. It shall also be ensured that the concrete is of the required workability at the point and time of placing.

Dropping of concrete from an excessive height or running or working it along forms will not be permitted. Any concrete which, before placement has begun to set and has become stiff shall be rejected.

Concrete shall not be disturbed after it has been placed in the form and has begun to set. Concrete shall be carefully placed in horizontal layers which shall be kept at an even height throughout the work. Concrete shall not be allowed to slide or flow down sloping surfaces directly into its final position but shall be placed in its final position from the skips, trucks, barrows, down pipes or other placing machines or device or, if this is impossible it shall be shoveled into position, care being taken to avoid separation of the constituent materials. Concrete placed in horizontal slabs from barrows or other tipping vehicles shall be tipped into the face of the previously placed concrete.

Concrete dropped into place in the work shall be dropped vertically. It shall not strike the formwork between the point of its discharge and its final place in the work and except by approval of the Engineer, it shall not be dropped freely through a height greater than 1.5 metres. Chutes & Conveyor belts shall be so designed that there is no segregation or loss of mortar and shall be provided with a vertical tapered down pipe or other device to ensure that concrete is discharged vertically into place.

Where a lift of concrete is built up in layers each layer shall be properly merged into the proceeding layer before initial set takes place.

7.4 QUALITY ASSURANCE

General Procedure:

A. General:

In order to achieve the required strength and associated properties of concrete, proper control of the Water / Cement ratio by weight need be enforced. The strength shall be prime consideration and W.C. ratio as prescribed by Engineer in charge shall have to be observed.

B. Operators:

At no time whatsoever will the mixer operator or those supervising or inspecting the works be permitted to alter the quantity of water specified by the Engineer for mixing the concrete. Batching shall be accurate and as specified by the Engineer.

C. Water / Cement Ratio:

The Water / Cement ratio will be determined after mix trials by the Contractor in the presence of the Engineer or his representative. If batching is by volume, the Contractor shall be required to fabricate such volumetric batches and water containers as the Engineer may determine and require so as to simulate the ideals of the trial mix without recourse to assessments by site staff and workmen.

D. Weighing:

The Contractor shall make available always a weighing machine if so required, guaranteed by the Contractor for its accuracy, for weighing cement and batches of aggregate as and when the Engineer or his representative or his assistant may require. The machine shall be capable of weighing upto 75 Kilograms and shall be accurate to half (0.5) Kilogram.

E. Compaction:

All concrete shall be thoroughly compacted and fully worked round the reinforcement by vibration just sufficiently so that the appearance of laitance is kept to a minimum and in such manner as directed by the Engineer's Representative. Under no circumstances shall concrete be compacted by trowels or the like.

F. Transport and Placing:

Fresh concrete from the mixer shall be transported where required by the quickest and most efficient means so as to prevent pre-set or segregation or any loss of ingredients and shall maintain required workability. Any laitance from previous mixes shall be removed.

7.5 SAMPLING, TESTING AND STORAGE OF MATERIALS:

Samples of aggregates for mix design and determination of suitability shall be taken under the supervision of Engineer and delivered to the laboratory well in advance of the scheduled placing of concrete. Records of tests made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to the Engineer in advance of the work for use in determining aggregate suitability. The cost of all such tests, sampling etc. shall be borne by the Contractor.

Materials shall be tested as hereinafter specified and unless specified otherwise, all sampling and testing shall be performed by Testing Laboratory approved by Board at the Contractor's expense.

A. Cement:

Cement shall, whether supplied by the Board or not, comply with the requirements of IS: 8041, IS: 455, IS: 8043, IS: 6909, IS: 1489, IS: 12269. The testing laboratory at the discretion by the Engineer, shall perform such tests as are deemed necessary. Cement bags or bulk silos shall be tagged for identification at location of sampling. Tests will include tensile tests and weighing the cement supply to check for net weight received at site and used in the works.

1. On arrival at site, cement shall be stored in weatherproof silos designed for the purpose or in dry weather-tight and properly ventilated structures with floors raised 15 to 20cm above ground level, 30cm away from walls and with adequate provision to prevent absorption of moisture or flooding. All storage facilities shall be subject to approval by the Engineer and shall be such as to permit easy access for inspection and identification. Each consignment of cement shall be kept separately and the Contractor shall use the consignments in the order

in which they are received. Any cement in drums or bags, which have been opened, shall be used immediately. Different types of cement shall be kept in clearly marked separate storage facilities. Not more than 15 bags shall be stacked vertically in one pile. Cement shall be stored in double locking arrangement, so that cement transactions can be with the knowledge of supervisory staff. Daily account of cement shall be maintained by the Contractor in the prescribed register and shall be made available to inspecting authorities for store verification.

2. The Contractor shall provide from each consignment of cement delivered to the site such samples as the Engineer may require for testing. Any cement which is, in the opinion of the Engineer, lumpy or partially set shall be rejected and the Contractor shall promptly remove such cement from the site.

3. Cement which has been stored on the site for more than ninety (90) days and cement which in the opinion of the Engineer is of doubtful quality shall not be used in the works until it has been retested and test sheets showing that it complies in all respects with the relevant standard have been delivered to the Engineer.

B. Water for Concrete Mixing & Curing:

Water shall be clean, clear and free from injurious quantities of salt, traces of oil, acids, alkalis, organic matter and other deleterious materials. The sources of water shall be approved by the Engineer and the containers for conveyance; storage and handling shall be clean. If necessary, standard cement tests shall be conducted using the water intended to be used, in comparison with those adding distilled water to check quality of water.

Water shall meet the requirement of 4.3 of IS: 456 – 2000. Generally potable water is fit for mixing and curing.

C. Aggregates:

Aggregate will be tested before and after concrete mix is established and whenever character or source of material is changed. Tests will include a sieve analysis to determine conformity with limits of gradation.

1. Samples of aggregates 50 kg. in weight will be taken by the Contractor at source of supply and submitted to the Engineer before placing orders. These samples if approved shall remain preserved in the Engineer's care for reference and the type of aggregate used in the works may not be altered without Engineer's prior approval.

2. Aggregate shall be obtained from an approved source and shall conform to the requirements of IS: 383.

For the aggregate grading, in table of IS: 383 – 1970 shall be applicable. Aggregate shall not be flaky or elongated particles, defined as particles having a maximum dimension greater than five times the minimum dimension. Aggregate shall have water absorption not exceeding two percent when tested in accordance with IS 383.

3. The Contractor shall sample and carry out analysis in the presence of the Engineer's representative, or the fine aggregate and each nominal size of coarse aggregate in use employing the methods described in IS: 383 and 2386 at least once in each week when concreting is in progress and such more frequent intervals as the Engineer may require. The grading of all aggregates shall be within the respective limits specified in the codes. For aggregates, which vary more than the approved fineness modulus, the Engineer may instruct

the Contractor to alter the relative proportions of the aggregate in the mix to allow for such difference, or may require further trial mixes.

4. Storage of aggregates shall be provided at each point where concrete is made such that each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times. Contamination of the aggregates by the ground or other foreign matter shall be effectively prevented at all times, and each heap of aggregate shall be capable of draining freely. The Contractor shall ensure that graded coarse aggregates are dumped, stored and removed from store in manner that does not cause segregation.

Coarse aggregate shall be piled in layers not exceeding 1.2m in height to prevent coning or segregation. The aggregates must be of specified quality not only at the time of receiving at site but more so as the time of loading into mixer.

Wet fine aggregate shall not be used until, in the opinion of the Engineer, it has drained to a constant and uniform moisture content, unless the Contractor with the knowledge of the Engineer measures the moisture content of fine aggregate and adds water in each batch of concrete mixed to allow for the water contained in the fine aggregate.

7.6 MIX DESIGN:

Mix design is normally a prerequisite to any concreting job and will be required on all major works. If so required, an approved testing laboratory shall, at the Contractor's expense, design a mix for each class of concrete and shall submit full details of the mix designs to the Engineer for his approval. The Engineer's representative and the Contractor shall clearly code each approved mix with a number and date, and file all details for identifying and reproducing exactly the same mix.

A. General:

Each mix design shall be such that the aggregate shall comprise fine aggregate and coarse aggregate of the size specified and the combined aggregate grading shall be continuous. Aggregate shall be calculated by weight, and batching procedures shall be established. The cement content by weight shall not be outside the minimum and maximum limits calculated from the minimum and maximum dry aggregate to cement ratios specified. The mixes shall be designed to produce average concrete cube strength at twenty eighth day after manufacture not less than the trial mix test strength specified. The water / Cement ratio shall be in the region of 0.45 to 0.55 and shall never exceed 0.60.

B. Preliminary Mix:

The proportions of cement, aggregate and water determined by the Contractor in his mix design shall be used in preliminary mix of concrete made and tested for strength and workability under laboratory conditions observing the appropriate requirements. These preliminary mixes shall be repeated with adjusted proportions as necessary until concrete mixes meeting the requirements of the preliminary and trial mix tests specified and with the workability defined herein have been produced. If at any time during construction of the works, the source of cement or aggregates is changed, or the grading of the aggregate alters, then further preliminary mixes shall be undertaken.

C. Trials:

After the Engineer's approval of the preliminary concrete mix design for each class of concrete and during or following the carrying out of the preliminary tests, the Contractor shall prepare a trial mix of each class in the presence of the Engineer. The trial mixes shall be mixed for the same time and handled by means of the same plant that the Contractor

propose to use in the works. The proportion of cement, aggregates and water shall be carefully determined by weight in accordance with the approved mix design (or modified mix design after preliminary tests) and sieve analyses shall be made, by approved methods of the fine aggregate and each nominal size of coarse aggregate used.

D. Admixtures:

Admixtures shall mean material added to the concrete materials during mixing for the purpose of altering the properties of normal concrete mixes. If the Contractor wishes to use admixtures, otherwise than as expressly ordered by the Engineer, he shall first obtain the Engineer's written permission. The methods of use and the quantities of admixture used shall be subject to the Engineer's approval, which approval or otherwise shall in no way limit the Contractor's obligations under the contract to produce concrete with the specified strength and workability. Concrete of any class containing an admixture shall be separately designed and have separate preliminary tests and trial mixes made and tested for approval by the Engineer as if it were a separate class of concrete.

Waiver of Mix Design and Weigh Batching:

On certain works, the Engineer may waive the requirement of designing mixes and may allow the use of established nominal mix proportion, provided always that preliminary trials are made to establish the volumetric batching procedure and mix strengths. The Contractor will ensure that any established procedure approved by the Engineer is strictly adhered to, so as to achieve consistent strength, durability and economy of the concrete while ensuring approved workability of the mix. Any waiver of mix design or weigh batching will not relieve the Contractor of his obligations to consistently produce concrete of the specified and approved strength and durability as determined by works tests. However in any particular work / part of work, the Engineer may decide to adopt mix design (mix) concrete.

Workability:

The workability of each class of concrete shall be such that satisfactory compaction can be obtained when the concrete is placed and vibrated in the works. There shall be no tendency to segregate when it is handled, transported and compacted by the methods, which the Contractor proposes to use when handling, transporting and compacting that class of concrete in the works.

Grades of concrete:

The concrete shall be in grades designed in Table 2 IS: 456 – 2000.

Concrete Mix Design:

Procedure for designing concrete mixes shall be as per IS: 10262 – 82. "Recommended guidelines for concrete mix design".

7.7 BATCHING:

Cement:

All cement used in making concrete shall be measured by weight either with an approved weighing machine or by making the size of each batch of concrete such as to require an integral number of complete bags of cement of weight consistent with the requirements of Cl 9 of IS: 12269 - 1987. In case of ordinary mixes, the cement bag shall be taken to be 50 kg. (35 litres).

Aggregate:

The fine and coarse aggregate shall be measured separately either by volume in gauge boxes or by weight using machines with weigh batching attachments. For high grade concrete, the fine aggregate shall be measured singly or cumulatively by weight. The Engineer will rule on this requirement.

Gauge Boxes:

Gauge boxes shall be soundly constructed by the Contractor, with the approval of the Engineer and shall be of timber or of steel to contain exactly the volume of the various aggregates required for one batch of each mix. Each gauge shall be clearly marked with the mix code and the aggregate for which it is intended. When calculating the size of the gauge box for fine aggregate, allowance shall be made for the bulking of the fine aggregate due to the average amount of moisture contained in the stockpiles on the site. Before the Contractor shall put any gauge box into use on the site, he shall obtain the approval of the Engineer of the size and construction of such gauge box.

Water Container:

Containers for measuring water shall be soundly constructed of metal to contain the exact quantity of water required for a batch of mix, due allowance having been made for the moisture content of the aggregates, or such fractions of the quantity as are approved by the Engineer. Containers shall have spouts, the pill levels of which determine the quantity. Fixed containers shall be elevated and have overflow pipes, which determine the quantity held in the container, and shall have an outlet valve and hose fixed to the bottom of the container. Before any container is put into use, the approval of the Engineer shall be obtained.

Weigh-Batching:

Weigh batching machines shall provide facilities for the accurate control and measurement of the materials either singly or cumulatively and shall be capable of immediate adjustment by operators in order to permit variations if ordered by the Engineer. All weight dials shall be easily visible from the place at which filling and emptying of the hoppers are controlled.

Addition of Water and Mixing:

A. Water:

The addition of water to a mixer shall be controlled such that between five and ten percent of the water enters the mixer before the cement and aggregate and a further five to ten percent of water enters the mixer after the said materials have been batched. The remainder of the water shall be added at a uniform rate with the said materials. The water-measuring device shall also be readily adjustable so that the quantity of water added to the mixer can, if necessary in the opinion of the witnessing Engineer's representative be varied. The natural moisture contents of the aggregates shall be determined before the commencement of concreting or at such intervals as may be necessary or as required by the Engineer. The Contractor shall make due allowance for the water contained in the aggregate when determining in consultation with the Engineer's representative, the quantity of water to be added to each mix, and shall adjust the amount of water added to each mix to maintain consistently the approved water / cement ratio of the mixed concrete. All important concrete shall be machine mixed to give complete coating of cement mortar on each coarse aggregate particle and to produce uniform coloured concrete with uniform distribution of materials. The mixer shall be run minimum 1 ½ minutes. In case, for a minor job, hand mixing is permitted

by the Engineer, it shall be done on smooth watertight platform not allowing the added water to flow out. The fine aggregate shall be spread in uniform thickness layer over which cement as required shall be placed and they shall be mixed thoroughly to give dry mortar. Water is then added gradually in required proportion, turning the mass, to give desired consistency mortar. The required quantity of coarse aggregate is then placed on mixing platform, wetted and mortar added. The entire mass is turned and returned to give uniform concrete of required consistency. 5% additional cement shall be used for hand mixed concrete.

B. Admixtures:

Any admixtures approved by the Engineer, which may be used, shall be measured separately in calibrated dispensers and shall be added to the mixture together with the water.

C. Uniformity of Mix:

Concrete shall be mixed in batches in plant capable of mixing the aggregates, cement and water (including admixtures, if any) into a mixture uniform in colour and consistency and of discharging the mixture without segregation.

D. Contractor's Returns:

The Contractor shall render to the Engineer, daily return for each class of concrete of the number of batches mixed, and total volume of concrete placed, the number of batches wasted or rejected and the weight of cement used. In case of ordinary mixes, where permitted, the cement bags consumed for quantities of various classes of concrete shall be furnished. In addition daily details of time of starting concrete, closure, No. of batches through mixer, W.C. ratio, slump, date of striking form works etc. shall be maintained. This day-to-day record shall be authenticated by responsible supervisory staff.

E. Plant and Equipment Generally:

All mixing and batching plants boxes, containers and other equipment shall be maintained free of defects or of set concrete or cement and shall be cleaned before commencing mixing. At such intervals as may be directed by the Engineer, the Contractor shall provide weights, containers and equipment necessary for testing the accuracy of the weighting plant, water measuring plant and admixture dispenser.

7.8 CONCRETING:

Preparation:

The Contractor shall clear from the surface of the foundations or previously placed concrete all oil, loose fragments of rock, earth, mud, timber and any other foreign matter and shall clear standing water and wash the surface of a previous lift of concrete to the satisfaction of the Engineer.

a. Laitance:

Where laitance on a lift of concrete is evident or if a substantial bond between this lift or bay or concrete and the next is required, in the opinion of the Engineer's representative, the Contractor shall have the surface wire brushed after initial set of the concrete or have it bush-hammered at no extra cost to the Board. Any reinforcing bars covered in laitance shall be wire brushed to clean the surface of the metal.

b. Blinding:

As ordered by the Engineer, or as shown on the drawings the formation surfaces on which concrete is to be placed shall be covered with either blinding concrete not less than 75mm thick, or waterproof, building paper, or polythene sheeting immediately after completion of the final trimming of the excavation.

7.9 INSPECTION:

Concrete shall not be placed until the Engineer has inspected the formwork and the reinforcing steel, and taken necessary measurements of the latter, and has approved the surface upon which the concrete is to be placed.

a. Transporting:

Fresh concrete shall be transported from the mixer to its place in the works as quickly and as efficiently as possible by methods, which will prevent pre-set or segregation. If segregation has nevertheless occurred in any instance, the materials shall be remixed or discarded at the opinion of the Engineer.

b. Placing:

Fresh concrete shall be placed and compacted before initial set has occurred and in any event, not later than thirty minutes from the time of mixing. Concrete shall be carefully placed in horizontal layers which shall not be allowed to slide or flow down sloping surfaces but shall be placed in its final position from skips, or similar devices. If this is impracticable, it shall be shoveled into position care being taken to avoid segregation. No concrete shall be dropped more than 1.5m. If greater drops are necessary approved chutes may be used. If the concrete abuts against earth or any other material liable to become loose or to slip, care shall be taken to avoid falls of materials on the surface of the wet concrete.

As far as possible concrete for any particular portion shall be done in one continuous operation leaving construction joints, if specified by drawing.

Before commencing subsequent concrete on the one left incomplete, all the loose particles, laitance etc. shall be removed and surface shall be covered with thick cement slurry. The concrete compacted manually shall be laid in layers not more than 15 to 20cm. The successive layer shall follow within 30 minutes or earlier.

7.10 COMPACTION:

All concrete placed in-situ shall be compacted with power driven or pneumatic internal type vibrators unless otherwise approved by the Engineer in writing, and shall be supplemented by hand spading and tamping where required. Vibrating by screed type vibrators may be used for thin slabs. There shall be sufficient and spare vibrators of adequate capacity to compact the work in hand.

a. Vibration:

Vibrators shall be inserted into the uncompact concrete vertically and at regular intervals. Where the uncompact concrete is in a layer above freshly compacted concrete, the vibrator shall be allowed to penetrate vertically for about 75mm into the previous freshly compacted layer. The vibrators shall not be allowed to come into contact with the reinforcement of formwork nor shall they be withdrawn quickly from the mass of concrete but shall be drawn back slowly while in motion so as to leave no voids. Internal type vibrators shall not be placed in the concrete in any arbitrary manner nor shall concrete be moved from one part of

the work to another by means of the vibrators. The vibrators shall have minimum 3600 (preferably 5000) impulses per minute.

b. Duration:

The duration of vibration shall be limited to that required to produce satisfactory compaction of the concrete without causing segregation. Vibration shall an no account be continued after the appearance of water or grout on the surface.

c. Hand compaction:

This shall be permitted exceptionally for small jobs by the Engineer. In such cases, compaction shall be attained by means of rodding, tamping, ramming and slicing with suitable tools. The thickness of concrete layers will also be suitably reduced when hand compaction is resorted to.

7.11 UNDER WATER CONCRETING:

No concrete shall be placed in water without the Engineer's written permission, which may only be granted if in his opinion it is not practicable to place the concrete in the dry. Concrete shall not be placed in running water nor shall concrete be allowed to fall through water. Any water entering the area where concrete is being placed shall, at the Contractor's expense, be kept clear of the concreting works. If under water concreting is permitted, the specified mix of concrete shall be strengthened by increasing the cement content by at least 10.0% and reducing the water / cement ratio to no more than 0.45, and the placing shall be only through a tremmie approved by the Engineer. The volume or mass of the coarse aggregate shall not be less than 1 ½ times not more than twice that of the fine aggregate. The material shall be so proportioned as to produce a concrete having a slump of not less than 100mm and not more than 180mm.

7.12 CURING:

All concrete shall be protected from the effects of sunshine, rain, running water or mechanical damage and cured by covering with jute, hessian or similar absorbent material kept constantly wet or a layer of sand kept covered with water is also permissible for a continuous period of fourteen days at least from the date of placement. Should the Contractor fail to water concrete continuously, the Engineer may provide labour and materials required for curing and recover the cost from the Contractor.

7.13 FINISHING:

Immediately after removal of forms, any undulations, depressions, cavities, honey combing, broken edges or corners, high spots and defects shall be made good and finished with C.M. 1:2, but the necessity of such finishing must be exceptional and total surface requiring finishing shall not exceed 1%. Where concrete surface is to receive plaster, the surface shall be roughened immediately after removal of forms and within a day thereof to secure a hold for the plaster. The rate of concrete is inclusive of this roughening and finishing. Concrete after finishing shall be cured for the full period.

7.14 JOINTS:

Construction Joints:

Construction joints are defined as joints in the concrete introduced for convenience in construction at which special measures are taken to achieve subsequent continuity without provision for further relative movement.

a. Submittal:

No concreting shall be started until the Engineer has approved the methods of placing, the positions and form of the construction joints and the size of lifts.

b. Jointing:

The face of a construction joint shall have all laitance removed and the aggregate exposed prior to the placing of fresh concrete. The laitance shall wherever practicable be removed by spraying the concrete surface with water under pressure and brushing whilst the concrete is still green. Where the laitance cannot be removed whilst the concrete is green, the whole of the concrete surface forming part of the joint shall be hacked to expose the aggregate. Where aggregate is damaged during hacking, it shall be removed from the concrete face by further hacking. All loose matter shall be removed and the exposed surface thoroughly cleaned by wire brushing, and washing down, and the surface to which fresh concrete is applied shall be clean and damp.

Expansion Joints:

Expansion joints are defined as joints intended to accommodate relative movement between adjoining parts of a structure special provision being made where necessary for maintaining the water tightness of the joint.

a. The joint location and type will be as indicated in the drawings.

1. The Contractor shall comply with the instructions of manufacturers of proprietary jointing materials and shall, if required by the Engineer, demonstrate that the jointing materials can be applied satisfactorily and will last the life of the structure.

2. Flexible water stops shall be fully supported in the formwork, free of nails and clear of reinforcement and other fixtures. Damaged water stops shall be replaced and during concreting care shall be taken to place the concrete so that water stops do not bend or distort.

b. Jointing:

The surface of set concrete shall not be disturbed and concrete shall be placed against the dry finished surface.

3. If ingress of water or corrosive agents in the joint is possible, the steel, where such steel is continued, shall be cleaned and coated with two coats of an approved bituminous paint to a distance not exceeding 10mm.

4. Where specified, the surface of the set concrete shall be painted with two coats of an approved bituminous paint, which shall be allowed to dry before placing new concrete against it. Care shall be taken to prevent paint getting on the water stop, if any.

5. Expansion joints shall be formed by a separating strip of pre-formed compressible imperishable joint filler, to be approved by the Engineer.

7.15 TESTING OF CONCRETE:

Sampling and strength test of concrete shall be as per 14 of IS: 456 – 2000.

CHAPTER 8 - FORM WORK

8.1 MATERIAL:

All formwork for concrete work shall be mostly of M.S. Plates. The plates shall be free from wrinkles, lumps or other imperfections. Steel plates shall have sufficient thickness to withstand the construction loads and the pressure exerted by the wet concrete as well as vibration during placing of concrete. Normally the thickness shall not be less than 18 gauge for M.S. Plates.

The formwork may also be constructed of timber, or other approved material. It shall be firmly supported, adequately strutted, braced and tied to withstand the placing and vibrating of concrete and the effects of weather. One copy of the Contractors shoring and formwork drawings shall be submitted to the Board for record purpose only and not for review or approval. Forms, shoring and false work shall be adequate for imposed live and dead loads including equipment and men, height of concrete drop, concrete and foundation pressures and stresses, wind pressures, lateral stability, and other safety factors during construction. The Contractor shall be responsible for the calculations and designs for the formwork. The Contractor shall be held solely responsible for any failure and for the safety of work and workmen. He shall pay necessary compensation, if need be, for damages to work, property and injuries to persons. The scaffolding, hoisting arrangements and ladders shall have easy approach to work spot and afford easy inspection.

All formwork shall be fabricated in compliance with the best modern practice, so that the finished surface is even, unblemished free of fins and true to line, level and shape as shown in the drawings. The forms shall comply with the requirements of IS: 456.

8.2 ARRANGEMENTS:

All formwork shall conform to the shape, lines, dimensions as shown on the plans of the concrete members. the formwork shall include all wedging, bracing, the rod, clamps, stop off boards and other devices necessary to mould the concrete to the desired shape. The formwork shall be constructed as to remain sufficiently rigid during the placing and compacting of the concrete and shall withstand the necessary pressure, ramming and vibrations without any deflection from the prescribed lines and curves. It shall be properly strutted and braced in at least two directions. It shall be sufficiently tight to prevent loss of liquid slurry from the concrete. It shall be strongly and firmly erected. The moulds shall be free from holes, open joints, and other imperfections. The formwork shall be so arranged as

to permit easy erection initially and easy removal without jarring or disturbing the concrete finally. Wedges and clamps shall be used wherever practicable instead of nails.

Where the depth of formwork exceeds 1.5 metres, the Contractors shall keep one side partly open, from which the concrete could be placed and the planking on the open side could be raised as the work proceeds. This will avoid segregation of material in concrete and also facilitate its proper vibration.

Before concrete is placed, all rubbish shall be removed from the interior of the form and the surfaces of the formwork in contact with concrete shall be cleaned and thoroughly wetted. The inside surface of the formwork shall be treated with a coat of lime, oil or any other material approved by the Engineer. Care shall be taken to see that the above approved composition is kept out of contact with the reinforcement. The slab centering shall be covered with "Double Wax" water proofing paper or tar paper or polythene sheet as directed by the Engineer.

Where no special finish is desired and where form finish is acceptable, the formwork may be prepared out of water proof black board, which shall give a good finish to the concrete surface and thus there will be no necessity of providing cement plaster finish. For work, which are of repetitive nature, such as column footings, pedestals for pipes, pedestal footings; the formwork shall be fabricated out of steel plates and structure to obtain uniform finish throughout the work. In all cases the formwork shall be inspected and approved by the Engineer, before any concreting is started. The Contractor shall, however, be solely responsible for the proper design, adequacy and stability of the formwork. If at any time, in the opinion of the Engineer, the formwork provided is not considered sufficiently rigid and / or is defective, the Contractor shall improve or strengthen the same in such manner as the Engineer may direct. In no circumstances shall form be struck off until the concrete attains adequate strength as required or without obtaining permission of the Engineer. All formwork shall be removed without such shock or vibration as would damage the concrete. Before the soffit and the struts are removed, the concrete surface shall be exposed where necessary in order to ascertain that the concrete has hardened sufficiently. The responsibility for the removal of the formwork whether whole or part, shall rest, entirely with the Contractor who must nevertheless be guided by the opinion of the Engineer in this regard. The work of striking and the removal of formwork shall be conducted in the presence of the Engineer and under personal supervision of a competent foreman in the employment of the Contractor.

8.3 REMOVAL OF FORMS AND SHORING:

Formwork shall be so designed as to permit easy removal without resorting to hammering or levering against the surface of the concrete. The periods of time elapsing between the placing of the concrete and the striking of the formwork shall be as approved by the Engineer after consideration of the loads likely to be imposed on the concrete and shall be in any case be not less than the periods shown below, depending on the ambient temperature.

- | | |
|--|---------|
| 1. Vertical surfaces of wall | 1 day |
| 2. Columns & vertical sides of beams | 2 days |
| 3. Slab bottoms with props left under | 7 days |
| 4. Beam bottom with prop left under | 7 days |
| 5. Removal of props under slabs | |
| Span upto 4.5 m | 7 days |
| Span over 4.5 m | 14 days |
| 6. Removal of props to beam and arches | |
| Span upto 6.0 m | 14 days |
| Span over 6.0 m | 21 days |

Sequence of striking formwork shall be approved by the Engineer.

Notwithstanding the foregoing, the Contractor shall be held responsible for any damage arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading. The Contractor shall be wholly responsible for repairing or reconstruction as directed by the Engineer the section of the works so affected.

1. Shoring and False work Removal:

In retaining wall construction shoring and false work shall not be removed until 21 days after concrete placement or until concrete has attained at least 90 percent of the 28 days design compressive strength as demonstrated by control test cylinders, whichever is earlier.

2. Restriction:

Construction equipment, or permanent loads shall not be imposed on columns, supported slabs, or supported beams until concrete has attained the 28 days design compressive strength as demonstrated by control test cylinders.

3. Concrete Curing during removals:

Concrete shall be thoroughly wetted as soon as forms are first loosened and shall be kept wet during the removal operations and until curing media or sacking is applied. Portable water supply with hoses or buckets shall be ready at each removal location before removal operations are commenced.

8.4 SURFACE TREATMENT & FINISH:

When the formwork is struck, all the faces of concrete shall be smooth and sound, free from voids and air holes. Any roughness or irregularity on the exposed surfaces shall be immediately filled up while the concrete is still green with cement grout, cement wash and / or 1:1 mortar properly trowelled and finished. Such patching of the concrete face shall be carried only with the permission of the Engineer. If the concrete is found honey-combed, the honeycombed portion and whatever surrounding concrete that may be considered unsatisfactory by the Engineer shall be dismantled and fresh concrete of proper quality shall be provided at Contractor's cost.

CHAPTER 9 - REINFORCEMENT

9.1 GENERAL:

Reinforcement shall be either plain round mild steel bars Grade I as per IS: 432 (Part - I) or medium tensile steel bars as per IS: 432 (Part – I) or high strength deformed bars as per IS: 1786. Wire mesh or fabric shall be in accordance with IS: 1566. Substitution of reinforcement will not be permitted except upon written approval from the Engineer.

9.2 STORAGE:

The reinforcement shall not be kept in direct contact with the ground but stacked on top of an arrangement of timber sleepers or the like. If the reinforcing rods have to be stored for a long duration, they shall be coated with cement wash before stacking and / or be kept under cover or stored as directed by the Engineer. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

9.3 QUALITY:

a. All steel shall be of Grade I quality unless specifically permitted by the Engineer. No re-rolled material will be accepted. If requested by the Engineer, the Contractor shall submit the manufacturer's test certificate for the steel. Random tests on steel supplied by the Contractor may be performed by the Engineer as per relevant Indian Standards. All costs incidental to such tests shall be at the Contractor's expense. Steel not conforming to specifications shall be rejected.

b. All reinforcements shall be clean, free from grease, oil, paint, dirt, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer. If welding is approved, the work shall be carried out as per IS: 2751 according to the best modern practices and as directed by the Engineer. In all cases of important connections, tests shall be made to prove that the joints are of full strength of bars welded. Special precautions, as specified by the Engineer, shall be taken in the welding of cold worked reinforcing bars and bars other than mild steel.

9.4 SUBMITAL OF DRAWINGS AND SAMPLES:

Drawings:

The Engineer will supply detailed drawings of reinforced concrete works. Working drawings and bar bending schedules shall be prepared by the Contractor from the drawings supplied to him by the Engineer.

Samples:

At least one month in advance of placing an order by him, the Contractor shall submit four samples of reinforcing bars which he intends ordering in case, the steel is to be supplied by the Contractor.

The samples shall conform to IS: 10790 Part 2 – 1984. The Engineer may carry out any test he may require to satisfy that the steel to be brought by the Contractor complies with the test Specifications.

9.5 LAPS AND SPLICES:

Laps and splices for reinforcement shall be as per IS: 456 – 2000. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the approved Drawings, shall be only as approved by the Engineer. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

9.6 DOWELS:

Where and as designated on the drawings, steel bar dowels shall be provided for anchorage to previously cast concrete.

For anchorage where shown or required to existing construction, an approved non-shrink epoxy type grout or approved bolting devices shall be used.

9.7 BENDING:

a. Reinforcement bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done cold and without damaging the bars.

b. All bars shall be accurately bent according to the sizes and shapes shown on the approved detailed working drawings / bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and in a manner that will injure the material; bars containing cracks or splits shall be rejected. They shall be bent cold, except bars over 25mm in diameter which may be bent hot if specifically approved by the Engineer. Bars, which depend for their strength on cold working, shall not be bent hot. Bars bent hot shall not be treated beyond cherry red colour (not exceeding 845 degree C) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebending be such as shall not, in the opinion of the Engineer, injure the material. No reinforcement shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

9.8 FIXING:

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position by the use of blocks, spacers and chairs, as per IS: 2502, to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of bars in beams or similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

The Contractor shall ensure that all reinforcing bars are thoroughly wire brushed and cleaned free of loose mill scale, loose rust, coats and paints, oils, mud or other coating.

Mesh reinforcement, where specified shall conform to IS: 1566 – 1982.

Binding wire shall be annealed wire conforming to IS: 280.

9.9 COVER:

Unless indicated otherwise, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:

- (i) At each end of a reinforcement bar, not less than 25mm nor less than twice the diameter of the bar.
- (ii) For a longitudinal reinforcing bar in a column not less than 40mm, nor less than the diameter of the bar. In case of columns of minimum dimension of 20cm or under with reinforcing bars of 12mm and less in dia. a cover of 25mm may be used.
- (iii) For longitudinal reinforcing bars in a beam, not less than 25mm nor less than the diameter of the bar.
- (iv) For tensile, compressive, shear or other reinforcement in a slab, or wall, not less than 15mm, nor less than the diameter of such reinforcement.
- (v) For any other reinforcement, not less than 15mm, nor less than the diameter of such reinforcement.
- (vi) For footing and other principal structural members in which the concrete is poured on a layer of lean concrete, the bottom cover shall be minimum of 50mm.
- (vii) For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, grade beams, footing sides and tops, etc. not less than 50mm for bars larger than 16mm diameter and not less than 40mm for bars 16mm diameter or smaller.
- (viii) Increased Cover thickness shall be provided for surfaces exposed to the action of harmful chemicals or exposed to earth contaminated by such chemicals acids, alkalis, saline atmosphere, sulphurous smoke etc. and such increase of cover may be between 15mm and 50mm beyond the figures mentioned here as may be specified by the Engineer.
- (ix) For liquid retaining structures, the minimum cover to all steel shall be 40mm or the diameter of the main bar, whichever is greater. In the presence of soils and waters of a corrosive character, the cover shall be increased by 10mm.
- (x) The correct cover shall be maintained by cement mortar cubes or other approved means. Reinforcement for footing, grade beams and slabs on sub grade shall be supported on precast concrete blocks as approved by the Engineer. The use of pebbles or stones shall not be permitted.
- (xi) The 28 day crushing strength of cement mortar cubes / precast concrete cover blocks shall be at least equal to the specified strength of concrete in which these cubes / blocks are embedded.
- (xii) The minimum clear distance between reinforcing bars shall be in accordance with IS: 456.

9.10 INSPECTION:

All continuous inspections shall be performed by the Engineer's Representative. Erected and secured reinforcement shall be inspected and approved by the Engineer prior to placement of concrete.

9.11 REINFORCEMENT BARS PROCUREMENT:

All reinforcement steel (TMT) should be procured as per IS 1786:2008 Grade Fe415/Fe500. Steel to be procured only from Primary steel producers/ Integrated Steel Plants such as TATA / SAIL / RINL / JSW / SHYAM STEEL using iron ore as the basic raw material and having in-house iron making facilities followed by production of liquid steel and crude steel with in-house rolling, adopting BF-BOF route or DRI-EAF technology as per Ministry of Steel guidelines. No Re-rolled material/secondary steel will be accepted or allowed for any structural works.

As per IS.1786:2008, under clause 4.2.3, Low-alloyed/Micro alloyed/CRS steel can also be used by adding alloying elements like Cr, Cu, Ni, Mo and P, either individually or in combination to improve allied product properties. However the total content of these elements shall not be less than 0.40%. In such alloy steels when phosphorous is used, it shall not exceed 0.12% and carbon shall be restricted to a maximum of 0.15%.

The steel manufacturing company should have latest ISO accreditation for Quality Management System.

Every lot of supply shall require to be accompanied by manufacturers test certificate for establishing correlation with TMT/CRS bars supplied.

Every lot shall be tested in the independent laboratory to assess whether the properties are confirming to IS.1786:2008.

The Contractor shall arrange for transport, loading, unloading and storage at the work sites. The Contractor should plan the procurement of steel in such a way that at least required quantity of steel of specified sizes is available at site for 3 months period.

In case Board supplies steel, the carting from Board stores to work site is included in the item. Reinforcement shall be transported stacked and stored at site away from soil contact and protected from rain so as not to damage or rust the material. The bars shall be stored above ground surface upon platforms or supports to avoid distortion and sags of long length.

The rate quoted for steel reinforcement shall be inclusive of taxes, transport incidental charges etc., apart from labour component as specified in the respective item in the Bill of Quantities.

Steel brought on site shall be stored in a proper manner as approved by the Engineer so as to avoid distortion, deterioration and corrosion. The Contractor shall maintain proper registers for the steel account, showing the steel received at site, steel used, and the balance stock on site, to the entire satisfaction of the Engineer. Further, it shall be obligatory on the part of the Contractor to submit monthly, quarterly and yearly statements giving the full account of steel on the works and the balance on hand.

9.12 ANTI CORROSIVE TREATMENT FOR REINFORCEMENT:

9.13.1 The item covers providing fusion bonded epoxy coating not less than 175 microns thickness and upto 300 microns to reinforcement steels bars of all diameters as per IS Code 13620-1993 for RTS rods for RCC works including testing of coating at plant.

CHAPTER 10 - PLASTERING

10.1 DEFINITIONS:

- a) The term “plastering” shall cover all types of rough or fair finished plastering, rendering, floating and setting coat or finishing coat, screed, etc., in mud, lime, cement lime or cement mortar.
- b) “Dubbing out” shall mean filling in hollows in the surface of wall and roughly levelling up irregular or out of plumb surfaces, prior to rendering.
- c) “Rendering” or “rendering coat” shall mean the plaster coat, which is applied following the “Dubbing out” or the final coat in case of one coat work.
- d) “Floating coat” shall mean the second coat in a three-coat plasterwork, to bring the rendering coat to a true and even surface before the setting or finishing coat is applied.
- e) “Setting of finishing coat” shall mean final coat in a two or three coat plaster work.
- f) “Thickness of plaster” shall mean the minimum thickness at any point on a surface. This does not include thickness of dubbing out.
- g) The term “even and fair” as referred to finishing of the plastered surface shall mean a surface finished with a wooden float.
- h) The term “even and smooth” as referred to finishing of the plastered surface shall mean a surface leveled with wooden float and subsequently smoothed with a steel trowel.

10.2 SCAFFOLDING:

Where possible, independent scaffolding shall be used to obviate the subsequent restoration of masonry in putlog and other breaks in the work. Stage scaffolding shall be provided for ceiling plaster.

10.3 PREPARATION OF MORTAR FOR PLASTERING:

10.3.1 Materials:

Cement Mortar:

Cement mortar shall have the proportion of cement to sand as mentioned in the item or in the special provisions and shall comply with following:

Cement:

Cement shall conform to IS: 12269 - 1987 Ordinary Portland Cement shall be used. The weight of ordinary Portland cement shall be taken as 50 kg. per bag. The Contractor shall ensure that the cement is of sound and required quality before using it. Any cement, which has deteriorated, caked or which has been damaged shall not be used. The Specifications covered under the section brickwork and concrete work shall be applicable in addition.

Water:

Water shall be clean, clear and free from injurious quantities of salt, traces of oil, acids, alkalis, organic matter and other deleterious materials. The sources of water shall be approved by the Engineer and the containers for conveyance; storage and handling shall be clean. If necessary, standard cement tests shall be conducted using the water intended to be used, in comparison with those adding distilled water to check quality of water.

Water shall meet the requirement of 4.3 of IS: 456 – 2000. Generally potable water is fit for mixing and curing.

Fine Aggregate:

All fine aggregate shall conform to IS: 383 – 1970 and relevant portion of IS: 515 – 1959. Sand shall be clean, well graded, hard, strong, durable and of 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 approved by the Engineer. The maximum size of particles shall be limited to 5mm. If the fine aggregate contains more than 4 percent of clay, dust or silt, it shall be washed.

The fine aggregate for cement mortar for masonry and first coat of plaster should generally satisfy the following grading:

I.S. Sieve	Percent by wt. Passing sieve
4.75mm	100
2.36mm	80-95
1.18mm	70-90
600microns	40-85
300microns	5-50
150microns	0-10

The fineness modules shall not exceed 3.00.

The fine aggregate for cement mortar for fine joints of ashlar masonry, pointing and second coat of plaster may have the following grading:

I.S. Sieve	Percent by wt. Passing sieve
4.75mm	100

2.36mm	100
1.18mm	75-100
600microns	40-85
300microns	5-50
150microns	0-10

The fineness modulus shall not exceed 1.6.

IS: 2116 – 1980 shall generally apply for sand for plaster. The fine aggregate should be stacked carefully on a clean, hard surface so that it will not get mixed up with deleterious foreign materials.

10.3.2 Proportion:

Cement and sand shall be mixed in specified proportions, sand being measured in measuring boxes. The proportions will be by volume. The mortar may be hand mixed or machine mixed.

10.3.3 Preparation:

In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform. Fresh and clean water as specified above shall be added gradually 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 may be as under or as directed by the Engineer.

Cement	Sand	Water – Cement ratio	Quantity of water per 50 kg. of cement (Litres)
1	1	0.25	12.5
1	1 ½	0.28	14.0
1	2	0.30	15.0

1	2 ½	0.35	17.5
1	3	0.40	20.0
1	4	0.53	26.5
1	5	0.60	30.0
1	6	0.70	35.0
1	8	0.90	45.0

Machine mixed mortar shall be prepared in an approved mixer. Water cement ratio shall be as per hand mixed mortar. The mortar so prepared shall be used within 30 minutes of adding water. The mortar remaining unused after that period, mortar, which has partially hardened or is otherwise damaged shall not be re tempered or remixed. It shall be destroyed or thrown away.

10.4 PREPARATION OF BACKGROUND FOR APPLICATION OF PLASTER:

Cleanliness:

All dirt, dust and other foreign matter on masonry and laitance on the concrete surfaces shall be removed by watering and brushing as required. If the background contains soluble salts particularly sulphates, the application of plaster shall be done only after the efflorescence of the salts is complete and the efflorescence is completely removed from the surface.

Joints in brickwork, stone masonry and hollow block, masonry shall be raked out to a depth of not less than 10mm as the work proceeds. Local projection in brickwork and masonry beyond the general wall face shall be trimmed off where necessary.

Roughness:

Smooth surfaces of in-situ concrete walls and ceilings etc. shall be roughened by wire brushing, if it is not hard; and by hacking or bush hammering if it is hard, to provide for proper adhesion. Projecting burrs of mortar because of gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surface shall be pock marked with a pointed tool at spacing of about 50mm, the pocks made to be not less than 3mm deep.

Suction Adjustments:

Adequate drying intervals shall be allowed between the erection of masonry and plastering to bring the surface suitable for suction adjustment. High rate of suction makes the plaster weak, porous and friable. The wall shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry in spots, such areas shall be moistened again to restore uniform suction. Excessive water leads to failure of bond between the plaster and the background.

Evenness:

Any local unevenness must be leveled and projections removed to avoid variance in the thickness of plaster.

Immobility:

Differential movements between the background and the plaster due to moisture change, temperature change, structural settlement, deflection, etc. cause cracks. The major part of such movements shall be allowed to set in before the plaster is applied.

10.5 PLASTERING:**Plastering Generally:**

The type and mix of mortar for plastering, the number of coats to be applied, the surface finish of the plaster and the background to which the plaster is to be applied shall be as indicated.

The mortar for dubbing out and rendering coat shall be of the same type and mix. Dubbing out may be executed as a separate coat or along with the rendering coat.

Protection:

All existing work and fittings that are likely to be damaged in the application of plastering shall be protected. Care shall be taken to avoid, as far as possible, the splashing of mortar on to the finished surfaces such as joinery, paint work and glazing; all such splashes shall be cleaned off immediately.

Screeds 15 x 15cm shall be laid vertically and horizontally not more than 2m apart to serve as guides in bringing the work to an even surface.

Plastering shall be done from top to bottom and care shall be taken to avoid joints in continuous surface.

Maintenance of proper time intervals:

To avoid break down of adhesion between successive coats, drying shrinkage of first coat shall be allowed to be materially completed before a subsequent coat is applied

All corners, arises, angles, junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering of corners, arises and junctions shall be carried out with proper templates to the required size. Plastering of cornices, decorative features, etc. shall normally be completed before the finishing coat is applied.

In suspending the work at the end of the day, the plaster shall be cut clean to the line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scraped clean and wetted with lime putty or cement slurry before plaster is applied to the adjacent area. Partially set and dried mortar shall not be re tempered for use.

Cleaning of completion:

On completion, all work affected by plastering and pointing shall be left clean, special care shall be taken when removing any set mortar form glass and joinery, etc. to avoid damaging their surface.

10.6 ONE COAT PLASTER WORK:

Mortar shall be firmly applied to the masonry walls and well pressed into the joints and forcing it into surface depressions to obtain a permanent bond. The plaster shall be laid in a little more than the required thickness and levelled with a wooden float. On concrete walls, rendering shall be dashed on to roughened surface to ensure adequate bond. The dashing of rendering coat shall be done using a strong whipping motion at right angles to the face of walls. The surface shall be finished even and fair. Unless indicated to be finished even and smooth.

10.7 TWO COAT PLASTER WORK:

First Coat:

The first coat of the specified thickness shall be applied in a manner similar to one coat plasterwork. Before the first coat hardens, the surface of the cement and cement lime plasters shall be scored to provide key for second coat. In case of lime plasters the surface shall be beaten with edges of wooden thapies and close dents shall be made on the surface, to serve as a key to the subsequent coat. The rendering coat shall be kept damp for at least two days, it shall be allowed to become thoroughly dry.

Second Coat:

Before starting to apply second coat, the surface of the rendering coat shall be damped evenly. The second coat shall be completed to the specified thickness in exactly the same manner as the one coat plaster work.

10.8 NEERU FINISH:

After applying and finishing the undercoats and before they set, the finishing coat of specially prepared lime putty about 1.5mm thick shall be applied. It shall be well polished with a trowel.

10.9 SAND FACED PLASTER:

After the undercoat of cement and sand mortar 1:4 not less than 10mm thick, has been applied and finished, the final coat of cement and sand mortar 1:4 shall be applied to a thickness not less than 5mm and brought to an even surface with a wooden float. The surface shall then be tapped gently with a wooden float lined with cork to retain a coarse surface texture, care being taken that the tapping is even and uniform.

10.10 CURING:

Each coat shall be kept damp continuously for at least two days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury. The water shall be applied preferably by using a fine fog spray. Soaking of wall shall be avoided and

only as much water as can be readily absorbed shall be used. Excessive evaporation on the sunny or wind ward sides of buildings in hot dry weather shall be prevented by hanging matting or gunny bags on the outside of the plaster and keeping them wet.

After the completion of finishing coat, the plaster shall be kept wet for at least seven days and shall be protected during that period from extremes of temperature and weather.

10.11 WATER PROOFING PLASTER:

Integral water proofing compound shall be mixed with cement in the proportion indicted by weight. Care shall be taken to ensure waterproofing material gets well and integrally mixed with cement and does not run out separately when water is added.

ANNEXURE – (B)
(SPECIFICATIOIS FOR SEWERAGE WORKS)

CHAPTER 11 - LAYING AND JOINTING OF REINFORCED CONCRETE PIPES

11.1 Reinforced Concrete Pipes

The RCC S/S pipes shall be of NP3 class manufactured with sulphate resisting cement as per IS 458:1988, hydraulically tested as per specification. To protect from sewer gases, an additional 12 mm thick alumina lining shall be provided and the spigot portion shall be coated with epoxy on the outside and socket portion with approved poly solution. The contractor shall order the pipes required for the work marked with the following information.

11.2 Laying of RCC Pipes

The laying and joining of RCC pipes shall be carried out as follows:-

The R.C.C pipes shall be laid on a well compacted bed of granular material or selected fill materials excavated for the full width of the trench. There shall be sufficient material at the sides to permit the pipes to be worked into the pipe bedding material and firmly supported to true line and level. Sufficient space should be left to enable the joints to be made tested and inspected but the Contractor shall ensure that at least three quarters of the pipe length is fully supported. The pipe shall proceed upgrade of a slope. If the pipes have spigot and socket ends, the socket end shall face upstream direction. In all pipelines the recesses at the ends between the socket and the pipe shall be filled with jute dipped in hot bitumen and the pipes shall be jacked by any suitable method. After the pipeline has been tested and approved by the Engineer the trench shall be carefully filled in layers not exceeding 150mm to the required levels.

11.3 Cutting of R.C.C Pipes

Where necessary and as ordered by the Engineer the Contractor shall cut the pipe and fix and join common collars for jointing spigot ends. The cut ends of the pipe shall be made truly at right angles with the axis of the pipe.

11.4 Jointing of Pipes

The trench must be kept quite dry during jointing unless in any particular case the Engineer permits laying of the pipe in wet conditions. Plain spigot and socket pipes shall be joined as follows.

11.5 Rubber Ring Joints

In the case of rubber ring joints or push on joints, the groove and the socket shall be thoroughly cleaned before inserting the gasket. When inserting the gasket it shall be made sure that it faces the proper direction and that it is correctly seated in the groove. After cleaning dirt or foreign materials from the plain end, lubricant shall be applied in accordance with the pipe manufacturer's recommendations.

The Contractor shall make sure that plain end is bevelled as square or sharp edges may damage or dislodge the gasket and cause a leak .When the pipe is cut at site, the plain end shall be beveled with a heavy file or grinder to remove all sharp edges.

The plain end of the pipe shall be pushed into the socket of the pipe and while pushing, the pipe shall be kept straight. If any deflection are to be made in the alignment, it may be made after the

joint is assembled. A timber header shall be used between the pipe and crow bar or jack to avoid damage to the pipe while the plain end of the pipe is pushed into the socket either with a crow bar or jack, or lever puller.

CHAPTER 12 - LAYING AND JOINTING OF DI PIPES

12.1 TRANSPORTATION

The transportation of materials to work site and stacking shall be done in such a manner as to cause minimum inconvenience to the traffic and other construction works. Pipes shall be protected during handling against impact, shocks and free fall to avoid cracks and damage. Pipes shall be loaded for transportation in such a way that they are secured and no movement can take place on the vehicle during transit. The same care shall be taken if pipes are transferred from one vehicle to another, however short the journey may be. The cement mortar lining of pipes that are damaged during transportation is to be repaired by hand application if possible; otherwise it has to be rejected. The decision for rejection shall be taken by the Engineer in charge. The pipe shall conform to IS 8329 (2000)

12.2 UNLOADING OF PIPES:

Each pipe consignment shall be inventoried and inspected with care upon arrival even though the pipes have been inspected and loaded with care at the factory. Overall examination shall be made during unloading to ensure that the pipes have reached destination in good condition. If there is any sign of rough treatment on the coating, each pipe shall be inspected for damage.

While unloading, pipes shall not be thrown down from the truck to the hard roads. Cranes or Mechanical equipment shall be used for unloading the pipes from the truck. If mechanical equipment is not available, care should be taken to unload the pipes on timber skids. Unloading them on timber skids without a steadying rope and thus allowing the pipe to bump hard against one another should not be allowed. In order to avoid damage to the pipes specially to the spigot end, pipe should not be dragged along concrete and similar pavements with hard surfaces.

The pipes shall be laid on timber battens and secured with wooden wedges. The pipes shall be stacked with each tier at right angles to the preceding tier.

12.3 LOWERING OF PIPES AND FITTINGS:

The pipes shall be lowered cautiously to prevent disturbances of the bed and sides of the trench. Proper implements, tools and facilities satisfactory to the Authority shall be provided and used for the safe and convenient execution of the work. All pipes, fittings, valves and hydrants shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipes materials and protective coatings and linings. Under no circumstances shall pipes materials be dropped or dumped into the trench. Pipes over 300mm diameter shall be handled and lowered into trenches with the help of chain pulley blocks or preferably by cranes. Tripod supports used for this purpose shall be regularly checked to prevent all risks of accidents.

12.4 CLEANING OF PIPES AND FITTINGS:

All lumps, blisters and excess coating material shall be removed from the socket and

spigot end of each pipe. The outside of the spigot and the inside of the socket shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

12.5 LAYING:

Before lowering the pipe, the trench section shall be got approved from the Engineer in charge. Trenches are to be dug to the specified level / grade. Sufficient cushion shall be provided for protection from surface traffic, future changes in the ground elevation. The width of the trench shall be to the required specifications providing room for pipe laying operation, backfilling, compaction etc., Trenches should be shored and braced when conditions so warrant.

The bottom of the trench shall form a continuous bed for the pipe. Where rock is encountered, trenches shall be dug deeper and then filled and compacted to grade with suitable bedding material. The Contractor shall have to provide and maintain sight rails and boning rods wherever required till the completion of work. The pipe shall be laid in reasonably dry condition and under no circumstances they shall rest on slushy bedding.

The pipes shall be lowered slowly into the trench by means of chain pulley block and tripod stand or with the help of ropes and suitable size of wooden bullies or with the help of cranes. They shall be brought to the required level by giving packing with wooden sleeper pieces and ultimately with well-consolidated hard murum if required. The chain pulley block and tripod stand must be approved from the Engineer in charge. Under no circumstances pipe shall be allowed to be thrown in the trenches. At the end of each day, the end of the pipe should be plugged to prevent entry of rodents, foreign substances, water etc. Refer IS 9523 (2000) & IS 12288 (2007) for laying of DI pipes

12.6 SUPPORT OF PIPE FOR NALLAH / RIVER CROSSING:

Ventek piles are proposed for portion of pipeline which crosses the nalla / river or slushy soils. Each pipe shall be supported on a pair of Ventek piles driven upto 3.50m or firm ground whichever is met earlier.

One pair of timber piles shall be driven 150mm behind the shoulder of toe socket and another pair about 750mm in front of the spigot end of the pipe.

The size of timber section to be used for Ventek piles shall be: 100mm x 100mm for pipe sizes upto 300mm

150mm x 150mm for pipe sizes above 300mm

A cross piece of section same as that of pile shall be bolted to a pair of piles which have been driven to the required depth.

The level of the cross piece should be such that when the pipe rests on its top, its Invert level coincides with the proposed invert of the pipe.

The pipe shall be aligned for straightness and secured in position by wooden wedges nailed down to the wooden cross piece. The spigot end of each pipe shall be thoroughly homes in to socket of preceding pipe and jointing made. The pipe shall be further

secured from moving upwards by timber cross pieces bolted to the supporting piles. The section of the cross piece shall be same as that of pile.

The socket ends of all pipes shall face up hill irrespective of the direction of water flow. Any deviation either in plan or elevation of less than 11 ¼ deg. angle shall usually be effected by laying straight pipes round a flat curve; of such radius that rubber gasket shall not be disturbed in its place. Wherever new pipes laid are to be jointed with existing pipe line, first pipe laying work of new pipes are to be completed. Jointing of new pipe line with existing pipe line has to be completed within a stipulated time as per the instructions of Engineer in charge to keep the distribution system ready to supply water to the city. No extra payment will be made for this time bound urgent work.

12.7 TESTING:

After laying and jointing, the pipe line must be pressure tested to ensure that the pipes and joints are sound enough to withstand the maximum pressure likely to be developed under working conditions. The Contractor shall submit for the Engineers approval, details of his proposed methods and programme for testing including details of test equipment and shall provide for all tests to be carrying out testing and cleaning including water pumps, gauges, piped connections, stop ends, and all other temporary works.

Pipe lines shall be properly completed and supported before being put under test. No testing will be permitted until ten days after thrust blocks and other holding down works have been completed. In addition to any tests of individual joints or other interim tests which may be specified elsewhere, the Contractor shall submit, all parts of the pipe lines to a final test. Notwithstanding the foregoing, the Contractor may at any stage of construction, carry out such other tests as he considers desirable to check materials and workmanship on the pipe lines but this shall not relieve the Contractor of his obligations to achieve successful test under the contract.

All water required for testing and cleaning the pipelines shall be potable water and shall be provided by the Contractor at his cost. The test can be carried out by means of a hand pump or a pressure pump.

Pipelines shall be tested in lengths between valve pits or such lengths as the Engineer may direct or permit.

Fittings required for temporarily closing the openings in pipelines to be tested shall be properly designed for this purpose and shall be adequately strutted to withstand the pressure specified. The completed pipe line may be tested in sections, the length of section should be decided by considering:

- a) the availability of suitable water;
- b) the number of joints to be inspected; and
- c) the difference in elevation between one part of the pipe line and another.

The maximum length that can be tested in one operation shall be restricted to 500m and

minimum length shall be 50m.

Where joints are left uncovered until after testing, sufficient materials should be back filled over the centre of each pipe to prevent movement under the test pressure. The Contractor shall make his own arrangements to procure necessary equipment, apparatus etc., required for testing and shall provide necessary labour for filling with water the length of pipes to be tested, fixing all apparatus and for carrying on the testing operations until the length of pipe, specials and connections are firmly passed by the Engineer.

Before the actual testing pressure is applied, any air which has logged in the length of pipe to be tested shall be got rid of, by screwing on at the highest part of the length of pipes or temporary air valve, or by opening a temporary stop – cock or by means as the Engineer may direct.

The test pressure shall not be less than 2.5 kg / Cm^2 .

Each pipe line or section thereof shall be filled with water and all air removed. The pressure in the pipe lines shall be raised steadily until the site test pressure is reached in the lowest part of the section. This pressure should be disconnected and no further water permitted to enter the pipe line for a period of 1 hour. At the end of this period, the reduced pressure in the pipe line should be measured, the original test pressure restored by pumping and the loss measured by drawing off water from the pipe line until the pressure has fallen to match the reduced pressure previously noted.

But should any pipe, joint, special or connection be found to sweat or leak, Contractor shall make good at his cost such defective joints and the length of pipe line shall be retested until all pipes, joints specials and connections are found to be satisfactory.

After satisfactory test, the Contractor shall remove water from the pipeline and clean it after testing at his own cost, without flooding adjoining areas.

Duration of Hydraulic Test:

The test is for 1 hour only. The rate of allowable leakage is given on per day basis. The leakage observed within one hour shall be converted to per day basis and compared with criteria given.

12.8 INTERCONNECTION WORK:

The interconnection work between the existing sewer main and the proposed sewer main to be laid under this contract shall proceed from the new main to the existing main. Before actually proceeding with the interconnection work, the Contractor shall make ready necessary tools and plants required for the work at site, such as pump sets, shoring materials etc. He shall also keep ready at site necessary pipes, jointing materials, specials and valves required for the work.

The Contractor shall keep necessary skilled workmen of sufficient strength at site and once the work commenced, the entire interconnection work shall proceed without interruption by engaging labour for carrying out the work on a continuous basis both day and night till the work is completed. The work shall be executed as per programme drawn up by the Engineer and shall be completed within the time ordered by the Engineer, for each individual interconnection. The work shall be carried out under the direction of the Engineer from the beginning to end.

Laying of specials, valves (except straight pipes from the branch of the new main to the connecting point in the existing main) including conveying specials etc., from the stores or site of stacking, excavating, timbering, pumping out water from the trenches, lowering, aligning, jointing specials and valves, cutting the existing mains, dealing with water, inserting the necessary branches, jointing, testing, refilling etc., is included in the item of providing, laying and jointing DI pipes. Any ancillary work either of Temporary or Permanent nature required for interconnection and not covered by schedules shall be executed by the Contractor at no extra cost.

12.9 FLANGED JOINTS:

Flanged joint should be made by painting the facing of the flange with white lead freely and bolting 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. When packing must be used, it should be of rubber insertion three ply and of approved thickness. The packing should be of the full diameter of the flange with proper pipe hold and bolt holes cut out evenly on both the inner and outer edges. Where the flange is not full faced, the packing may be of diameter of the packing strip only, proper placing of the packing should be checked before another pipe is jointed on.

12.10 Fixing Sluice Valve

The sluice valves to be fixed on the pipelines shall be examined, cleaned and placed in the positions as shown in the drawings. The valves shall be placed on the pipeline and valve chambers constructed according to drawings. The depth at which the valve is to be laid and the dimensions of concrete and masonry shall be varied when necessary under the orders of the Engineer.

As the pipes in some instances may be required to be fixed at a less depth than will permit the top of the valve spindle being below the level of the road (but this may only be in cases

where the position of the valve is to one side of the metalloid road) the walls of the valve chamber shall in such cases be carried upto such height at may be ordered, and the chamber shall have such covering as the Engineer may direct. The valve shall be supported in the valve chamber so that no stress or strain occurs in the flange or other joints of the valve. The valve shall be carefully protected from slime or dust by a suitable mat or gunny covering and the pit itself shall be cleared of all unwanted material.

12.11 Fixing Scour Valve

Scour valves shall be fixed at places shown in the drawings or as directed by the Engineer, and the scour connections from the main shall be carried out completely as per drawings.

12.12 Fixing Air Valve

Air valves shall be fixed at the summits of pipe lines or at places as may be directed by the Engineer. The air valve connections etc. shall be carried out as per drawing.

12.13 Interconnection Work

The Interconnection Work between the existing main and proposed main to be laid under this contract shall proceed from the new main to the existing main. Before actually proceeding with the interconnection work, the Contractor shall make ready necessary tools and plants required for the work at site, such as pump sets, shoring materials etc., He shall also keep ready at site necessary pipes, specials, valves if any required for the work. The Contractor shall keep necessary skilled workmen of sufficient strength at site and once the work is commenced, the entire interconnection works shall proceed without interruption by engaging labour for carrying out the work on a continuous basis both day and night till the work is completed. The work shall be executed as per Programme drawn up by the Engineer and shall be completed within the time ordered by the Engineer, for each individual interconnection. The work shall be carried out under the direction of the Engineer from the beginning to end.

Laying of Specials, valves (except straight pipes from the branch of the new main to the connecting point in the existing main) including conveying specials etc., from the stores or site of stacking, excavation, timbering, pumping out water from the trenches, lowering, aligning, jointing specials and valves cutting the existing mains, baling out water, inserting the necessary branches, jointing, testing, refilling etc ., shall comprise as one unit of work and will be paid at the lump sum rate quoted in the schedule for interconnections.

12.14 Works to be left Water tight

The Contractor shall construct the pipes chambers and all other Works so that they shall be water tight. Should any leakage appear, it shall be made good by him at his expense by removing and reconstructing the portions of the Work so affected or by other method which will render the Work thoroughly water tight to the satisfaction of the Engineer.

12.15 Cleaning of Mains

During the execution of the work the contractor shall keep the interior surface of the mains free from cement, brick, soil or other superfluous matter and shall hand over the mains perfectly clean and free from deposit on completion.

12.16 Masonry chambers

Chambers for sluice valves, inspection, scour valves, air valves shall be constructed on the pipes in the positions as shown in the drawings or in such positions as the Engineer may direct. The work shall be done strictly in accordance with the detailed drawings or as ordered by the Engineer.

The excavation shall not be made lower than necessary to admit of the earth being

properly timbered. The bottom of the excavation shall be properly leveled, rammed and a bed of concrete laid thereon. When the concrete has sufficiently set the building of the brick walls shall then be proceeded with and all iron work fixed in as the building proceeds. The inside of all chambers shall be plastered with cement mortar 20 mm thick and the outside with cement mortar 12mm thick.

The chamber shall be topped with pre-cast RCC Slab 1:2:4 or cast iron surface box of valve cover as ordered by the Engineer. The surface box or valve cover shall be fixed on the top of the RCC slab by a layer of; cement mortar and sides of the surface box or valve cover covered over with cement concrete.

Where pipes pass through walls of chambers relieving arches shall be turned neatly over the upper half of the pipes or RCC lintels shall be provided to avoid load of the walls transmitted to the pipes.

Cast Iron steps shall be built in each chamber as the Work proceeds on being inserted to every 4 courses of brick work, horizontal distance center to center of each row being 30cm.

The Contractor shall include in his rate for brick work cost for fixing steps, frame, cover etc., for completing all chambers in accordance with the drawings and with the above specifications.

12.17 Restoring Road Surface

The surface of the road or ground shall be finished off to the proper level with the same kind of materials upto the surface consisted of before the excavation commenced, except in the case of superior roads and tarred roads in which case the surfaces should be finished off with water bound macadam surface as per the directions from Engineer-in-charge. **The road top surface/finishing restoration shall be carried out by seppperate road work by ASCL.** Should any settlement occur after refilling is completed, and upto the end of the period of maintenance, it shall be made good at once and the surface restored to the satisfaction of the authority under whose jurisdiction such road or ground may be, all at the cost of the contractor.

12.18 Collection of Rubbish

The Contractor shall, at his cost, on the completion of the Work remove all water and all materials or rubbish of every description which may have been collected in the works find a deposit thereof and anything which may have collected within the works, during the period of maintenance shall also be removed before the W orks are finally accepted by the Employer.

CHAPTER 13 - DOUBLE WALL CORRUGATED (DWC) HDPE PIPES

13.1 APPLICABLE CODES

The manufacturing, testing, supplying and testing at work sites of HDPE-DWC pipes shall comply with IS 16098 Part-II: 2013 and all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern:

Code No.	Title/Specification
IS 4905:1968	Methods for random sampling.
IS 5382:1985	Specification for rubber sealing rings for gas mains, water mains and sewers (first revision). Type-I & Type-VI
IS 12235	Methods of test for thermoplastics pipes & fittings.
(Part 1): 1986	Method of measurement of outside diameter.
(Part 5):1986	Reversion test
(Part 8):1986	Internal hydrostatic pressure test
IS 16098 Part-II:2013	Structured wall plastics pipes for non-pressure drainage and sewerage- specifications.

Others Codes not specifically mentioned here but pertaining to the use of HDPE-DWC pipes form part of these Specifications.

The manufacturer's own rework material conforming to the requirements given in 3.25 of IS:16098 is permissible. No other rework material shall be used.

13.2 MARKING : GENERAL

Marking shall be labelled, printed or formed directly on the pipe or fitting, in such a way that after storage, weathering and handling the legibility shall be maintained. Marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipes or the fitting. Minimum Required Marking

13.3 PIPES

Each pipes shall be marked at intervals of maximum 3 m, at least once per pipe, with the following information:

- a) Manufacturer's name/Trade-mark;
- b) Diameter series, nominal size;
- c) Stiffness class;
- d) Material; and
- e) Lot number/batch number containing information regarding period of manufacture.

13.4 FITTINGS

Each fitting shall be marked with the following information:

- a) Manufacturer's name/Trade-mark;
- b) Diameter series, nominal size;
- c) Nominal angle;
- d) Stiffness class;
- e) Material; and
- f) Lot number/batch number containing information regarding period of manufacture.
- g) BIS Certification Marking each pipe or fittings may also be marked with the standard Mark. The use of the Standard mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under.

13.5 PRODUCT IDENTIFICATION

Product markings on Crumpler Plastic Pipe will include the following information to facilitate jobsite inspection.

Nominal pipe size

Manufacturer's name

Date code

Application standard(s)

13.6 WORKMANSHIP / APPEARANCE

Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe

13.7 MEASUREMENT

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm. Specials shall be excluded and measured and paid separately under the relevant item. The portion of the pipe at the joints (inside the joints) shall not be included in the length of pipe work. Excavation, refilling, masonry and concrete work wherever required shall be measured and paid for separately under relevant items of work.

13.8 INSPECTION AND TESTING:

The pipe shall be delivered at site after inspection by the nominated inspectors by the Employer.

Physical Dimensions and visual inspection: The Manufacturers test reports shall be provided for review.

Mechanical Characteristics shall be in accordance to IS 16098- 2013.

Ring Flexibility shall be as per IS 16098.

13.9 CONNECTING CORRUGATED POLYETHYLENE PIPE TO OTHER PIPE MATERIALS

It is not unusual for corrugated polyethylene pipe to be connected to other types of pipe materials. Available options depend on the joint duality required throughout the system and the particular combination of pipe materials. The pipe can be jointed by heating the pipe ends together, wrapping them with a geotextile, and pouring a concrete collar around them. Although such a connection is dependent on contractor expertise, it will generally limit soil intrusion but not provide a watertight joint. Watertight connections between different materials will require additional fittings and adapters. If those options are not acceptable, a manhole can be used to make the transition.

Pipe manufacturers are a valuable resource during the project planning stage since they are familiar with adapters that work well with their own products.

13.10 PLAIN END PIPE COUPLERS

1. Soil Tight Split Coupler – This is a clam Shell type coupler used in Non-Water Tight application. They are used on perforated or solid style CPP pipes at site where the native soil is stiff and cohesive enough to reduce the possibility of a loose soil infiltration into the pipe that could create a flow restriction.

2. Silt Tight Split Coupler – These are Calm Shell type coupler to which a gasket material has been added for the purpose of restricting Silt Infiltration into the pipe at a coupling joint. This non-water tight gasket material meets ASTM-D-1056, Grade 2A2 or ASTM-F-477. The installer should take care to remove all dirt and foreign matter from the pipe ends and gasket material to ensure a secure fit.

13.11 BELL & SPIGOT COUPLERS WITH “O” RING GASKETS

These couplers to impede or prevent the infiltration or infiltration of liquids in NON-PRESSURE application.

1. Bell & Spigot Couplers with “O” Ring Gaskets:- These couplers are produced on the pipe during the pipe extrusion process. Bell & Spigot pipes are available in 20-foot lengths, each coupler Spigot End comes with a non-pressure pipe water leak restriction gasket manufactured per ASTM-D-477. Should gravity flow pressure tests be required per ASTM-F-1417, one should not test until the pipes have been backfilled or restrained for safety.

2. Shear gasket gravity flow seal couplers: - These pliable couplers with stainless steel clamp- Grip Compression bands have been used for years connecting clay, concrete, steel and plastic pipes in all types of environments. They are impervious to normal water / sewer, chemicals, fungus growth and all other associated in – ground hazards. As with any coupler, before applying, insure that no foreign matter jeopardizes contact between the two surfaces.

3. Mastic Wrap Coupler:- Wrap around style mastic couplers have an outer layer of cross laminated polyethylene plastic and an under layer adhesive surface of rubberized mastic material. In between these two surface layers is a high strength shear and puncture resistant layer of woven polypropylene. This center third layer provides toughness against puncture as well as stretch resistance under earth load shifts or settlements. The Mastic wrap coupler is mechanically sealed by stainless steel screw type hose clamp compression bands. These adjustable compression clamp bands are easily secured using simple tools such as screwdrivers, nut drivers, or socket wrenches. Proper tension on those bands will provide a seal against infiltration and exfiltration in gravity flow, non-pressure pipes. Each mastic coupler comes with three hose clamp compression bands or ties located within the coupler. There is one compression strap located in the heat joint corrugation pipe valley, and one strap in the first valley on each side of the heat joint. Proper compression tension on each strap (centered over a corrugation valley) will forcibly apply the mastic surface around the corrugation crests and walls to provide a seal. Enough tension should be applied to substantially sink the compression straps into the corrugation valleys below the corrugation crests in order to have a leak resistant seal. Prior to applying the mastic side to the pipe be sure to clean the pipe of soil/dust particles that could interfere with the mastic seal making contact with the pipe surface. Mastic couplers can also be used to couple corrugation pipes manufactured with different corrugation designs of the same pipe size as well as to couple pipes to other pipes made from a different raw material base.

13.12 UNLOADING

- a) The Contractor should set aside an area for products to be stored on site.
- b) This area should be flat, free of large rocks, rough surfaces and debris.
- c) It should also be out of the way of construction traffic.
- d) Pipe may be delivered either palletized or loose, depending on the type and quantity of product.
- e) Pallets may be unloaded with a backhoe, forklift or other piece of equipment and a nylon sling or cushioned cable.
- f) The sling should be wrapped around the pallet at the third points as it lifts the pallet onto the ground. As an alternative to using a sling to unload full pallets, the pallet may be opened and lengths of pipe unloaded individually be carefully rolling single lengths of loose pipe from the delivery truck onto the front end loader, then onto the ground.
- g) Alternately, the pipe can also be lifted using a nylon sling or cushioned cable at the third points.

- h) End handling with a forklift MUST NOT be used as pipe damage will occur.
- i) Due to joint weight, larger diameter pipes should not be off loaded by hand.
- **JOB SITE STORAGE**
- a) Reasonable care should be used in handling pipe.
- b) The pipe should not be dropped, dragged or bumped against other pipe or objects.
- c) Palletized pipe should remain in the pallet for jobsite storage.
- d) Non-palletized pipe can be stockpiled for temporary storage in a flat debris-free area out of the way of construction traffic.
- e) Begin the stockpile with secured timbers spaced the width of the proposed stockpile at a distance not exceeding the third points.
- f) For pipe with attached bells, a recommended stacking method is to alternate the direction of the pipe lengths so that the bells are not stacked on each other.
- g) As upto three pipes can be laid before alternating directions. Subsequent layers should follow the same pattern as the first but with fewer sticks of pipe in each row.
- h) For smooth interior pipe, storage space can be minimized by nesting smaller diameters into large diameter pipe.
- i) Factory installed gaskets on the spigot should be protected by positioning them between corrugations.

13.13 STRINGING THE PIPE

- a) Placing the pipe and accessories along the open trench, or “stringing” Can save handling time.
- b) Each pipe length should be laid on a level surface as near as possible to the trench on the side opposite the excavated trench material; allow some space between pipe to protect pipe ends.
- c) The pipe should be out of the way of any equipment in a location that will allow excavation to proceed uninterrupted.

• LOWERING, LAYING OF PIPES

- a) Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Project Manager shall be laid.
- b) While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones.
- c) PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done
- d) When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.
- e) However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus site conditions study is necessary to ensure the avoidance of flotation.
- f) Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

13.14 JOINTING OF PIPES

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as specified above shall be selected considering site and working condition, pressure and flow of liquids

13.15 JOINTS

Elastomeric sealing rings shall be free from substances that can have a detrimental effect on the pipes or fittings used in conjunction with pipes.

The design of the profile and dimensions of the sealing ring is left to the manufacturer, as long as the pipe with the sealing ring meets the requirements of this standard. Where the design of the socket is such that the ring is not firmly fixed in position, the housing for the ring shall be so designed as to minimize the possibility of the ring being dislodged during insertion of the pipe (or spigot or fitting) to complete the joint. Elastomeric sealing rings shall be in accordance with one of the type (Type 1 to Type 6) of IS 5382. The manufacturer should specify the type of sealing ring (namely Type 1, 2, 3, 4, 5 or 6) that is being offered.

NOTE — A test report or conformity certificate may be obtained from the manufacturer of the sealing ring for conformity to IS 5382.

CHAPTER 14 - APPURTENANCES

14.1. GENERAL:

All valves shall be double-flanged valves of Indian manufacture and in the size range 50mm to 300mm conforming to IS: 14846 – 2000 or any other national standard equivalent or higher than the Indian Standards mentioned. The materials used in construction, the design and all other relevant features shall be such that the valves are entirely suitable for use of force mains. Valves shall be of suitable pressure rating which shall not be less than twice the normal operating pressure.

14.2. DESIGN:

The design of the valves will be such that erosion, cavitation, vibration and head loss (in the fully open position) shall be a minimum.

14.3. SLUICE VALVES:

Sluice valves shall generally conform to IS: 14846 - 2000. Valves should close with clockwise rotation of the hand wheel. The direction of closing should be marked on the hand wheel. Valves shall be flanged (flat faced) and drilling shall conform to IS: 1537.

14.3.1. MATERIALS OF CONSTRUCTION:

Body	-	C.I. to IS: 210 Gr. FG 200
Wedge	-	C.I. to IS: 210 Gr. FG 200
Seat Rings	-	Bronze / SS 304
Channel lining	-	Gun Metal
Shoe	-	Gun Metal
Spindle	-	SS A1S1 431

Parameters:

Quantity	-	As per Bill of Quantities
Size	-	As per Bill of Quantities
Rating	-	10 Bar (PN 1.0)

Shop Testing Witnessing:

Seat leakage test	-	10 bar (1.0 M Pa)
Body Hydrostatic test	-	15 bar (1.5 M Pa)
Back Seat Leakage test-	-	15 bar (1.5 M Pa)

14.3.2. VALVE BODIES:

a. Castings:

The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surface of casing which are not machined shall be smooth and shall be carefully filed to remove all foundry irregularities.

b. Forgings:

All major stress bearing forgings shall be made to a standard specification, which shall be submitted if required to the Engineer for approval before work is commenced. Forgings shall be subjected to non-destructive tests to detect flaws if any. Forgings shall be heat treated for the relief of residual stresses. The name of the maker and particulars of the heat treatment proposed for such forging shall be submitted to the CMWSSB. The Executive

Engineer or his inspector may inspect such forgings at the place of manufacture with a representative of the Contractor.

c. Workmanship:

Workmanship and general finish shall be of first class commercial quality and in accordance with best workshop practice.

All similar items of the valve and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall be accurate and to specified tolerances so that replacements made to manufacturer's drawings may be readily installed.

All parts, which can be worn or damaged by dust, shall be totally enclosed in dust proof housings.

d. Protective coating:

Protective coating shall comply with IS: 14846 - 2000.

14.3.3. LUBRICATION:

All the points where lubrication is needed, the Contractor shall furnish full details of the method to be employed. The supply of the requisite lubricating equipment and lubricants for commissioning and operating and maintaining the valves shall be furnished.

14.3.4. FLANGES:

Valves of sizes 80mm – 300mm shall have flat flanges as per IS: 1538 Part IV Table – I. The flange-to-flange distances shall be as per IS 14846.

14.3.5. JOINTING MATERIALS:

Each valve shall be supplied under this Contract, with all requisite joint rings, nuts, bolts and washers for making the joints on all the valves to be installed under this Contract. Jointing material between the connecting flanges shall conform to the relevant IS code. Unless otherwise specified bolting used for jointing exposed connections shall be of carbon steel, conforming to IS: 210 Grade 20 Grade B, with galvanized finish.

14.3.6. FACTORY TESTS:

All the valves shall be tested at the factory for smooth, trouble free operation and operating torque requirements by operating between fully open and fully closed position three times.

The hydrostatic tests shall consists of

Closed End Tests where valve is held on both sides. Each valve is subjected to three hydraulic tests.

a. Wedge open and pressure applied for 5 minutes to the whole body of the valve pressure given in Section 19.4.

b. Second Test shall be applied to one face with pressure given in Section 19.4.

c. Third Test shall be similar to second, but pressure applied to the other side of the wedge with same pressure.

For valves having terminal position shall be subjected to open-end test.

Testing for valves from Foreign Manufacturers:

- i) Sampling: Each valve is recommended to be tested.
- ii) Testing and Inspection: For foreign manufacturer: The testing and inspection procedure in this case shall confirm with respective equivalent code.

14.3.7. AIR VALVES

14.4. Constructional Features:

Double ball air valves shall be of the kinetic, double orifice type able to release air in small quantities under pressure and in large quantities during filling. They have to allow for large inflow of air during emptying. The type and locations shall be fixed according to the detailed design and after approval by the Engineer in charge. The valves shall have an integrated sluice valve. If required, they shall be installed on a flange welded on the MS pipe / special. The possible air velocity (inflow and outflow) must be at least 20 m/s.

Materials of Construction & Pressure Rating:

Body	CI to IS Gr. FG 200
Cowl	CI to IS Gr. FG 200
Valve seat, nut	Leaded tin bronze
Spindle	SS. AISI 304
Orifice	SS. AISI 304
Ball	Seasoned teak wood, covered with neoprene rubber
Ball seat	Anti-stick material such as nitrile rubber or equivalent
Pressure	Suitable for 16 Kg / sq.cm, Working Pressure.

14.5. REFLUX VALVES

14.5.1. Constructional Features:

Reflux valves shall comply with BS.5153 and be double flanged cast iron unless otherwise specified.

Valves shall be of the quick action single door type, designed to minimise slam on closure by means of heavy gunmetal-faced doors weighted as necessary. The valves shall be fitted with positively fixed renewable gunmetal door sealing faces. The door hinge pin/shaft shall extend through a sealing gland on the side of the body, and be fitted with an external lever to permit back flushing.

Gland shall be of the stuffing-box type with the exception that for valves below 450mm bore they may be of the 'O' ring type.

The valve door shall be weighted to suit the application and the lever shall be of the heavy duty type designed for the addition of external weights.

All reflux valves shall be suitable for operating in the horizontal plane unless otherwise specified. Covers shall be provided to allow ample access for cleaning and service and shall be supplied complete with tapped bosses fitted with air release cocks.

Valves above 350mm, bore shall be provided with feet.

The design of the valve body shall be such that there is adequate clearance around and at the back of the door to minimize jamming by rags and debris. Stops shall be provided to limit the back life of the door, these shall be positioned to prevent fouling.

The hinge pin/shaft shall be stainless steel and square in section, to ensure positive location of the door. If circular shafts are utilized, the back flushing lever shall be located on a squared section, the diagonal dimension of which shall be equivalent to the full diameter of the shaft. Both door and lever shall be positively and securely fixed to the hinge pin/shaft. Grub screws, pins (parallel or taper) or clamps will not be acceptable. All internal fixing devices shall be of stainless steel.

Valves shall carry identification marks and/or plates in accordance with BS.5153.

Valves shall be sized, such that the velocity through the valve when fully open does not exceed 2.25 metres per second at the rated throughput. They shall have flanges to BS.4504 NP.16 and shall be capable of withstanding the same test pressures as the pipeline on which they operate. All nuts and studs subject to vibration shall be fitted with spring washers or locking tabs.

All materials used in the manufacture of reflux valves shall conform to the following minimum standards:-

Cast Iron	IS : 210	Grade FG 200
Gunmetal	IS : 318	Grade 2
Stainless Steel	IS : 6603	Grade 431S29

14.6. PENSTOCKS

14.6.1 General

Penstock shall be suitable for their application, the liquid being passed and shall be installed and positioned in such a manner as to allow ease of operation and maintenance.

Penstocks shall carry identification marks and/or brass plates in accordance with BS.5153 which identify the penstock number and function.

All penstock shall be clockwise closing.

All materials used in manufacture of the penstocks shall conform to the following minimum standards unless otherwise specified.

Cast Iron	BS 1452	Grade 220
Gunmetal	BS 1400	Grade LG25
Aluminium Bronze	BS 2872	Grade CA 104
Stainless Steel	BS 970 Pt.1	Grade 316 S31
High Tensile Brass	BS 2874	Grade CZ 114

(Manganese Bronze)

Manganese Steel BS 970 Pt.1 Grade ISOM19

Phosphor Bronze BS 2574 Grade P13

Austenitic Ni resist

Cast Iron BS 3468 Grade F3 with 3% Nickel

Fixing nuts and bolts supplied by the manufacturer shall be of stainless steel.

Each penstock shall be provided with a suitable hand wheel of adequate diameter for the duty required. Gearing shall be supplied where necessary.

i) To ensure that the required operating force applied by hand to the rim of the wheel does not exceed 25 Kgf.

ii) If the hand wheel cannot be readily accessed, extension spindles, head stocks and foot brackets shall be provided where specified.

iii) Where possible, the extension spindle shall be of the rising type with the threaded portion positioned above top water level.

iv) Head stocks for non-rising spindle installations shall incorporate a position indicator.

Hand wheels shall have smooth rims and the direction of closing which shall be clockwise shall be cast on them. Vandal and weather proof clear polycarbonate tube covers shall be securely fitted to protect the threads of rising stems and spindles. Tubes shall be clearly and permanently engraved to indicate the position of the value.

Penstock spindles shall be forged aluminium bronze or stainless steel, machined all over, with a machine cut robust trapezoidal or square form thread, operating in a gunmetal nut.

Extension spindles shall be of stainless steel and shall be complaint with requirements for penstock spindles. Extension spindled couplings shall be of the muff type and shall be drilled and provided with a nut and bolt for securing the spindle to the penstock spindle, which shall likewise be drilled to accept the bolt.

Extended spindle installations of the rising type shall be provided for valves of 300mm bore and above, and for all motorized/actuated penstocks. Thrust tubes shall be provided between the Penstock frame and head stock to absorb the thrust in both directions of operation. Thrust tubes shall incorporate all necessary fixing brackets and spindle guide plates.

Where penstocks are required to be operated by tee keys, spindle caps shall be fitted. The caps shall be drilled and each provided with nut and bolt for securing to the spindle which shall likewise be drilled to accept the bolt. Where caps are fitted they shall be supplied complete with operating tee key. The extended spindle shall be such that the tee key will be operated at 0.9-1.2 metres above floor level.

14.7. MANHOLES

Manholes shall be constructed on the sewers in the positions shown in the drawings or in such position as the Engineer may direct. The work shall be done strictly in accordance with the detailed drawings except where alterations are required by the Engineer. The excavation shall not be larger than sufficient to admit of the trench being properly timbered and to facilitate plastering outside.

The bottom of the excavation shall be properly leveled up, rammed and a bed of concrete laid thereon. When the concrete has sufficiently set the construction of the brick walls shall then be proceeded with and all stoneware pipe connections through the walls shall be made and all ironwork fixed in as constructions proceeds. Manholes less than 2.5m from invert of sewer to ground level shall be built rectangular and shall have a flat top constructed as shown in the drawings, Manholes more than 2.5m from surface to invert shall be built circular and the walls corbelled as shown in the drawings.

The inside of all manholes shall be plastered with cement mortar 20mm thick and the outside of all manholes with cement mortar 12 mm thick. The manholes bottoms shall be properly formed with stoneware channels fixed in cement mortar. The channels shall be neatly formed to the radius of the pipe and all side connection curved and channeled to admit the sewage to enter at an angle of 45 degree to the line of flow. Manholes shall be topped with a circular cast iron frame with cover or cover of such pattern may be ordered by the Engineer. The manhole frame shall be fixed to the top of the brick work by a layer of cement mortar.

Where pipes pass through walls of manholes relieving arches shall be turned neatly over the upper half of the pipes. If any pipe enters at such an angle that a relieving arch cannot be properly turned the bricks shall be carefully cut and laid so as to fit closely and neatly against the pipe, and a R.C.C. lintel shall be provided to avoid load of the walls being transmitted to the pipes.

The stoneware drop pipe connection in manholes shall be secured to the wall of the manholes by suitable clamps and shall be built in as the work proceeds in accordance with the drawings and the above instructions. The cost of this work will be paid separately.

PVC encapsulated Cast Iron steps shall be built in each manhole as the work proceeds one being inserted to every four courses of brick work, horizontal distance centre to centre of each row being 300 mm.

The Contractor shall include in his prices for completing all manholes in accordance with the drawings.

The manhole shall be provided with extra heavy duty FRC manhole cover frame of size 600mm dia for rectangular and circular type manholes.

For all surfaces wherever there is a possibility for contact with sewage Sulphate resisting cement (SRC) shall be used for plastering, finishing, joining etc....

14.8. CHAIN PULLEY BLOCK

The Chain pulley block shall be of the following specifications:

Sl. No.	Description	
1.	Type	Manually operated Balanced Spur Gear type
2.	Duty Class	Class 11, IS:3832
3.	No of Hand Chain Falls	Endless
4.	No of Load Chain Falls	1

5.	Effort on Hand Chain to raise full working load For Bush Bearing type (kg)	51
6.	For Ball Bearing type (kg)	44
7.	Type of Load Brake	Ratchet & Pawl Arrangement
8.	Hand Chain Details	Through pocketed hand chain wheel guided by hand chain guard
9.	Load Chain size (d x p x w)	12.5 x 35.2 x 40
10.	Load chain material	Grade 40, IS:3109 (Part II)
11.	Hand Chain size (d x p x w)	6 x 26.5 x 21
12.	Hand Chain Material	Grade 30 as per IS:2429 (Part II) and IS: 3832
13.	Load Chain Material & Grade	Spheroidal Graphite Iron, IS: 1865 400/15
14.	Hand Chain Wheel	Cast iron, Grade 25, IS: 210
15.	Gear	En9 /En8 - Case Hardened & Tempered
16.	Pinions	En32B - Case Hardened & Tempered
17.	Rate net Wheel	En 8 - Hardened, Tempered & Ground
18.	Hooks	Conforms to IS: 8610 (Material: Class II, IS:1875
19.	Frames	M.S. IS: 2062 Gr A

CHAPTER 15 - FIXING OF VALVES

15.1 FIXING OF SLUICE VALVES:

15.1.1 General:

The specification lays down the requirement for lowering, laying and jointing Sluice valves.

15.1.2 Preparation:

The sluice valves and tailpieces shall be examined before laying for cracks and other flaws. Only undamaged S.S. shall be used.

The sluice valve shall be operated and checked before laying. All grit and foreign material shall be removed from the inside before placing. All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease. 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 on all sides.

15.1.3 Jointing Materials:

The Contractor shall provide all the necessary jointing materials such as nuts, bolts, rubber packing, white zinc, jute, lead wool etc. at his cost. All tools and plant required for installation of sluice valve shall be provided by the Contractor at his cost. All the jointing materials shall be got approved from the Engineer in charge before use. The nuts and bolts shall conform to IS: 1364 and the rubber packing shall conform to IS: 638.

15.1.4 Installation:

The sluice valve shall be lowered into trench carefully, so that no part is damaged during lowering operation. If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered into the trench.

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 valve bore. It shall be even at both the inner and outer edge. The flange faces shall be thoroughly greased. If flanges are not free the Contractor shall use thin fibers of lead.

After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.

The valve shall be tightly closed being installed to prevent any foreign materials from getting in between the working parts of the valve.

Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternately.

The sluice valve shall be installed in such a way that spindle shall remain in truly vertical position. The other end of the tailpiece shall be fitted with pipes so that continuous lines can work. Extra excavation necessary to facilitate the lowering and fixing of sluice valve shall not be paid for.

15.1.5 Testing:

After installation of sluice valve the same is tested to 1 ½ times of its test pressure. The joints of sluice valve shall withstand the test pressure of pipeline. 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.

15.1.6 Mode of Measurement and Payment:

The measurement shall be taken per number of sluice valves of specified size and payment shall be on number basis for providing and fixing.

15.2 FIXING OF AIR VALVES:**15.2.1 General:**

The specification placed down requirement for lowering laying and fixing Air Valves.

15.2.2 Preparation:

The air valves and the isolating valves shall be examined before laying for cracks and other flaws. Only undamaged air valve shall be used. The air valves shall be opened and shaken for the air opening below the vulcanite balls on the bronze seats of the balls before fixing. All grid and foreign material shall be removed from the inside before placing. The flanged face shall be thoroughly cleaned and coated with a thin layer of mineral grease. In case of screw down type, the threads shall not be in damaged condition.

15.2.3 Jointing Materials:

The Contractor shall provide all the necessary jointing materials, such as nuts, bolts, rubber packing, white zinc jute, lead wool etc. at his cost. All tools and plant required for installation of air valve shall be provided by the Contractor at his cost. All the jointing materials shall be got approved from Engineer in charge before use. The nuts and bolts shall conform to IS: 1364 and the rubber packing shall conform to IS: 638.

15.2.4 Installation:

The air valves shall be fixed on a branched flange Tee on the main pipeline. The air valve and isolating sluice valve shall be housed in a chamber.

15.2.5 Testing:

The specification pertaining to sluice valve shall also apply to air valves.

15.2.6 Mode of measurement and payment:

The measurement shall be taken per number of air valves of specified size and payment shall be on number basis for providing and fixing.

15.3 Fixing scour valve

Scour valves shall be fixed at places shown in the drawings or as directed by the Engineer, and the scour connections from the main carried out completely as per drawings.

15.4. Masonry Chambers

Chambers for sluice valves, inspection branches scour valves, air valves shall be constructed on the pipes in the positions as shown in the drawings or in such positions as the Engineer may direct. The work shall be done strictly in accordance with the detailed drawings or as ordered by the Engineer. The excavation shall not be made lower than necessary to admit of the earth being properly timbered. The bottom for the excavation shall be properly leveled up rammed and a bed of concrete laid thereon. When the concrete has sufficiently set the building of the brick walls shall then be proceeded with and all iron work fixed in as the building proceeds. The inside of all chambers shall be plastered with cement mortar 20 mm thick and the outside with cement mortar 12 mm thick. The Chamber shall be topped with pre-cast R.C.C. slab by a layer of cement mortar of the sides of the surface box or valve cover covered over with cement concrete.

Where pipes pass through walls of chambers relieving arches shall be turned neatly over the upper of the pipes or R.C.C. lintels shall be provided to avoid load of the walls being transmitted to the pipes.

Cast Iron steps shall be built in each chamber as the work proceeds one being inserted to every 4 courses of brick work, horizontal distance center to center of each row being 30 cm.

The Contractor shall include in his rate for brick work cost for fixing steps, frame, cover etc., for completing all chambers in accordance with the drawings and with the above specifications, unless otherwise indicated.

15.5 FIXING OF FRC M.H. FRAME AND COVER IN RCC SLAB:

15.5.1 General:

The specification includes all requirements of fixing FRC M.H. frame and cover of specified size and weight in the RCC slab with locking arrangement. For fixing the FRC M.H. frame and cover of specified size and weight, the frame shall be fixed generally at the time of casting RCC slab with proper anchoring.

After fixing the M.H. frame and cover locking arrangement shall be provided as per following unless specified in the wording of the item. The size of the M.S. flat shall be 50mm x 10mm with M.S. bar U shape of 16mm dia. The U shape M.S. bars shall be properly embedded in the RCC roof slab and anchored. The FRC M.H. frame and cover and the locking arrangement after fixing shall be painted with anticorrosive black paint. The work shall be done to the entire satisfaction of the Engineer in charge.

15.5.2 Mode of measurement and payment:

The item shall include:

- a) All labour for fixing M.H. frame and cover
- b) All material and labour of locking arrangement
- c) Painting of the frame, cover and locking arrangement

ANNEXURE – (C)
(SPECIFICATIOIS FOR Electrical WORKS)

- **GENERAL SPECIFICATIONS**

GENERAL :

1. Equivalency of Standards and Codes

Wherever reference is made in the contract to specific standards and codes to be met by the materials, plant, and other supplies to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the contract. Where such standards and codes are national or relate to a particular country or region, other authoritative standards which ensure a substantially equal or higher performance than the standards and codes specified will be accepted subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure substantially equal performance, the Contractor shall comply with the standards specified in the documents.

2. Use of Trade Names

Wherever reference is made in the Contract to specific manufacture's or trade names the Contractor shall be entitled to substitute plant and materials supplied by other manufacture's or produce's. Such substitutions shall be to the approval of Engineer, which will not be unreasonable withheld. At the request of the Engineer the Contractor shall provide full evidence to establish that the substituted plant and material is equal to or better than that from the manufactures or supplied mentioned in the Contract.

3. Requirement of Statutory Authorities

The electrical equipment / installations shall comply with the requirements of Rules / Regulations as amended up-to-date, required by Statutory Acts or Authorities.

- The Indian Electricity Rules, 1956
- The Indian Electricity Act.
- The Indian Electricity (Supply) Act, 1948
- The requirements of Chief Electrical Inspector to the Government of Uttar Pradesh.

- The requirement of Uttar Pradesh State Electricity Board.
- Fire advisory Committee Insurance Act.
- The contractor shall get the drawings, layouts of HT substation etc. approved from chief Electrical inspector to the Govt. of UP, wherever necessary. The contractor also shall arrange to get the installation inspected by CEIG and carryout modifications/rectification as required by CEIG, prior to commissioning of substation/electrical equipment.

4. Voltage Regulation

During starting of heavy equipment the voltage may drop by a maximum of 15% for period of 45-60 seconds depending upon the duty of the driving equipment. All the electrical equipment shall, therefore, be suitable for trouble free and uninterrupted operation even during such voltage variation at the time of starting of heavy equipment.

5. Ambient Temperature

Where the equipment is installed outside and exposed to direct sunrays, these shall be suitable for operation at higher ambient temperature and rigorous weather conditions under which they are required to operate.

6. Power Factor

Suitable rating capacitors shall be provided to each individual motor above 1.5 KW rating along with discharge device of appropriate rating to improve the power factor above 0.95.

7. Approval by Fire Insurance Authority

The equipment supplied along with the accessories shall be those approved for use in Electrical installations by the Fire Sectional Committee, Central Regional Council of the Insurance Association of India.

8. Conditions of Operation

The equipment offered shall be suitable for continuous operation under high ambient temperature 45°C. Motors for outdoor installation shall be weather proof.

The switch board shall not be exposed to moisture or corrosive gases.

The Contractor shall submit layout drawings showing the location of switch board and other equipment proposed to be installed for the approval of Engineer.

9. HT Sub Station

In general HT substation shall be out door type. The transformer shall be suitable for outdoor type and installed on cement concrete platform, having coping level well above the flood level of that area. The contractor, depending on the capacity number of transformer to be installed, shall decide the size of the platform. In case of indoor substation, the transformer shall be suitable for indoor type. The transformer, HT / MV panel rooms shall be decided to suit the requirement.

9.1 Out Door Sub Station

- **9.1.1 H-frame Steel Structure**

H-frame galvanized steel self-supporting structure shall generally have the following equipments:

- Lightning Arrestors.
- Gang Operated A. B. switch
- DO Fuses
- String Insulators
- Pin Insulators
- ACSR conductors of appropriate sizes to connect all the equipment

- **9.1.2 Lightning Arrester**

Lightning arresters shall be provided on each 11 KV line before the termination on the 11 KV isolators in the switch yard. Lightning Arresters shall be suitably mounted on the H pole structure or 4 pole structure provided for receiving 11 KV supply as per IS : 3070 part 3.

The lightning arresters shall be station class as per I. S., Heavy duty design fitted with anti-contamination feature and pressure relief devices with current limiting gaps generally conforming to IS:3070 Part -3. The lightning arrester may be of 200 Amps capacity and short time current of 15 KA (rms) having a peak current of 38 KA, for 1 second duration.

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- **9.1.3 Gang Operated AB Switch**

The switches shall be provided with horizontal connecting bar, for gang operation, G.I pipe as down rod lever coupling and operating handle with padlock and other components necessary for complete assembly.

- **9.1.4 11 kV Drop-Out Fuses**

The 11KV drop-out lift off fuses shall offer protection against short circuit and suitable for use in conjunction with 11KV system having fault level of 500 MVA. The fuses shall be designed for vertical mounting. The fuse carrier shall comprise of insulating material tubes open at both ends. The fuse carrier shall drop down in the event of fuse blow-out in order to enable clear indication from long distance. Rewiring of blown fuse shall be possible from ground level. All other current carrying parts shall be of aluminium bronze. The glazed porcelain insulators shall conform to IS:731 and IS:2544. The complete fuse shall meet impulse voltage in accordance with IS:9385 : Part-1 : 1979 and IS 12534 : 1988. Each fuse shall be assembled separately and mounted on channel base. Rated current of the fuse shall be decided as per the requirement. The complete fuse unit shall withstand power frequency wet withstanding voltage in accordance with IS:1818.

A suitable insulated operating rod shall be provided with each fuse assembly. Two pairs of rubber hand gloves for working on 11KV shall be provided.

- **9.1.5 Insulators**

The disc, pin and post type insulators used shall be of high quality glazed porcelain. the electrical and mechanical characteristics shall conform to IS:731 and IS:2544. The insulators shall have following characteristics suitable for use in an effectively earthed system.

- System voltage : 11 kV
- Dry \ Wet one minute power frequency to withstand voltage: 35 kV
- 1.2/50 micro second impulse withstand voltage : 75 kV
- Power frequency puncture withstand test voltage on units : 1.3 times of the dry flashover voltage of the unit.

- Visible discharge voltage : 9 kV
- Total minimum creepage distance for post and disc insulator : 320 mm for post insulation
320 mm for disc insulation

9.1.6 Bus Bars and Jumpers

The Bus Bars shall be of aluminum Tubes / Flats of adequate size to carry continuous current and 13.1KA short circuit current for one second duration. The current density of Bus Bars, jumpers and inter connection shall be designed such that, the temperature shall not exceed 70°C and hot spot temperature shall not exceed 750 over an ambient temperature of 450 C. The terminations shall be through locked type clamps. The clamps and connections shall be suitable of withstanding the stress due to cyclic temperature variation as a result of variation in the low current. The bus bars are Tee shall conform IS 5561.

- **9.1.7 Fencing**

The fencing around the out-door transformer substation shall be at a distance of not less than 1.5 metre on all sides of the substation (pole structure and transformer plinths) to ensure free movement all-round. Fencing shall be with chain links with proper supports (concrete poles) for better look. The RCC posts shall be installed at 2.5 m centre to centre and of 2.75 m height. The posts shall be 100 mm square at top and 150 mm square at bottom, 2.15 m height above ground level and 0.6 m below ground level, fixed in cement concrete foundation in 1:4:8 with 40 mm size stone jelly. The foundation is of size 45 x 45 x 90 cm including sand filling of 15 cm height. The fencing shall be of chain link 75 mm size, 10 gauge. The height of fence is 2.0 m after leaving 75 mm gap from ground level including fixing the fence with the posts using GI binding wire etc. complete. A gate of width 2.45 metres shall be provided on one side of the fencing for easy mobility of transformers. Fencing shall be earthed properly covering all rows on all sides. Caution notices should be fixed one on the 4-pole structure and another on the gate. The sub-station shall be uniformly levelled and spread with 35 mm blue granite jelly to a depth of 15 cm or laid with PCC (lean mix) over a layer of sand.

10. Power Transformers

The HT transformers in general shall be oil filled and natural air cooled conforming to IS 2026 latest version. The transformer shall be suitable for out-door type or indoor type as per the requirement of a particular pumping station. Dry type transformer of indoor type may be considered for indoor substation as against oil filled transformers. The transformers shall be suitable for service under, voltage and frequency fluctuations permissible under Indian Electrical rules.

The transformer shall be non inflammable if there is any electric arc in the transformer winding and self-extinguishing.

10.1 Tanks

Transformers tank shall be manufactured from high grade steel plates suitably reinforced by providing stiffeners of structural steel. Tanks shall be provided with lifting lugs, so located that safe clearance is obtained between sling attached to the lifting / lug and transformer fittings without use of spreader. Four jacking pads shall be provided at appropriate locations so as to enable lifting of the transformer by jacks.

Main tank drain valve shall be provided with flanged connection at the bottom-most location of the tank to ensure complete drainage of the transformer oil. Two filter valves, one at the top end the other at the bottom of the tank shall be provided.

The tanks shall be so constructed as to prevent collection of water at any location.

All gasketed joints on the tanks such as Main tank cover, inspection manhole covers, bushings, mounting and other bolted attachments shall have high quality neoprene gaskets and so designed that the gasket will not be exposed to the weather. If necessary, suitable stops shall be provided to prevent crushing of the gaskets due to over tightening.

- **10.2 Tap Changer**

Off load tap changing links on HV side shall be provided. The tapping shall have variation on HV side plus or minus 5% in steps of 2.5 each.

The tap changer shall be electrically and mechanically rugged. Tap changer operating switch mounted on the top of the Transformer tank is not acceptable.

Provision of pad locking the tap changer without interfering with the visual tap position indicator shall be provided. Automatic tripping device shall be provided in the event of an in-advertent attempt to change the tap on load.

- **10.3 Transformer Cores**

The cores shall be constructed from high grade cold rolled grain oriented silicon steel laminations. The operating flux density shall be of the order of 16.5 to 17 Kilolines / cm². The design shall provide tank mounted core and the use of the core bolts shall be totally avoided for securing the core to the tank. Suitable arrangement shall be provided for lifting the core and winding for inspection.

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- **10.4 Windings**

The transformer windings shall be of Electrolytic copper conductors. Completed windings shall be subjected to vacuum impregnation. The temperature rise of the windings of the transformer shall not exceed 90⁰ C. The temperature of the core metallic parts and adjacent materials shall in no case reach a value that will damage the core itself, other parts or adjacent materials.

- **10.5 Conservators**

Conservators shall be fitted with filling hole with cap and drain plug. The conservators shall be connected to the highest point of any part of the transformers and associated equipment to which it may run. A dehydrating breather shall be fitted to the conservators. The breathers shall be designed to ensure that external atmosphere is not in contact with the dehydrating agent. The transformers shall be supplied with first filling of dehydrating agent. Conservators shall be provided with prismatic oil level gauge on one of the faces which shall be clearly visible from ground level.

- **10.6 Radiators**

Radiators shall be either tubular or plate type. Each radiator shall be provided with air releasing plug, isolating valve and drain valve. The radiators shall withstand the pressure tests specified for the tanks to which these are fitted. Radiator earthing shall be as per IS:3043 - 1982.

10.7 Bushings

The bushings shall be of solid porcelain as per IS:2099 or oil filled porcelain type conforming to IS:335. The bushings shall have continuous metal stud or tube from end to end making intimate contact with either solid or liquid dielectric at all points throughout the length.

Porcelain used for insulator shall be of best electrical quality, sound, free from defects and thoroughly vitrified so that glaze is not depended upon for insulation. The glaze shall be smooth and of uniform brown shade and shall completely cover the exposed parts of the insulators. The protected creepage distance shall be at least 50% of the total creepage distance.

- **10.8 Temperature Indicators**

Transformers shall be provided with oil temperature indicators which shall register the temperature of the top oil in the transformer tanks. the indicators shall be housed in the marshaling box of the transformers. The connection between the temperature sensing element mounted on the transformer tanks and the temperature indicators located in the marshaling box shall have adequate mechanical protection.

- **10.9 Marshalling Box**

Weather proof control cabinets of sheet steel construction shall be provided for accommodating all the control, protection and indicating equipment and terminal blocks, etc. Wiring from alarm and control equipment shall be carried out in conduits and terminated in the cabinets. Using 1.5 sq.mm shall carry out all wiring stranded copper conductors. All the terminal blocks in the control cabinets shall be of the screwed type of at least 10 sq.mm. size. Adequate number of spare terminals shall be provided in the control cabinets. Required number of power and control cable glands of appropriate size shall be provided on the gland plates of the control cabinets.

10.10 Insulating Oil

The transformer shall be supplied with insulating oil duly filled. The insulating oil shall conform to IS: 335. 10% excess oil shall also be supplied to account for loss.

10.11 Noise Level and Radio Interference

The radio interference voltage level shall conform to relevant NEMA standards. The sound level, when energized at normal voltage and frequency, shall not exceed the limits specified in NEMA standards, when measured in accordance with NEMA audible sound level test procedure.

10.12 Transformer Accessories

The transformers shall have the following Accessories:

- Off-circuit manual tap changing switch externally operated as specified and positioned on side of transformers accessible from the ground level;
- Conservator with drain plug, filling as specified.
- Explosion vent with diaphragm;
- Air-relief vents;
- Inspection cover on the tank covers for all transformers;
- Filtering connections with required valves;
- Following valves shall be provided:
 - Oil sampling valve - One No.
 - Oil Drain valve - One No.
 - Filtering valves - Two Nos.
- Grounding terminals, two for the transformers tank for clamping to purchaser's grounding grid connection;
- Lifting lugs or eyes for the cover top part of tanks, cores and coils, and for the complete transformers;
- Pulling eyes, for pulling the transformers parallel to and at right angles to the axis of bushings;
- Diagram and rating plate for transformers;

- Rollers
- Thermometer pockets with dial type thermometers for top oil temperature indication. The thermometer shall be clearly visible from ground level as specified:
- Weather proof control cabinet;
- Buchholz relay.

10.13 Transformers Testing

Testing of transformers shall comply with the requirements of IS:2026.

The following tests shall be carried out

- Measurement of winding resistance;
- Ratio polarity and phase relationship;
- Impedance voltage;
- Load losses;
- No-load losses and no-load current;
- Insulation resistance;
- Induced over voltage withstand;
- Separate source voltage withstand.

Type Tests;

- Impulse voltage withstand both chopped and fullwave;
- Temperature rise.

Unless otherwise stated by the Engineer, evidence of type tests carried out on identical transformers to those being provided under the Contract will be accepted in lieu of actual tests.

11. HT Switch Gear Panel

The HT Switchgear Panel shall be suitable for 3 phase, 11 KV, 50Hz AC system switch gear panel with all accessories complete in all respects conforming to latest design and practice and as per latest revisions of IS 3427.

The HT Switch gear panel shall have vacuum circuit breakers confirming to IS:13118 / IEC:56, of adequate capacity for incoming and outgoing feeder protective relays, measuring instruments, pilot lamps etc. The number of panels and the capacity of VCB, shall be decided as per requirement of individual pumping stations. In general the VCB Panel shall be indoor type unless otherwise specifically proposed to have out door type.

11.1 Bus Bars

Bus Bars and connections shall comply with IS 5082

Bus Bars and connection shall be made of high conductive aluminum strips shall run for the full length of the switch board. Total protection of bus bars with heat shrinkable sheathing, with PVC sleeves of appropriate phase colour in accordance with normal convention shall be provided. The bus shall be amply sized to carry the rated continuous current under the specified ambient temperature, without exceeding the total temperature of 85⁰ C. The current density in the bus bar shall not be more than 160 Amp per sq. cm.

The neutral bus bar shall be rated for 60% of the phase rating.

Bus bars and their connections shall be capable of withstanding without damage, the thermal and mechanical effects of fault current, equivalent to the short time rating of the switch gear.

Bus bars shall be contained in a separate compartment within the general casing of the switch gear with provision for extension at both ends. Bus bars compartment of each panel shall be separated from the compartment for the accommodation of switchgear component, by means of fire proof barriers. Between the panels and in all covers and doors neoprene gaskets shall be fitted, rendering the Board, dust and vermin proof.

11.2 Vacuum Circuit Breakers

The vacuum circuit breaker closing mechanism shall be provided with both manual and 240V single phase 50 Hz. motor charged spring capacitor type.

Tripping shall be effected by means of 30V DC shunt trip coil fed through stationery battery.

Each breaker shall be provided with visual, mechanised indicating device for open and closed position of Breaker. It shall be operative when the circuit breaker is in the Service, Test and isolated position. Operation counters shall be provided on each mechanism.

Means shall be provided for coupling the secondary circuits on the fixed portion to those on the movable portion, when the circuit is in Test position in order to permit closing, tripping and to check interlock circuit operation for test purposes.

It shall not be possible to render the electrical tripping feature inoperative by any mechanical locking device.

Each circuit breaker shall be provided with auxiliary switches, to interrupt the supply to the closing mechanism and to complete the trip circuit when the circuit breaker is in the closed position to cover all the necessary indication, interlocking and control facilities. Each circuit breaker shall be provided with 4 No. and 4 NC auxiliary contacts as spare, in addition to the other functional requirements.

11.3 Safety Shutter Device

A set of metallic shutters shall be provided to cover stationery isolating contacts. The shutters shall open automatically by a positive drive initiated by the movement of the circuit breaker. The closing operation shall also be automatic.

11.4 Labels

Labels shall be provided to describe the duty or otherwise identify every instrument or other items of equipment mounted internally and externally. Switch position shall be fully identified wording shall be clear, and unambiguous.

11.5 Earthing

All metal parts, other than those forming part of an Electrical circuit shall be connected to a hard drawn, high conductive 25 x 3 mm copper earth conductor on each panel unit. Earth bars of adjacent unit shall form a continuous earth bar, and any joints shall be tinned and bolted. Earthing facilities shall be provided in the incomer and outgoing circuit for discharging of bus bar and power cables., capacitor bank etc.

11.6 Equipment to Be Fitted in the HT VCB Panel

HT VCB capacity and characteristics varies as per requirement.

- 3 nos current transformer 1core class 1 for metering 1 core class 5P for protection.
- Potential transformer with 50VA burden 110V secondary
- Digital type ammeter with selector switch.
- Digital type Voltmeter with selector switch
- Digital type KVA meter with MDI on incomer panel
- Digital type Frequency meter on incomer panel
- Power factor meter digital on incomer
- Kwh meter (optional) TNEB normally provides.
- Microprocessor based digital combined IDMT and DMT relays for 2 over current and one earth with high set elements.

11.7 Current and Potential Transformers

The current and potential transformer for metering and protection shall be fitted with the standard accessories and will in general conform to IS:2705 and IS:3156 respectively.

11.8 Protective Relays

Relays shall be rectangular in shape, flush mounting type, having dust tight covers, removable from front, and shall be equipped with externally reset, positive action operation indicators. The relay shall have auxiliary units of either series connected or shunt connected type. All auxiliary relays shall be non-draw out type and protection relays shall be drawout type with test facilities.

Test plug shall be supplied loose. All relays shall conform to the requirements of IS:3231 and relevant IEC.

Relays shall be provided with adequate number of potential free self-reset / hand reset output contacts as required. Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance. Current transformer short circuiting arrangement shall be provided in case of draw out type relays.

Voltage relays shall have sufficient thermal capacity for continuous energization using external resistance, if necessary.

No control relay which will trip a circuit breaker when relay is de-energized shall be used.

All relays shall be suitable for operation at 30V DC control voltage and shall operate satisfactorily between 70% and 110% of the rated voltage. The auxiliary contact shall be rated to make and carry continuously at least 1 Amp. at 30V DC.

11.9 Inverse Definite Minimum Time Over - Current & Earth Fault Relay

Inverse definite minimum time over-current and earth fault relays shall be non-directional induction disc type with an operation indicator wherever necessary, an instantaneous high set unit, all assembled in one standard case. The damping shall be of permanent magnet type. The relays shall be provided with the plug settings on current coil and time multiplier to adjust the tripping time as desired.

The relay shall conform to IS-3231.

11.10 Under Voltage Relays

The induction disc type, single pole under voltage relay shall have inverse time voltage characteristics on all taps. The relay shall be designed to develop maximum torque at supply frequency and shall be in-sensitive to the voltages at harmonic frequencies.

The operating time shall be adjustable by time setting multiplier. Selection of the required voltage setting shall be possible by means of a plug setting bridge having an insulated plug. The relay shall conform to IS-3231.

11.11 Biased Differential Relay

The high speed biased differential relay for phase -to-phase and phase-to-earth fault protection shall be provided.

The salient features of the relay shall be as under :-

- The relay shall be electromagnetic/disc operated type.
- The relay shall be stable on heavy through faults.
- The relay shall not operate on normal magnetizing inrush currents.

The interposing CT s shall be used to balance the mismatch in the CT Ratio. The relay shall operate when the spill current exceeds 15% of the rated current and shall have 2/3 adjustable settings. Minimum two normally open contacts shall be provided.

11.12 High Speed Tripping Relay

The relay shall be low burden, fast acting, attracted armature type, with high degree of mechanical stability. The relay shall be suitable for number of simultaneous operations through hand reset auxiliary contacts.

12. LT Supply

The contractor shall ascertain the availability of LT supply from TNEB and to procure equipment accordingly.

12.1 MV / LT Panel

The medium voltage control panel or motor control panel shall normally have ACBs, MCCB and MCB as the case may be. The number of equipment and capacity of each equipment shall depend on the requirement of a particular pumping station. The Panel shall be made of 12 SWG (2.6mm) sheet steel for the front side and 14 SWG (2.0mm) sheet steel for bottom and other sides with powder coating for long life. Necessary neutral link block to be provided at required locations. These panels shall be front wired, front connected and provided with closing handles with ON and STOP mechanical indication having in built locking system so that back access would not be

required for inspection and maintenance. The enclosure shall be dust and vermin proof type. Since the entry of cables of the panel is generally from the bottom, the cable gland supporting plate shall be mounted not less than 300 mm above the floor level.

12.2 Air Circuit Breakers

The medium voltage cubicle type switch board shall consist of four pole Air Circuit Breakers conforming to latest revision of IS:13947 Part 2 / IEC:60947 Part 2. The breaker shall be manually draw out type in open execution with over current trip device adjustable 64% to 110%. Time setting for over load, adjustable current setting for short circuit protection and also earth fault protection adjustment facility shall be provided in the ACB.

ACB shall be fitted with following :

- Heavy duty switch having not less than 4 No. + 4NC contacts
- Built in resin cast current transformer
- Auxiliary contacts
- Shunt and under voltage tripping device
- Neutral CT for earth fault protection
- The ACB shall be suitable for locking the breaker in various position. Provision for door locking ACB shall be provided with the requisite end termination lugs/sockets. Terminal bars for connecting more than one terminal.

The ACB shall have breaking capacity not less than 35kA at 415V AC.

12.3 Moulded case circuit breakers

Moulded Case Circuit Breakers conforming to latest revision of IS:13947 Part 2 / IEC:60947 Part 2 shall be fixed type fitted with trip free, manually closing mechanism, accommodated in a sheet steel housing of robust and vermin proof construction matching with switch boards. All MCCBs shall be tested as per IS-2516 Part-1, Sec-1 and shall be provided short circuit and overload protection. (position of the knob shall clearly indicate ON, OFF and TRIP conditions).

12.4 Terminal Blocks

Terminal blocks shall be 650 V grade, 10 Amps., rated one piece moulded, complete with insulated barriers, screw type brass terminals suitable for stacking on C type rail and identification strips. Marking on the terminal strips shall correspond to wire numbers on the wiring diagrams. The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. Also CT secondary leads shall be provided with short circuiting and earthing facilities.

All spare contacts and terminal of panel mounted equipment and devices shall be wired to terminal blocks.

At least 20% spare terminal shall be provided on each panel, uniformly distributed on all terminal blocks.

12.5 Indicating Instruments

All electrical indicating instruments shall be digital square type of 144 sq.mm or 96 sq.mm according to the suitability of panel. These shall be suitable for flush mounting with only flanges projecting on vertical panel. Instrument dial shall be white with black numerical and lettering.

Instrument shall conform to IS - 1248 and shall have accuracy class of 1.00 or better. The current coil of ammeters and potential coils of voltmeters shall continuously withstand 120% of rated current and voltage, respectively, without the loss of accuracy.

The meters shall have external zero adjustments. The ammeters fitted in the motor circuits shall have suppressed scale to indicate the maximum starting current. The instrument shall be provided with glass cover to avoid the possibility of measurements due to static charge.

The three phase three wire trivector meter shall comprise of kWh meter and kVAR meter mounted together in one case with to register correct kVAR at all power factors.

All the meters shall have respective maximum demand indicators to record the average power over a period of half an hour. The trivector meter shall conform to relevant IS.

12.6 Equipment wiring

All the switch boards, panels, annunciator panel and mimic panel shall be neatly wired using 1100/660 volt grade PVC insulated stranded copper conductor cable of minimum 2.5 mm to suit the requirement. The wiring shall be bunched in groups by non-metallic clips or bands. Each group shall be adequately supported along its run to prevent sagging and strain on the terminals.

Sharp and tight bends shall be avoided. Each wire shall be identified at both ends by ferrules indicating the designation of the wire in accordance with the Schematic / wiring diagrams. The wire shall be terminated on the terminals of the relays, switches, instrument, conductors, lamps etc., or on the terminal blocks as the case may be. No joints shall be provided in between. Terminal blocks shall have screw type terminals which can take at least two wires per terminal on each side. At least 20% spare terminals shall be provided on each terminal block.

12.7 Interlocking Arrangement

The panels containing the MCCB / MCB etc. shall be enclosed in free standing steel sheet enclosure with front cover so interlocked with the isolator that the door cannot be opened with isolator at 'ON' position.

12.8 Inspection of Circuits

Facility for inspection of the circuits, to ascertain if all the Conductors, relays, fuses, etc. are in proper working order/condition or otherwise shall be provided by means of a push button or selected switch.

12.9 Labeling

Labels of switch gears shall indicate reference number of the switch, the specified current rating and the part of the distribution controlled. Labels on circuit breaker boards shall indicate the reference number of controlling switch. The lettering of all labels shall not be less than 5 mm, high. The schedule and details of the labels shall be submitted to the Engineer for approval.

12.10 Cable Entry

The cable entry shall preferably be from the bottom which shall be dust and vermin proof. The cable entry on each equipment shall be through a compression type cable gland. The cable gland plate shall be sufficiently strong to take the load of the cables and shall be mounted not less than 300 mm. above the floor level. The cables shall be suitably clamped before the cable gland to avoid any strain on it.

12.11 Painting

The panels shall undergo chemical derusting, sand blasting, degreasing, pickling in acid bath and phosphatized as per IS:6005 and primed. The panels shall be thoroughly rinsed with clean water after phosphating, followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed by the application of two coats of ready mixed, stoving type zinc chromate primer.

Two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The final finished thickness of the paint film on steel shall not be less than 100 microns and shall not be more than 150 microns. The colour for the finishing paint shall be bright battleship grey as per IS:5 (Shade No. 631). The finished painted appearance of panels shall present an aesthetically pleasing appearance free from dust and uneven surface.

The paint shall withstand humid tropical climate, rain, etc. The paint shall not scale or crinkle or removed by abrasion during normal handling.

Sufficient quantity for touch-up paint shall be furnished for application at site.

12.12 Low Voltage Bus Duct

The bus duct shall be three phase 4 wire non-segregated type suitable for 415V, 50Hz, AC supply. The bus duct shall be completely metal-enclosed and weatherproof with pitched roof for outdoor applications.

Design Requirements of Bus Duct:

The following parameters shall be considered and due care shall be taken while designing the bus ducts.

- Sizing of the bus bars vis-a-vis thermal capability to withstand rated continuous current and one second short time current.
- Spacing of the insulators vis-a-vis, mechanical strength to withstand forces due to normal operating current, momentary short circuit current and seismic forces.
- Calculations for bus duct support to withstand seismic forces.
- Heat loss and temperature rise calculations for conductor and enclosure

12.12.1 Bus Enclosure

The shape of the bus duct enclosure shall be square or rectangle and made of steel Grade 'O' as per IS 513. The enclosure of bus – duct shall be of 12 SWG electro galvanised sheet steel of minimum thickness of 2.5 mm bolted on to an angle iron / structural steel framework.

The bus duct shall be painted, after suitable pretreatment of all structural steel and plates, with anti-corrosive epoxy base primer paint & two coats of anti-corrosive epoxy base paint externally with approved colour and dried in a oven. Inner surface of the bus – duct shall be coated in the rubber paint.

The design of the bus duct enclosure shall be such that it will withstand the internal or external pressures resulting from (a) normal operating conditions, (b) momentary short circuit currents (peak) and (c) seismic forces.

The entire bus duct shall be designed for outdoor / indoor installation with adequate protection against dust and vermin. The enclosure shall conform to IP: 55 for outdoor and IP: 54 for indoor, as per Indian Standards.

Dust excluding gaskets of neoprene shall be used for enclosures to ensure water and dust tightness. Drain plugs shall be provided at the bottom of the bus – duct, at lowest points to drain out any moisture condensing within the bus enclosure. The drain plugs shall be fitted with porous filter elements which will permit the escape of

moisture but prevent the ingress of dust. The filter element shall be easily removable for cleaning purposes. The bus –duct shall be provided with silica gel breathers, in all sections.

Connection of the bus duct to the equipment like transformer, Generator, Panel boards etc. shall be made with provision of flanged joints. It shall be the bus duct manufacturer's responsibility to match the bus duct connection flanges to switchgear and transformers. If necessary, dimensions and details of the connecting equipment flange connections may be furnished to the manufacturer by Contractor.

Provision of inspection covers at suitable intervals shall be made for periodic inspection of insulators and conductors. Dust excluding gaskets of neoprene shall be used for these inspection covers to ensure water and dust tightness.

Care shall be exercised to ensure that covers and flanges fit easily that the required compression of gaskets can be obtained without damaging the inspection covers by bolts and that covers do not bend after this compression has been applied. Over compression of the gaskets shall be avoided.

Space heaters rated 240 volts AC, operating at 120 volts AC, shall be provided in all outdoor bus duct to prevent condensation. The space heaters shall be completely factory wired with no exposed wiring inside the bus housing. Heaters shall be thermostatically controlled.. The entire circuit shall be wired to an accessible terminal block providing for a single connection of the external power source. Space heaters shall be accessible from the outside of the bus duct. A drip shield shall be provided over the space heater opening to prevent entry of water into the enclosure.

The bus – duct shall be supplied with suitable earth bus running all along the length of the bus – duct made of suitable size copper strips / GI flats and shall be painted with green colour. All bus duct supporting structures shall be securely connected at two points to the earthing bus running along the bus duct.

A fire resistant divider or barrier shall be provided at all points where the bus duct extends through the building wall. The barrier shall have a minimum rating of (3) three hours.

All nuts and bolts shall be mild steel electric galvanized. GS spring washers shall be provided for making satisfactory joints. GS clamps space plates shall be provided wherever necessary.

12.12.2 Bus Conductor

The bus bars shall be hard drawn, high conductivity, electrolytic grade aluminium flats as per IS: 5082. The bus- bars shall be of uniform cross section along its entire length. No tapering of the bus bars' cross-section is allowed.

The bus bar arrangement shall generally conform to IS: 5578 and IS: 11353. The clearance between the individual bare phase power bus – bars and between the phase and earth bus –bars in air shall be not less than 25 mm and 19 mm respectively.

The bus conductor shall be designed to carry the rated current under normal site operating conditions without exceeding a hot spot temperature of 70°C. Also the temperature of the bus shall not exceed 250°C while carrying the short circuit current for one second when a fault occurs at the operating temperature. The losses in the conductor shall be limited to such a value that the temperature rise of the conductor does not exceed the specified values.

Except at bolted terminations the bus bar shall be insulated with flame retardant, epoxy insulation. All bus bar connections shall be bolted, accomplished by bolts passing through the bus bar conductor capable of being torqued and locked in place to provide and maintain full and uniform pressure under all operation conditions.

The bus shall be supported with rigid, high dielectric strength, resin bonded self-extinguishing, fungi and fire retardant, and non-hygroscopic insulating supports preferably of SMC / DMC with ribbed construction to prevent tracking due to dust paths, capable of withstanding the mechanical forces imposed by short-circuit currents equal to the momentary current. They shall permit free longitudinal movement of the bus bars during expansion and contraction. The spacing between consecutive bus – bar supports shall not exceed 500mm. The insulating supports shall have a high creepage distance and a withstand voltage rating sufficient to provide specified insulation under highly humid conditions.

The bus – bars shall be supplied with flexible expansion joints at both the ends and also at bends and along the length wherever necessary to take care of expansion and contraction of the bus bars under normal operating conditions. The supports and expansion arrangement shall be so chosen to avoid undue stress to the bus – bars, supports and end connections.

The busbars shall be phase identified by colour, at intervals. Colour code shall be RED, YELLOW and BLUE for phase and BLACK for the neutral bus – bar.

12.12.3 Jointing of Bus Bars

The joints in the bus – bars shall be of the bolted type and it shall be ensured that the following precautions are observed.

- The contact pressure must be ample and this shall be maintained during the time the panel is in service.
- The surfaces of the conductors must be clean.
- With flat conductors, the overlap should be equal to or greater than the width of the bars or ten times the thickness of the bar whichever is greater.

- The joints shall be treated by the application of joint compound to render the joint moisture-proof.
- For the joints use of bolts of cadmium plated high-tension MS bolts having expansion characteristics due to temperature change similar to the conductor may be used with steel nuts.
- Smearing the surfaces with oxide inhibiting grease shall be done just prior to making the joint in order to preserve the efficiency of the joints. Minimum phase and earth clearance required shall be maintained at joints. The joints shall be thoroughly shrouded.

Flexible braided tinned copper connectors shall be provided at the equipment terminal connections. Bimetallic connectors shall be provided between the bus bar and the flexible copper connectors. The joints shall have the flexibility to cater for 25mm settlement of the equipment mounting pads. The joints shall be suitably designed to take care of the vibration at the terminals as well as the expansion and contraction of the bus bars.

12.12.4 Bus Duct Supporting

The supporting structures shall include supporting members, brackets, hangers, longitudinal beams, channels, nuts, bolts, insulating pads, insulating washers and all other hardware which are necessary for the erection and support of the entire bus duct installation.

All the accessories and hardware of ferrous material shall be hot dip galvanized. Structures are to be galvanized both inside and outside after all cutting, punching, welding and cleaning have been completed. Average weight of zinc coating per unit area shall be at least 460 g/m^2 . Finished galvanized surfaces must be uniform in color, appearance and texture and must be free of excessive roughness, pimples, lumpiness and runs.

The indoor bus duct shall be supported from the ceiling or wall and the interval of the supports should not exceed 1.5 meters. Outdoor Bus Duct supports spans shall be 12 feet or less when free standing.

12.12.5 Miscellaneous

Studs, nuts, bolts and tapped holes shall conform to the relevant standards. Only hexagonal nuts shall be used. All bolt holes shall be spot faced for nuts.

All components of the bus duct along with the supporting structure shall be distinctly marked for erection in accordance with the erection drawings to be prepared and furnished by the Contractor. These marks shall be made in a manner as not to be obliterated and erased in transit or to damage the galvanizing of the bus duct or the supporting structure.

Each assembly of bus duct shall be supplied with a weather resistant name plate, detailing: Nominal Voltage rating, Insulation rating (Withstand and BIL), Frequency

rating, Continuous Current rating, Short-circuit Current rating, Temperature Rise of conductor(s) and enclosure, Manufacture date, and Manufacturing ID number.

13. Motor Control Panel

The motor control panel shall have the following equipment.

- Main switch fuse or MCB, MCCB with required capacity in case of 415V motor pumps sets.
- ACB or suitable circuit breaker to suit the motor capacity and voltage in case of HT motor pump sets.
- Motor starter - Auto transformer / Star Delta.
- Contactors
- Single phase preventer
- Ammeter with selector switch
- Voltmeter
- Pilot lamps for indication
- Trip Alarm
- Stop push button
- Start Push Button
- Addition equipment if any

13.1 Push Button Operated DOL Starter

DOL starter shall be of double break type and shall incorporate air break contactor with bimetallic thermal electromagnetic overload relays on all three phases with start/stop push button in front of switch board. The starter shall be capable of 10 operations per hour. The DOL starter shall conform to IS-13947 – Part 4 – Sec 1 (IEC 947-4-1 -1990).

13.2 Star / Delta Starter

The push button operated Star Delta Starter shall be of the fully automatic type with an adjustable timer incorporated for automatic change-over from Star to Delta. The starter shall incorporate the electromagnetic or thermal type bimetallic overload releases, pneumatic electro time delay relay, the solenoid coil operated under voltage release and current operating single phasing preventor. The starter shall be capable of 10 operations per hour. The starter shall conform to IS-13947 – Part 4 – Sec 1 (IEC 947-4-1 -1990).

13.3 Auto Transformer Starters

The auto transformer starter shall be of the fully automatic type. For auto transformer starting, magnetically operated starting, accelerating and running contactors shall be provided either, operating under solid state or electronic timing devices. The auto transformer shall limit the starting current to 1.5 times full load current for motors upto 100 HP and 1.25 times full load current for motor above 100HP with appropriate tapping. The auto transformer shall be provided with one under voltage coil, three magnetically operated overload coils, and a single phasing preventer relay. One ammeter of ample capacity to take care of the starting current shall also be provided in the starter. The starter in general conform to IS-13947 – Part 4 – Sec 1 (IEC 947-4-1 -1990).

13.4 Soft Starters

The Low Voltage Soft Starter for Pump motor will be flux compensated Magnetic Amplifier type suitable for 415volts +/-10%, 3phase/50hz +/-3%. The Soft Starter shall be rated equivalent to the motor rated power and shall be capable of operating satisfactorily with the motor under the various loading and starting conditions of the motor over the entire operating range. The Soft Starter shall reduce the starting current of the motor at least to 150% of Full Load current of the motor. The Soft Starter shall be so rated as to allow six starts per hour.

The soft starter shall work on the principle of full sine wave control and shall not lead to generation of harmonics.

The three phase windings of the Soft Starter shall be with insulation **class H and Max. Temperature of winding shall be limited to that of class B. FCMA should have iron core. FCMA coils should be Epoxy-cast resin. The FCMA unit should be Air Cooled and dust and vermin proof and suitable for indoor mounting.**

The FCMA Soft Starter shall be housed in a sheet steel enclosure of thickness not less than 14 gauge and painted with corrosion resistive paint such as epoxy or Polyurethane. The degree of protection shall be I.P.41. Soft Starter shall have a built in facility for run bypass so that the incoming voltage to the motor is equal to the supply voltage.

Routine test :-

Manufacturer should have following mandatory test facilities for routine tests at his shop.

1. High voltage test.
2. Full current injection test – A.C.Current equal to designed motor starting current should be injected in to FCMA coils for time equal to starting time.
3. Insulation resistance test.

Performance Tests :

Manufacturer should prove the motor starting current on the site as guaranteed by measuring the same with analog tong-tester.

13.5 Timer

Knob type electro-pneumatic time delay relay range 0-60 sec. It shall conform to IEC.337-1-1970 or IS-5834 Part I, convertible from ON delay to OFF delay or vice versa, suitable for 110 VAC 50 Hz rating, 1.5 Amps, terminal capacity for 2.5 mm² copper control wire, with 1 No + 1 NC.

13.6 Isolating Switches

Isolating switches shall be on load double break type and shall have suitable current and voltage ratings. The "ON" and "OFF" position shall be clearly marked.

Isolators used for motor control circuits shall be of motor cut type, capable of carrying the starting current of the motor.

13.7 Fuses and Fuse Carrier

All fuses shall be HRC cartridge type conforming to IS:13703, mounted on plug-in type fuse bases. All accessible line connections to fuse base shall be adequately shrouded. The fuses shall have operation indicators for indicating blown fuse condition. The fuse and fuse carrier shall be suitably selected for rated and fault currents. The fuse for motor control circuits shall be so selected that the same shall not operate during motor starting.

13.8 Contactors

The three pole contactors with minimum of 2 No. + 2 NC working contacts and one number of 1 No + 1 NC spare contact shall be used. The contact made of anti-weld silver cadmium shall be designed to give minimum bounce to ensure long contact life. The rating of the contactor shall suit the motor and capacitor circuit duty. The contactor shall be suitable for 415V, 50Hz, AC 3Phase duty in respect of making and breaking operations at specified power factors. The contactors shall conform to IS:13947 Part-1 and Part-4.

13.9 Single Phase Preventer

The single phasing preventor shall be provided for all 415 V, motors above 5 kW rating. The single phasing preventer shall be current operated type using minimum current detection / negative phase principle. Necessary current transformers shall be provided to suit the requirement of the single phasing preventer. The single phasing preventer shall be stable during the starting of the motor. The maximum operating

time to the single phasing preventer shall not exceed 2/3 second even in the starting condition of motor.

14. Cables and Cable Laying

Following type of cables shall be used.

- | | | | |
|---|-------------------------|---|--|
| 1 | For LT Power Supply | : | 3½ core, 3 core or 2 core 1100 / 600 V PVC insulated PVC sheathed armoured cables. |
| 2 | For control cables | : | Multicore copper cable minimum 2.5 mm ² with PVC insulation, armoured and PVC sheathed. |
| 3 | Submersible Motor cable | : | According to Manufacturer |

The minimum size of control cable shall not be less than 2.5 mm².

All cables shall be suitably de-rated for grouping and higher ambient temperature. For selecting cable sizes, 45⁰C ambient temperature shall be taken as base.

The cables shall conform for LT to IS:1554 - Part I and for HT to IS 1554 - Part - II., IS: 7098.

14.1 Cable Accessories

All accessories like cable glands, lugs and terminal markings etc. shall be used conforming to relevant standards / as specified. For 1100V grade cables Siemens type gland and crimping type lugs shall be used.

14.2 Cable Laying

The power cables and its accessories shall confirm to latest relevant Indian Standards. While laying the cables care shall be taken to avoid formation of kinks and damages to the cables.

LT cable shall be laid on wall with suitable clapping or trays or burried underground with appropriate protection. Black shall indicate the neutral, while red, yellow and blue for three different phases. All LT cables when laid on the cable racks shall be properly dressed and clamped as required without crisscrossing and unnecessary overlapping. Cables shall be properly dressed and clamped.

14.3 Laying of LT underground cables.

The laying of UG cables on ground is by excavating a trench of 0.75 meter depth for LT cable. Before the cable is laid in the trench, the bottom of the trench shall be cleared from stones and other sharp materials and filled with sand layer of 150 mm.

The width of the trench at bottom shall be 0.4 meters for one cable. In case the total number of cables laid in trenches is more than one, then the width shall be such that the spacing between cables is not less than 150 mm. Each run of cable shall be protected by placing bricks / RCC slabs on both the sides and top.

After placing bricks or RCC slabs, the trench shall be filled with the excavated soil, in layers ensuring that each layer is well rammed by spraying water and consolidated. The extra earth shall be removed from the trench and disposed as directed.

When cables pass through roads they must be well protected by either Hume pipes or GI pipes of suitable dimensions properly sealed at either end and also at the joints with suitable compound to avoid entry of soil and water.

While removing the cable from the drum, it shall be ensured that the cable drum is supported on suitable jacks and the drum is rotated to unwind the cable from the drum. The cable should never be pulled while unwinding from drum. It shall be ensured that the cables are run over suitable wooden rollers placed in the trench at intervals not exceeding 2 meters.

In routing, necessary barriers and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angles and these two shall not run in close proximity. LT cables shall be bent in radius not less than 12 times their individual overall diameters.

Routes of these cables shall be arrived at on the basis of the relevant drawings and after consulting the Engineer.

Contractor shall provide all necessary labour, tools, plants and other requisites at his own cost; for carrying out pumping of water and removing of water from trenches if required anywhere at the time of execution.

d)

14.4 H.T. Cables

H.T. 11 KV grade suitable rating 3 core XLPE aluminum conductor cable minimum size 150 mm² from TNEB supply point to Employer's 11 KV primary control switch gear and to transformers as per requirement.

e)

f)

14.5 Specifications for H.T. Cables

This specification covers the requirements of high voltage cables and associated accessories like straight joints and termination's etc. The cable sizes shall be

calculated based on the fault level of the local system. Minimum size of HT cables shall be 150 mm²

g) in case of XLPE cables.

h)

14.6 Codes and Standards

1. The design manufacture and performance of the cables shall comply with all currently applicable statutes regulations, and safety codes in the locality where they will be installed. Nothing in this specification shall be construed to relieve the Contractor of his responsibility in this regard.

2. The cables shall conform to the latest editions of following IS and other relevant IS mentioned therein

IS 7098 (Part-II): Specifications for cross linked polyethylene Insulated PVC sheathed cables for working voltages from 3.3 KV up to and including 33 KV.

14.7 Drawings and Schedules

Sizes of cables shall be given in single line power diagrams. A cable schedule shall be prepared on the basis of relevant drawings. All cable and wires shall be adequately sized to carry continuously the normal currents expected on the relative circuits. All trenches for electrical cables shall be separate from water or sewage pipe line trenches.

14.8 Splicing and Termination

Straight through joints shall be avoided. In case, these are absolutely necessary they shall be made at convenient locations suitably protected as approved and sanctioned by the Engineer-in-charge but in no case within the conduit pipes or ducts. Branch circuit wiring shall be spliced only in switch boxes, panel switch socket outlet boxes light fixtures outlets and circular junction boxes. They shall be made only with approved porcelain connectors.

Cable glands for strip armored cables shall include a suitable armour clamps for receiving and securely attaching the armoring of the cable in a manner such that no movement of the armour occurs when the assembly is subjected to tension forces. The cable gland shall not imposed on armoring, a bending radius not less than 15 times the diameter of the cable. The clamping ring shall be solid and adequate strength.

Provision shall be made for attachment of an external earthing bond between the clamp of the cable and the metallic structure of the apparatus to which the cable box is attached.

Compression type cable end glands shall be used for cable connections. Double compression cable end glands shall be used for flame proof switch gears. Cable glands shall be of brass with cadmium or nickel plating.

Tinned copper lugs shall be used for cable termination.
Cables shall be tested in accordance with IS:1554 / 7098

14.9 Testing of Cables

Once the cable is laid, following tests shall be conducted in presence of the departmental representatives authorized by Engineer, before energizing the cable.

1. Insulation resistance test (Sectional and Overall).
2. Sheathing continuity test.
3. Continuity and conductor resistance test.
4. Earth test.
5. High voltage test.

Test conducted shall be as per Indian standard and National Electrical code.

15. Control Switches

Control and instrument switches shall be of rotary type flush mounting having enclosed contacts which are accessible by the removal of cover and shall be provided with properly designated escutcheon plates clearly marked to show the operating positions. Control switches shall have momentary contacts, spring return to centre with pistol grip handle. Instrument and selector switches shall have oval knob.

16. Push Buttons

Push Buttons shall be of momentary contact type with rear terminal connections. The colour of the push buttons shall be "Green" for start and "Red" for stop. Whether required, the push button shall be suitably shrouded to prevent inadvertent operations. They shall be provided with integral inscription plates engraved with their functions. The contact element shall have at least 1 No. and 1 NC contacts. The contacts shall be able to make and carry at least 6 Amp. at 415 AC.

17. Indicating Lamps

Indicating lamps shall be panel mounting type with rear connection. The lamps shall be provided with the built-in series resistors on the lamp holder. The lamp shall have translucent lamp cover, of suitable colour. The cover shall be oil and dust proof poly-carbonate lines. The bulb and lenses shall be interchangeable and replaceable from front of the panel.

18. Safety Equipments to be Provided

The contractor shall provide the following safety equipment as per IE rules,

- Rubber mat conforming to relevant IS, in front of all the MV panel for their entire length - 1000m wide
- Sufficient pairs of electrically tested rubber gloves. These are to be kept in a suitable wooden box.
- A shock treatment instruction chart in Hindi and English duly framed as detailed in. The nearest medical facility available with phone number shall also be kept
- First aid box containing full compliments of medicines for treatment of electrical burns in the main switch room
- Adequate number of portable fire extinguishers of dry powder (store type) as per IS 2171 to suit the individual substation, pumping station requirement.
- Adequate number of caution notices in Hindi and English shall be fixed permanently on the equipment to comply the requirement of IE rules
- Safety posters for vigilance against electrical accidents.
- Adequate number of fire buckets with MS angles stand
- Round bottom fire buckets marked fire shall be provided in the HT sub stations.

19. Lighting & Small Power (IS: 1913, IS: 1777, IS: 1032 Part 5, IS: 13383 Part 2)

19.1 Definitions and Conventional Symbols

The definition of terms shall be in accordance with the Indian Standard Code of Practice for Electrical working installation except for the definition of a "Point". The wiring and the equipment shall comply in all respects with the requirement of rule 50 and 51 of IE rules / 56 as amended from time to time. The wiring and other electrical equipment shall be suitable for trouble free operation at variation of voltage and frequency prescribed in IE rules.

19.2 Pressure Frequency

Pressure and frequency of supply all current consuming devices shall be suitable for the pressure and frequency of the supply to which these are to be connected and shall function at variation voltage and frequency as per IE rules.

19.3 Point Wiring

Point wiring shall include all work necessary to complete wiring from switch circuit of any length from the tapping point on the distribution circuit switch board to the following.

- Ceiling rose for fans, Lighting etc.

- Socket outlet (in the case of socket outlet points).
- Lamp holder (in the case of wall brackets, batten points, bulk head and similar fittings).
- Call bell buzzer (in the case of the works “via the ceiling rose / socket outlet or bell push where no ceiling rose / socket outlet is provided”).

19.4 Circuit Wiring

Circuit wiring shall mean the length of wiring from the distribution board upto the tapping point of the nearest first points of that circuit, viz., upto the nearest first switch board measured along the run of wiring. Such wiring shall be measured on linear basis.

19.5 System of Wiring

The wiring shall be carried out on such a system as may be specified in the tender schedule or otherwise specified in the special specification (“Power” and “Heating” wiring shall be kept separate and distinct from “Lighting” and “Fan” wiring). Recessed conduit wiring shall be done on distribution system main and branch distribution boards at convenient physical and electrical centers and without fuses at isolated places. All conductors shall run, as far as possible, along the walls and ceiling so as to be easily accessible and capable of being thoroughly inspected. In no case, the open wiring shall be run above the false ceiling without the approval of Engineer-in-Charge. In all type of wiring due consideration shall be given for neatness, good appearance and safety.

19.6 Balancing of Circuits

The balancing of circuits in three phase installations shall be arranged beforehand to the satisfaction of Engineer.

19.7 Drawings

All wiring diagrams shall indicate clearly in plan, the main switch board, the distribution fuse board, the run of various mains and sub-mains and the position of all points with their classification

19.8 Cables

All cables shall conform to the relevant Indian Standard. Conductors of all cables except the flexible cable shall be of aluminum.

The smallest aluminum conductors for the final circuit shall have a nominal cross-sectional area of not less than 2.5 sq.mm. The minimum size of aluminium conductors for power wiring shall be 4 sq.mm. (1/2.24 mm).

19.9 Rating of Lamp, Fans, Socket Outlet Points and Exhaust Fans

Incandescent lamps installed in pump house & other means shall be rated at 60 watts and 100 watts respectively.

Table fans and ceiling fans shall be rated at 60 watts. Exhaust fans shall be rated according to their capacity.

5 Amps. socket outlet points and 15 amp. socket outlet points shall be rated at 100 watts and 1000 watts respectively, unless the actual values of load are known or specified.

19.10 Joint and Looping Back

Unless otherwise specified the wiring shall be done in the "Looping System". Phase of live conductors shall be looped at the switch box and neutral conductor can be looped from the light, fan or socket outlet. In non-residential buildings, neutral conductor and earth conductor and earth continuity wire shall be brought to each switch board situated in room and halls. These shall be terminated inside the switch boards with suitable connectors and the switch board shall be of adequate size to accommodate one number 5 amp. socket outlet and control switch in future.

19.11 Control at point of Entry Supply

There shall be a linked main switch gear with fuse on each live conductor of the supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of a linked switch gear. The neutral shall also be distinctively marked. In this connection rule 33(2) of the Indian electricity Rules, 1956 shall also be referred.

19.12 Installation of Main Switch Gear

The main switch gear shall be installed as near as practicable to the termination of service line and shall be easily accessible without the use of any external aid.

19.13 Indication Identifying Earthed Neutral Conductors

On the main switch gear, where the conductors include an earthed conductor of a two wire system or a conductor which is to be connected thereto, an indication of a permanent nature conductor. In this connection Rules 32(1) of the Indian Electricity Rules, 1956, shall be referred.

19.14 Marking of Apparatus

When a board is connected to voltage higher than 250 volts all the terminals or loads on the apparatus mounted on it shall be marked in the following colours to indicate the different poles of phases to which the apparatus or its different terminals may have been connected.

AC Three Phase : Red, Blue and Yellow
Neutral : Black

When four wire three phase wiring is done, the neutral shall preferably be in one colour and the other wires in another colour.

Where a board has more than one switch gear each such switch gear shall be marked to indicate which section of the installation it controls. The main switch gear shall be marked as such. Where there is more than one main switch board in the building, each switch board shall be marked to indicate which section of the installation and building it controls.

All markings required under this rule shall be clear and permanent.

All distribution boards shall be marked 'Lighting' or 'Power' as the case may be and also marked with the pressure and number of phases of the supply. Each shall be provided with a circuit, diagram and the current rating of the circuit and size of the fuse element.

19.15 Main and Branch Distribution Boards and their Locations

Unless otherwise specified in the special specification main and distribution fuse boards shall be the metal clad type.

Main distribution Boards shall be controlled by a linked fuse unit and a circuit breakers. Each outgoing circuit shall be provided, of MCB with SP / TP as per requirement

Branch Distribution boards shall be controlled by a MCB. Each outgoing circuit shall be provided with a fuse or MCB. The earthed neutral conductor shall have provision for disconnecting individually for testing purpose. At least one spare circuit breaker of the same capacity shall be provided on each branch distribution board.

19.16 Capacity of Circuits

Lights and fans may be wired on a common circuits, such circuit shall not have more than a total of ten points of light, fan and socket outlet or a load or 800 watts whichever is less.

Power circuits on buildings shall be designed with a maximum of two outlets per circuit, based on the loading.

Where, not specified the load shall be taken as 1 kW per outlet. Wherever the load to be fed is more than 1 kW it shall be controlled by an isolator switch or miniature circuit breaker.

19.17 Passing Through Walls

When conductors pass through walls, any one of the following methods shall be employed. Care shall be taken to see that wires pass very freely through protective pipe or box and that wire pass through in a straight line without any twist or cross in wires, on either ends of such holes.

A conductor shall be carried in an approved heavy gauge solid drawn or lap welded conduit or in a porcelain tube of such a size that it permits easy drawings in. The ends of conduit shall be neatly bushed with porcelain, wood or other approved material.

Where a wall tube passes outside a building so as to be exposed to weather, the outer end shall be well mounted and turned downwards and properly bushed on the open end.

19.18 Fixing to Walls and Ceiling

Plug for ordinary walls or ceiling shall be of well-seasoned teak or other approved hard wood not less than 5 cm. long by 25 cm. sq. on the inner and 2 cm. sq. on the outer end. They shall be cemented into walls within 6.5 mm of the surface the remainder being finished according to the nature of the surface with plaster. Where owing to irregular coursing or other reasons the plugging of the walls or ceiling with wood plugs present difficulties, the wood casing, wood batten or metal conduit shall be attached to the wall or ceiling in an approved manner. In the case of white washing. Plugging of walls or ceiling can be done in a better way where neatness is the first consideration. In all such case approved type of asbestos or fiber fixing plug (Rawl or Phil plug) with correct size of tees shall be used and done in a workman like manner.

Were this cannot be done, wooden plugs as described can be used with special permission of the Engineer.

19.19 Fittings

Lights, fans and sockets outlets shall be so located as to provide maximum comfort to the occupant and to enable him to utilize the electricity in the most economical manner.

Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edges.

Non-flammable shade form a part of a light fitting against all risks or fire, celluloid shade or light fitting shall not be used under any circumstances. Vitreous enameled iron shade shall be of size 250 mm x 90 mm (nominal) size with a tolerance to 5 mm). Plastic shade shall not be generally used in the fittings suitable for incandescent lamp.

Enclosed type fittings shall be provided with a removable glass receptacles, arranged to enclose the lamp completely and of such size of construction as to prevent undue heating of the lamp, or if the position of fittings be such that the glass shall be protected by a suitable wire guard. The loads of pre-wired fixture shall be terminated on ceiling rose or connector.

External light fittings and lamps shall have weather proof fittings of approved design so as to effectively prevent the admission of moisture. An insulating distance piece of

moisture proof material shall be inserted between the lamp holder nipple and the fittings.

In verandahs and similar exposed situations, where pendants are used they shall be of fixed rod type. Bulk head type fittings shall be of cast iron/cast aluminum body suitably painted white inside and gray outside complete with heat resistance glass cover, P.C. holder and wire guard suitable for 100 watts incandescent lamp. Where specified gasket for cover and shock proof B.C. holder shall be provided. Fluorescent tube light fittings of 40W / 80W fixed type shall be provided in general for conservation of energy and less maintenance.

19.20 Accessories

All switches shall be placed in the live conductor of the circuit and no single pole switch or fuse shall be inserted in the earth or earthed neutral conductors of the circuit.

19.21 Socket Outlets

A socket outlet shall not embody terminal as integral part of it. But the fuse may be embodied in plug in which case plug shall be non-reversible and shall be so arranged and connected that the fuse is connected to phase, live conductor or the non-earthed conductor of the circuit.

Every socket outlet shall be controlled by a switch.

The switch controlling the socket outlet shall be on the 'Live' side of the line.

5 Amps. and 15 Amps socket outlet shall normally be fixed at any convenient space 23 cms above the floor level or near such levels in special cases as desired by the Engineer-in-charge. 15 Amps switch and socket should be an integral provisions of an indicator diode. The switch for 5 Amps socket outlet shall be kept along with socket outlet. However, in special case, if desired by the Engineer the 5 Amps. socket outlet shall be kept at normal switch level and that for 15 Amp along with the socket outlet. However, in special case, if desired by the Engineer the 5 Amp socket outlet shall be placed at the normal switch level.

Where socket outlet are placed at lower levels, they shall be enclosed in a suitable metallic box, as the case may be to harmonize with the system or wiring adopted. In an earthed system of supply a socket outlet and plug shall be of the three pin type. The third terminal shall be connected to earth.

Conductors connecting electrical appliance with a socket outlet shall be of flexible twin cord with an earthing cored which shall be secured by connecting between the earth terminal of plug and the metallic body of the electrical appliance.

19.22 Attachment of Fittings and Accessories

In case of conduit wiring, all accessories like switches sockets, outlets, call bell pushes and regulators shall be fixed in flush pattern inside metal boxes. Accessories like ceiling roses, brackets, battens, stiff pendants, etc. shall be fixed on metal outlet boxes.

Aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases. The blocks/board shall normally be mounted with their bottom 1.25 m from floor level. The Boards shall have a sun mica finish.

19.23 Surface Conduit Wiring System

Conduit pipes of approved gauge thickness shall be used. The maximum number of VIR/PVC insulated 250 volts grade aluminum conductor cable that can be drawn in one conduit of various sizes and the number of cables per conduit shall not be exceeded. The minimum conduit disconnector shall not be less than 25 mm.

In long distance straight run of conduit, inspection type junction box at reasonable intervals shall be provided.

19.24 Fixing of Conduit

Conduit pipes shall be fixed by heavy gauge clamps, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than one metre but on either side of the couplers, bends, or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings. The saddle should not be less than 24 gauge for conduits upto 25 mm dia and not less than 20 gauge for larger diameter.

Where conduit pipes are to be laid along the trusses, steel joints etc. the same shall be secured by means of ordinary clips or girder lips as required by the Engineer-in-charge. Where it is not possible to drill holes in the truss members, suitable clamps with bolts and nuts shall be used. The width and the thickness of the ordinary clips or girders clips and clamps shall not be less than as stated below:

19.25 Switch Box

Switch box shall be made of metal on all sides, except on the front.

In the case of cast boxes, wall thickness shall be at least 3 mm and in case of welded mild steel sheet boxes the wall thickness shall not be less than 18 gauge for boxes, upto a size of 20 cm x 30 cm and above this M.S. boxes shall be

used. Except where otherwise stated 3 mm thick phenolic laminated sheets like sun mica shall be fixed on the front with brass screws. Clear depth of the box shall not be less than 60 mm and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern. All fittings shall be flush pattern. Only a portion of the above box shall be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

19.26 Conduit Wiring System

Conduit wiring system shall comply with all the requirements of surface conduit wiring system specified in clauses above and in addition to the requirements specified in the following clauses.

The chase in the wall shall be neatly made and ample dimensions to permit the conduit to be fixed in the manner desired. In the case of buildings under construction, fixed work, special care shall be taken to fix the conduit and accessories in position along within the building work, to avoid damage to the finished wall etc.

All outlets such as switches, wall sockets etc. shall be flush type.

The outlet box shall be same as above and shall be mounted flush with the wall. The metal box shall be efficiently earthed with conduit by an approved means of earth attachment.

To facilitate drawings of wire in the conduit. G.I mesh wire of 10 SWG shall be provided while laying of recessed conduit.

19.27 Fans, Regulators and Clamps (IS: 374)

Ceiling fans including their suspension shall conform to relevant Indian Standards.

All ceiling fans shall be wired to ceiling roses or to a special connector boxes and suspended from hooks or shackles with insulators between hooks and suspension rods. There shall be no joint in the suspension rod

For concrete roofs, ceiling fan hooks shall be buried in the concrete during construction. M.S. flat of size 40 mm x 60 x mm bent in the form of an inverted 'U' supported on two cross rods or cross flats. 60 mm long which are bound together to the top reinforcement of the roof shall be used. The distance between the vertical legs shall not be less than 15 cm. and the legs shall project at least 13 cm below the ceiling and oval holes shall be made in them for carrying a 15 cm dia rod hook.

Alternatively a 15 mm dia, M.S. rod in the shape of 'U' with their vertical legs bent horizontally at the top at least 19 cm. on either side and bound to the top reinforcement of the roof shall be used.

In building with concrete roofs having a low ceiling height where the fan clamp mentioned under clause (c) cannot be used or whatever specified, recessed type fan clamp inside a cast iron box shall be used.

Canopies on top of suspension rod shall effectively hide the suspension.

Unless otherwise specified all ceiling fan shall be hung 2.75 M above the floor. In the case of measurement of extra down rod for ceiling fan including writing the same shall be measured in units of 10 cm. Any lengths less than 5 cm. shall be ignored.

19.28 Exhaust Fans

Exhaust fans shall conform to the relevant Indian Standards.

Exhaust fans shall be fixed at the places indicated by the Engineer-in-charge. For fixing an exhaust fan, a circular hole shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded to the wall. The hole shall be neatly plastered to the original finish of the wall. The exhaust fan shall be connected to exhaust fan point which shall be wired as near to the hole as possible by means of a flexible cord, care being taken that the blades rotate in the proper direction.

Exhaust fans for installation in corrosive atmosphere fan shall be painted with a special PVC paint or chlorinated rubber paint (Chloro rubber paint). Installation of exhaust fans at locations need careful consideration. The regulators of ceiling fans/exhaust fans shall be connected to earth by loop earthing.

19.29 Indoor Decorative Luminaires

Luminaire shall be suitable for use with twin/single T.L. 40 watt 1200 mm (4'). 240V fluorescent lamps, comprising of CRCA sheet steel channel stove enameled grey which incorporates all electrical accessories like quick fit la holder, starter holder, polyester filled ballast, power factor correction capacitor and duly prewired upto the terminal block, with earthing arrangement facility, cover made for channel from CRCA sheet steel stove white enameled covering the channel fixed by twin screw, suitable for ceiling or pendent mounting suitable for 19 mm dia conduit, reflector plate for acrylic diffuser and end covers, complete in all respects ready for use. The luminaire shall conform to IS:1913.

19.30 Outdoor Lighting

19.30.1 Poles

Street light poles shall be steel tubular swaged type, conforming to IS:2713 - 1969., suitably long with M.S. base plate with pipe cap and over hung 2 metres long having dia to suit the socket of 70/250 watts, 240V, High pressure sodium vapour lamp or metal halide fitting.

19.30.2 Outdoor Luminaire

The luminaire shall be 250 watt H.P.S.V. with all accessories and shall be deep drawn aluminium reflector stove enameled grey outside and brightened and annodised inside lined with felt gasket to prevent insect entry.

Die cast aluminium housing covered with a lid shall be provided to accommodate all electrical accessories, such as independent ballast, power factor improvement capacitor, wired upto terminal block.

A clear acrylic cover shall be fixed to the reflector by means of 4 toggles.

The luminaire shall be mounted on the mast arm of 50 mm O.D. Mirror compartment and tray compartment shall have degree of protection IP 43 and IP 33 respectively. The reflector shall be manufactured of drawn aluminium sheet and be painted to stove enamel grey outside and brightened and anodized inside.

The housing shall be die cast aluminium - A6 Grade MBV treated covered with acrylic sheet clear.

20. Emergency Light

Emergency light unit working on 230 volts. A.C. supply shall be self-containing unit with 20 watts 600 mm long florescent lamp type 'SWITCH ON MAIN FAILURE'. It shall be electronic automatic fluorescent type which incorporates a unit trickle charge circuit, which shall prevent overcharging of battery. The battery shall be maintenance free. The unit shall provide 4 hours illumination following power failure. The units shall generally conform to IS:9583.

21. Earthing

Earthing in general shall comply with C.P. (Code of Practice) 3043 of Indian Standards. Earth electrode either in the form of pipe electrode or plate electrode should be provided at all premises for providing earthing system. As far as possible, all earth connection shall be visible for inspection and shall be carefully made.

Except for equipment provided with double installation, all the non-circuit carrying metal parts of electrical installation are to be earthed properly. All metal conduit trunking cases, sheets, switch gears, distribution fuse boards, lighting fittings and all other parts made of metal shall be connected to an effective earth electrode.

The main earth electrode should be G.I perforated pipes driven into the soil as per standard practice. Continuous looped earthing should be provided with adequate size G.I. wire / feat. Earthing work should conform to I.E Rules.

The earth pit shall conform to IS : 3043 and GI earth electrodes of not less than 100 mm external dia shall be driven to a depth of atleast 3m in the ground below the ground level. The surrounding of the electrodes, soil shall be treated up with salt, coke and charcoal.

Earth electrode shall be installed near the main supply point and shall comprise a copper / GI earth of appropriate diameter and driven to depth of 3 metres below ground level, or to a greater depth, if so required to obtain a sufficiently low earth resistance value. Alternatively copper plate may be used as the main earth electrode conforming to IS:3043. The electrodes shall be driven at least 1.5m away from the building or any other earth station.

Minimum requirement of earth pits as per I.E. rules are as under:

The main earth electrodes after being driven into the ground shall be protected at the top by constructing a concrete or masonry chamber of size 300 mm x 300 mm x height 300 mm. and shall be provided with CI cover. The resistance of any point in the earth continuity system of the installation to the main earth electrode shall not exceed 1.0 ohm. The remaining space in the bore hole shall be filled with bentonite. The bentonite will hold the earth rod in position. The neutral conductor shall be insulated throughout and shall not be connected at any point to the consumers earthing system.

An earth continuity conductors shall run continuously from the farthest part of installation to the main earth electrode and shall be connected by branch conductor to all metal casing and sheathing housing electrical apparatus and/or wires and cables. all branches shall be connected to earthing. The earth continuity conductors shall have a cross-sectional area at least half to the size of the phase conductor and in no case less than 1.5 sq.mm of copper / GS.

All earth wires and earth continuity conductor shall be galvanised M.S flats of appropriate size. Interconnections of earth continuity main conductors and branch wires shall be brazed properly, ensuring reliable, permanent and good electrical connections. The earth lead run on structures must be securely bolted. Neutral earth leads shall be run on a separate supports without touching the body of the transformers. Earth wires shall be protected against mechanical damage and possibility of corrosion particularly at the junction points of earth electrodes and earth wire interconnections. Earth electrodes shall be connected to the earth conductors using proper clamps and bolt links.

It shall not be allowed to use the armour of the incoming feeders cable to the sub-distribution board as the only earthing system.

Sheathed lugs of ample capacities and size shall be used for all underground conductors for sizes above 3 mm² whenever they are to be fitted on equipment or flat copper conductor.

The lugs shall be fitted on equipment body to be grounded or flat copper only after the portion on which it is to be fixed is scrubbed, cleaned of paint or any oily substance on a subsequently tinned.

No strands shall be allowed to be cut in case of stranded ground round conductors. G.I embedded conduits shall be made electrically continuous means of good continuity fixing and also be rounding copper wires and approved copper clamps.

21.1 Earthing of Lighting Poles

All external poles are to be looped together with continues 14 SWG TC earth wire clamped at dollies provided on every fuse box of poles and looped onwards to the other pole. Every fifth pole shall be connected to earth through an earth electrode.

21.2 Earthing for Lighting Installation

This shall be common grid system, the main grounding conductor laid and embedded in concrete being grounded at earth pits outside the buildings at approved locations or other places. The earthing of L.T panels shall be connected to two main grounding conductors each of which along with main cables shall run with cables to distribution boards in each floor. This shall run along with the cable and at the top floor be connected to the same section completing the grid.

21.3 Sizes of Earthing Conductors

Sl.No.	System	Earthing conductor size and Material
1	415V switchgear, DG set, Capacitor Control panel	Suitable to its rating.
2	415V LT Motors - less than 50 HP - 50 - 150 HP - above 150 HP	25 X 6 mm GI 40 X 6 mm GI 50 X 6 mm GI
3	Lighting distribution Board,	14 SWG GS wire
4	Local push Button Stations, Junction Boxes.	14 SWG GS wire
5	Lighting and receptacle system	14 SWG GS wire
6	Earth Electrode	50 mm dia. 3000 mm long heavy duty GI pipe electrode
7	Street lighting poles	14 SWG TC wire

Note: 1. Conductors above ground shall be of galvanized steel to prevent atmospheric corrosion.

Note: 2. Conductors buried in ground or embedded in concrete shall be of mild steel.

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22 Power capacitor

Power shunt capacitors in general shall conform to latest version of IS:13585, Part-1. Power capacitor control panel shall be housed in metal enclosed cubicle. Power capacitor shall be mounted on MS angle frame works and capacitor control panel along with MV panel.

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.

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.

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.

The assembly of the banks shall be such that it provides sufficient ventilation for each unit.

Each capacitor case and the cubicle shall be earthed to a separate earth bus.

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 : 13585 Part 1.

Film dielectric, Aluminium foil conductor, impregnated with Non PCB, Non Toxic biodegradable capacitor grade oil, under vacuum, two layers of biaxially oriented propylene film shall be used.

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 upto a maximum of 10% above the rated voltage, excluding transients.

22.1 Unit Protection

Each capacitor unit shall be individually protected by an MCCB / MCB fuse suitably rated for load current and interrupting capacity, so that a faulty capacitor unit shall be disconnected by the fuse without causing the bank to be disconnected.

Thus, the fuse shall disconnect only the faulty unit and shall leave the rest of the units undisturbed. An operated fuse shall give visual indication so that it may be detected during periodic inspection. The MCB breaking time shall co-ordinate with the pressure built up within the unit to avoid explosion. Mounting of the individual fuse may be internal or external to the capacitor case.

22.2 Capacitor Control Panel

The control equipment shall be mounted in the MV panel made of 2.6mm / 2.0mm cold rolled sheet steel for the front and other sides respectively. The panel shall be of indoor type and shall consist of :

- Isolating switch / MCB / MCCB
- Red and Green lamps for capacitors ON/OFF indication.

22.3 Technical Particulars - The Equipment shall conform IS 13585 Part 1

General

- Quantity : as per requirement
- Rated capacity as per requirement
- Rated Voltage : 433 V
- Rated frequency, and phases : 50 Hz, 3 Phase

- Design Requirements

Insulation level :2.5 KV (rms)

- Capacitor bank connection :Delta
 - Short circuit withstand for busbars :
 - Short time (1 sec) : 40 KA (rms)
 - Dynamic : 102 KA (peak)

Type of switching : MANUAL switching

Income current rating :To suit-rated capacity of kVAR

22.4 Tests and Test Reports

- All tests shall be conducted in accordance with the latest edition of IS – 13585 Part 1 and as applicable for the controls.
- Type test certificates for similar capacitor units shall be furnished.

22.5 Drawings

The following drawings shall be submitted for the approval of the Engineers Representative.

- Fully dimensioned general arrangement drawings of capacitor and capacitor control panel with elevation side view, sectional view and foundation details.
- Complete schematic and wiring diagrams for capacitor control panel.

23. PUMPING MACHINERIES

23.1 Applicability

The following clauses shall specify general mechanical requirements and standards of workmanship for equipment and installations and must be read in conjunction with the particular requirements of the Contract. These general specification clauses shall apply where appropriate except where redefined in the particular requirement sections of the Specification which shall be applicable

23.2 Materials

All materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of first class commercial quality, free from imperfection, and selected for long life and minimum maintenance.

23.3 Design and Construction

The plant design, workmanship and general finish shall be of sound quality in accordance with good engineering practice. Design shall be robust and rated for continuous service, at the specified duties, under the prevailing operational site conditions.

The general design of mechanical and electrical Plant, particularly that of wearing parts, shall be governed by the need for long periods of service without frequent attention but shall afford ready access for any necessary maintenance.

Similarly items of Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same material specification as the originals.

No welding, filling or plugging of defective work will be permitted without the written permission of the Engineer. All welding spatter shall be removed.

It shall be the responsibility of the contractor to ensure that all the equipment selected is fully compatible, mechanically, electrically and also with respect to instrumentation, control and automation.

It shall be the responsibility of the contractor to ensure his equipment interfaces with any existing equipment correctly. Any interfaces must not affect the integrity of the equipment, or invalidate any warranties or guarantees.

Each component or assembly shall have been proven in service in a similar application and under conditions no less than those specified therein.

The plant shall be compatible with the civil structure, when installed, with sufficient space for operator access and maintenance procedures.

All materials shall be of the best commercial quality and free from any flaws, defects or imperfections.

Materials shall be selected to eradicate or reduce corrosion to a minimum.

23.4 Tropicalisation

All plant and materials used shall in all respects be suitable for the climatic conditions of the UP as detailed in Table - _ hereof. The following maximum conditions shall be used for all design.

- i) Maximum peak ambient shade temperature : 43°C
- ii) Maximum daily average ambient shade temperature : 38°C
- iii) Maximum yearly average ambient shade temperature : 30°C
- iv) Maximum Relative humidity : 100%

In damp situations and wherever exposed to the weather, precautions shall be taken against corrosion of metal work, cable armour, conduit and the like.

All electrical equipment including cables shall be de-rated for continuous operation in an ambient temperature of 45°C in accordance with the appropriate regulations.

All materials and equipment which are subject to certification by testing authorities etc., shall be certified as being tested at 45°C ambient.

Tropical grade materials should be used wherever possible. Some relaxation of these provisions may be permitted where equipment is hermetically sealed.

Iron and steel are in general to be painted or galvanized as appropriate in accordance with the Specification. Small iron and steel parts (other than stainless steel) of all instruments and electrical equipment, the cores of electro-magnets and the metal parts of relays and mechanisms are to be treated in an approved manner to prevent rusting. Cores etc. which are built up of laminations or cannot for any other reasons be anti-rust treated, are to have all exposed parts thoroughly cleaned and heavily enamelled, lacquered or compounded.

The use of iron and steel is to be avoided in instruments and electrical relays whenever possible. Steel screws, when used, are to be zinc, cadmium or chromium plated or, when plating is not possible owing to tolerance limitations, shall be corrosion resisting steel. Instrument screws (except those forming part of a magnetic circuit) are to be of brass or bronze. Springs are to be of brass, bronze or other non-rusting material. Pivots and other parts for which non-ferrous material is unsuitable are to be of an approved stainless steel.

Fabrics, cork, paper and similar materials, which are not subsequently to be treated by impregnation, are to be adequately treated with an approved fungicide. Sleaving and fabrics treated with linseed oil or linseed oil varnishes are not to be used.

- **23.5 Packing and Delivery**

All plant and equipment as necessary shall be packed in first quality containers or packing; no second-hand timber shall be used. All packing must be suitable for several stages of handling via sea or air freight, inland transport and movement on site.

Flanged pipes are to have their open ends protected by adhesive tape or jointing and are then to be covered with a wooden blank flange secured by service bolts.

The sleeves and flanges of flexible couplings shall be bundled by wire ties. Cases containing rubber rings, bolts and other small items shall not normally weigh more than 500 kg gross.

Precautions are to be taken to protect shafts and journals where they rest on wooden or other supports likely to contain moisture. At such points wrappings impregnated with anti-rust composition or vapor phase inhibitors are to be used of sufficient strength to resist changing and indentation due to movement which is likely to occur in transit. The form of the protective wrappings and impregnation are to be suitable for a minimum period of twelve months.

Lids and internal cross battens of all packing cases are to be fixed by screws and not nails. Hoop metal bindings of cases are to be sealed where ends meet and if not of restless material are to be painted. Contents of cases are to be bolted securely or fastened in position with struts or cross battens and not with wood chocks, unless they are fastened firmly in place. All struts or cross battens are preferably to be supported by cleats fixed to the case above and below to form ledges on which the batten may

rest. Cases are to be up-ended after packing to prove that there is no movement of contents.

Where parts are required to be bolted to the sides of the case, large washers are to be used to distribute the pressure and the timber is to be strengthened by means of a pad. All stencil marks on the outside of the casings are to be either of a waterproof material or protected by Shellac or varnish to prevent obliteration in transit. Wood wool is to be avoided as far as possible. Waterproof paper and felt linings are to overlap at seams at least 12mm and the seams secured together in an approved manner, but the enclosure is to be provided with screened openings to obtain ventilation.

Where applicable, indoor items such as electric motors, switch and control gear, instruments and panels, machine components, etc. are to be 'cocooned' or covered in polythene sheeting, sealed at the joints and the enclosures provided internally with an approved desiccator.

Bright metal parts are to be covered before shipment with an approved protective compound or coating and protected adequately during transport to site. After erection these parts are to be cleaned by the Contractor.

Each crate or package is to contain a packing list in a waterproof envelope and copies in duplicate are to be forwarded to the Engineer; prior to dispatch. All items of material are to be clearly marked for ready identification against the packing list. All cases, packages, etc. are to be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and to indicate the correct positions for slings, and are to bear an indelible identification mark relating them to the appropriate shipping documents.

The Engineer may require to inspect and approve the packing before the items are dispatched but the Contractor is to be entirely responsible for ensuring that the packing is suitable for transit, and such inspection will not relieve the Contractor for any loss or damage due to faulty packing.

23.6 Workmanship

Workmanship and general finish shall be of first class commercial quality and in accordance with best practice. All covers, flanges and joints shall be properly faced, bored, fitted, fixed, hollowed, mounted or chamfered as the case may be, according to the best approved practice and all working parts of the plant and other apparatus, shall similarly be well and accurately fitted, finished, fixed and adjusted

23.7 Castings and Metals

All castings shall have an homogenous structure and be free from blowholes, flaws and cracks. Any casting having a thickness in parts in excess of 3 mm to that which it is purported to be shall be rejected. No repairs or patchwork to castings shall be allowed other than that approved by the Engineer.

Castings subject to hydraulic pressure shall be tested to 1.5 times the maximum working pressure. Certified copies of Test Reports shall be forwarded to the Engineer as soon as the test is completed.

Where not otherwise specified steel castings shall be selected from the appropriate grade. as per relevant IS.

All grey iron castings supplied shall be to the appropriate grade of IS:210. The Contractor shall replace any casting which the Engineer considers is not of first class appearance or is not in any way the best which can be produced, although such a casting may have passed the necessary hydraulic or other tests. No plugging, filling, welding or "burning on" will be acceptable

All spheroid graphite or modular graphite iron shall be to the appropriate grade of IS.1865.

Where not otherwise specified the bronze used shall be made of a strong and durable zinc free mixture as per relevant IS:318.

Aluminum and aluminum alloys shall not be utilized unless alternative materials are considered unacceptable. The use of aluminum requires the approval of the Engineer in all cases. Bars and extruded sections shall be as per relevant IS.

Aluminum and Aluminum Alloy Castings shall be manufactured as per IS:617:1994 and subjected to a chill cast to increase tensile strength. Immersed structures or structures that are periodically immersed shall not be constructed from aluminum or aluminum alloys. All chromium plating shall comply with IS 1986.

23.8 Painting and Metal Protection

The surface preparation and painting or application of corrosion protection coatings to the following materials shall be carried out in accordance with relevant IS for the particular environmental conditions where the materials are used.

- Mild Steel
- Cast and Duct Iron
- Aluminum
- Nonferrous Parts
- Other small parts

23.9 Galvanizing

Where steel or wrought iron is to be galvanized, it shall be carried out by the hot-dip process and shall conform in all respects with IS:2629. Adequate provision for filling, venting and draining shall be made for assemblies fabricated from hollow section. Vent holes shall be suitably plugged after galvanizing.

All surface defects in the steel including cracks, surface laminations, laps and folds shall be removed in accordance with IS:6159. All drilling, cutting, welding, forming and final fabrications of unit members and assemblies shall be completed before the structures are galvanized, The surface of the steelwork to be galvanized shall be free from welding slag, paint, oil, grease, and similar contaminants. The articles shall be pickled in dilute sulphuric or hydrochloric acid, followed by rinsing in water and

pickling in phosphoric acid. They shall be thoroughly washed, stoved and dipped in molten Zinc and brushed, so that the whole of the metal shall be evenly covered and the additional weight thereof after dripping shall not be less than 610 grams per square metre of surface galvanized, except in the case of tubes to BS.1387 when it shall be 460 grams per square metre.

On removal from the galvanizing bath the resultant coating shall be smooth, continuous, free from gross imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross. Edges shall be clean and surfaces bright.

Bolts, nuts and washers shall be hot-dip galvanized and subsequently centrifuged in accordance with IS:2629. Nuts shall be tapped up to 0.4 mm. oversize before galvanizing and the threads oiled to permit the nuts to be finger turned on the bolt for the full depth of the nuts.

During off-loading and erection the use of nylon slings shall be used. Galvanized work which is to be stored in Works or on Site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining.

Small areas of the galvanized coating damaged in any way shall be restored by:-

- i. Cleaning the area of any weld slag and thoroughly wire brushing to give a clean surface.
- ii. The application of two coats of zinc-rich paint (not less than 90 per cent zinc, dry film), or the application of a low melting-point zinc alloy repair rod or powder to the damaged area, which is heated at 300°C.
- iii. Fastenings of galvanized steelwork shall be hot drip galvanized and subsequently centrifuged in accordance with IS:2629. Nuts shall be tapped upto 0.4 mm oversize before galvanizing and the threads oiled to permit the nuts to be finger turned on the bolt for the full depth of the nuts.
- iv. Where surfaces of galvanized steelwork are to be in contact with aggressive solutions and/or atmospheres the galvanizing shall receive further protection by painting.

23.10 Fasteners

All bolts, nuts and studs with nominal diameters up to and Fasteners including 39mm required to be made in carbon steel shall conform to BS.6104 and threaded in accordance with IS:1367. Bright steel washers 3.0mm in thickness shall conform to BS.4320 and shall be provided beneath bolt head and nut. The above items required to be supplied in stainless steel shall conform to IS:1570. These items together with holding-down bolts and anchor plates required to be supplied in high tensile steel shall conform to BS.970 Ref. Symbol T Drilled anchor fixings for use on concrete structures shall be of a type Fasteners approved by the Engineer's Representative. The positions of all drilled anchors shall be approved by the Engineer's Representative and a Contractor proposing to use such fixings shall be deemed to have undertaken to supply, mark off, drill and fit. All exposed bolt heads and nuts

shall be hexagonal and the length of all bolts shall be such, that when fitted and tightened down with a nut and washer, the threaded portion shall fill the nut and not protrude from the face thereof by more than a half diameter of the bolt. Rivets shall conform to BS.641 and tested in accordance with BS.1109.

23.11 Forgings

Carbon steel forgings shall be manufactured heat treated and tested in accordance with IS:2004-1991

23.12 Foundations and Setting of Machinery

The Contractor shall arrange for the provision of all foundations and plinths required for the plant and shall ensure that it is in accordance with the approved drawings.

The Contractor shall provide all necessary templates for suspension of the holding-down bolts during grouting of same. The machinery shall be mounted on flat steel packings of a thickness selected to take up variations in the level of the concrete foundations.

The packing shall be bedded by chipping or grinding of the concrete surface. Only one packing of selected thickness shall be used at each location, which shall be adjacent to each holding down bolt. The number of shims shall not exceed two at each location and the thickness of each shim shall not exceed 3mm. The machinery shall be aligned, leveled and pulled down by the nuts of the holding down bolts with a spanner of normal length, and no grout shall be applied until the machinery has been run and approved by the Engineer for stability and vibration.

23.13 Bearings and Lubricators

The size of bearing shall be not less than that calculated for Bearings and a minimum L10 basic rating life in accordance with BS.5512 Lubricators Part 1., taking into account all considerations of reliability, materials of manufacture and operating conditions. All bearings shall be rated and sized to ensure satisfactory running without vibration under all conditions of operation for a minimum life of 50,000 hours running. They shall be efficiently lubricated and adequately protected from ingress of moisture, dust and sand and the particular climatic conditions prevalent at the site. All bearings shall be to ISO standard SI unit dimensions where practicable. All ball or roller bearings, except those supplied as "sealed for life" shall be arranged for grease gun lubrication and a suitable high pressure grease gun shall be supplied.

Adequate "Stauffer" screw top pressure grease lubricators with 'tell tale' stems or "Tat" grease nipples shall be provided for all moving parts. The position of all greasing and oiling points shall be arranged so as to be readily accessible for routine servicing. Where necessary, suitable access platforms shall be provided. The type of lubricant and intervals of lubrication, which shall be kept to a minimum (not less than

nine days), for each individual item of plant shall be entered on a working schedule, which shall form part of the Operation and Maintenance instructions. A list of recommended Lubricants and their equivalents Bearings and shall be entered in the Operation and Maintenance instructions.

23.14 Labels

The Contractor shall arrange for the supply and fitting of engraved identification labels to all valves and items of plant. The reference numbers of all valves shall be as indicated on the schematic diagram to be supplied under the Contract. All warning labels shall comply with BS 5378 parts 1, 2 and 3 and of screw fixed rigid construction

Designation labels shall be of 5 mm Traffolyte with black lettering on white background. Embossed materials and techniques shall not be accepted.

The Contractor shall provide 2 No. enamelled iron plates worded "Men Working on Plant". The plates shall be 200mm x 75mm with red lettering on a white background. The Contractor shall also provide and fit warning labels for machinery that is operated under automatic control. All identification and warning labels shall be in English and in the local Language.

23.15 Guards

Adequate guards shall be supplied and installed throughout the installation to cover drive mechanisms. All rotating and reciprocating parts, drive belts, etc. shall be securely shrouded to the satisfaction of the Engineer to ensure the complete safety for both maintenance and operating personnel. However, whilst all such guards shall be of adequate and substantial construction they shall also be readily removable for gaining access to the plant without the need for first removing or displacing any major item of plant. The guards shall be of the open mesh type except where retention of fluid spray is required.

23.16 Suppression of Noise

All plant offered shall be quiet in operation. The noise levels in the entire premises shall be as per the norms of the Pollution Control Board. The noise level within the building shall not be more than 85 decibels (+5 per cent on this over the audible frequency spectrum measured at mid-band.) "A" scale when measured along a contour 3 metres from any single item of plant during starting, running and stopping. The noise level outside the building shall not be more than 60 decibels (+5 per cent on this over the audible frequency spectrum measured at mid-band.) "A" scale when measured along a contour 3 meters from the external wall. Noise test measurements shall be made on completion of the installation of the plant at Site to verify that it complies with this Clause. Plant which fails to comply with the noise level limits when tested will render it liable for rejection unless it is satisfactorily modified at the Contractors expense by the programmed commissioning date.

24. Submersible Sewage Pumps

The Contractor shall provide manufacturer's published pump curves, system curves and the necessary hydraulic calculations to justify the sizes of any pumps selected. The Contractor shall provide the following shop drawings:

- impeller diameter
- maximum impeller diameter
- minimum impeller diameter
- velocity of liquid in pump suction at duty point
- velocity of liquid in pump delivery at duty point
- velocity of liquid in the pump casing or impeller eye at duty point
- net positive suction head (dry well submersibles only)
- the materials of construction shall be specified in detail and itemized against a sectional drawing of the pump proposed.

After approval of the pump types the Contractor shall submit the test data as required under factory inspection and testing

The Contractor shall submit Operation and Maintenance Manuals and Instructions which shall include all the documentation provided as above and as required in the Specification.

24.1 Pump Requirements

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range specified in the Specification without surging, cavitations, or excessive vibration to the limits specified. All pumps and drives shall be from approved manufacturers.

The pumps shall meet maximum allowable shut-off head.

The pumps shall not overload the motors for any point on the maximum pump speed performance characteristic curve and the pump operating range, within the limits of stable pump operation, as recommended by the manufacturer, to prevent surging, cavitation, and vibration.

To ensure vibration-free operation, all rotative components of each pumping unit shall be statically and dynamically balanced to IS:11723 Part 1 - 1992 and the following requirements shall be met:

- The mass of the unit and its distribution shall be such that resonance at normal operating speeds is within acceptable limits
- In any case, the amplitude of vibration as measured - at any point on the pumping unit shall not exceed the below limits
- At any operating speed, the ratio of rotational speed to the - critical speed of a unit, or components thereof, shall be less than 0.8 or more than 1.3.

Vibration levels shall not exceed the levels as per relevant IS.

The completed units, when assembled and operating, shall be free of cavitations, vibration, noise, and oil or water leaks over the range of operation.

All units shall be so constructed that dismantling and repairing can be accomplished without difficulty.

The Contractor shall be responsible for proper operation of the complete pumping system, which includes the pump, motor, variable speed drive unit (if designated), and associated controls furnished with the pump.

The Contractor shall ensure that the controls and starting equipment are suitable for use with the pump motor, taking into account all requirements including starting currents and number of starts per hour.

For the performance curve of the selected pump impeller, the head shall continuously rise as flow decreases throughout the entire curve from run out to shutoff head.

The Contractor shall ensure that drive motors, variable speed drive systems (if specified) and pumps shall be supplied and tested together by the pump manufacturer, who shall supply full certification for the proper function of the entire pumping system.

If variable speed drive systems are specified, motor and drive system shall be fully compatible, and shall be of sufficient power and torque, and be capable of sufficient heat transfer for starting, accelerating and continuously operating over the entire range of head/capacity conditions, from minimum to maximum pump operating speed, as designated. The motor shall be de-rated to take into consideration the reduced cooling effect when running at the lowest speed with the variable speed drive.

24.2 Design Conditions

Pumps shall be single stage mono-block type with non clog design. It should pump all kinds of sewage in particular unscreened sewage containing long fibres, solid admixes, sludges, liquid containing trapped air and gas etc, long fibres, polythene covers, and capable of dealing with sewage of specific gravity 1.1

Profile gasket should be provided in pump casing so as to avoid metal to metal contact between pump and the special designed duck foot bend/ flanged elbow, automatic coupling to ensure leak proof joint with delivery pipe . The profile of pumpside flange shall be matched with pump claw so as to automatically lock by virtue of its own weight or an automatic coupling device for easy installation and easy removal.

Pumps shall be designed and constructed to satisfactorily operate and perform within the designated design conditions and the requirements specified herein. They shall be designed for a life of 100,000 hours with service intervals at 20,000 hours.

Castings, fabrications, machined parts and drives shall conform to the industry standards for strength and durability and shall be rated for continuous duty over the entire operating range.

Bearings shall be of the anti-friction type designed for load and life in accordance with relevant IS according to the type of bearing used. The maximum operating speed shall not exceed 1450 / 960 rpm and shall be supplied as per BOQ.

Pumps shall be of non-clog design, capable of passing spheres of a size of 100mm diameter unless other diameters are specified. The pumpset shall be supplied along with special duckfoot bend / flanged elbow, lifting chain, guide wire / guide pipe.

Suitable RCC slab / ISMB (with necessary anti-corrosive painting) to be erected over suction well to fix guide wire / guide pipe holding bracket.

The pump, motor and associated electrical equipment shall be rated for a minimum 10 starts per hour, unless otherwise specified.

The Contractor shall ensure that the pump manufacturer provides certification which guarantees the following:

- flow rate
- total head
- power input
- efficiency

24.3 Materials

Pumps shall be manufactured of the following materials as a minimum:

- volute casings shall be cast iron, as per IS 210 Gr Fg 200 with 2 to 3 % Nickel. The internal surfaces shall be free of rough spots. The casing shall have center line discharge.
- impellers shall be stainless steel (CF8M) .
- Pump shaft shall be of stainless steel (SS- 410) . The shaft shall be of one piece construction.
- motor casings shall be cast iron,
- shafts shall be stainless steel,
- fasteners shall be stainless steel,

The lifting system shall be manufactured of the following materials:

- the guide rail system shall be CI.
- lifting chains shall be MS-GLVD.

- **24.4 Fabrication**

General. Pumps shall be fabricated in accordance with the following requirements:

- Pumps shall be capable of handling raw, unscreened sewage.
- in the case of submersible installations no portion of the pump shall bear directly on the floor of the wet well.
- pumps shall utilise a guide system to permit easy removal and reinstallation without dewatering the pump sump discharge connections shall be made automatically with a simple downward motion without rotation when the pump is lowered into operating position. The pump shall be capable of being removed without disconnecting any fasteners
- an appropriate length of chain shall be connected to the motor eyebolts to permit raising and lowering of the pump.
- Impellers shall be fabricated according to the rated motor size as follows:
 - non-clog type statically and dynamically balanced, keyed to the shaft
 - provided with pump-out vanes to prevent material from getting behind the impeller and into mechanical seal area
 - impellers shall not be trimmed unless approved by the Engineer. Provision for adjustment of clearance between impeller and casing for restoring the pump efficiency, without dismantling the pump will be an added advantage.
 - single/multi vane or vortex type, with a cutter impeller in the case of small flows.

Discharge Connection and Guide Rails shall be fabricated as follows:

Sliding guide bracket and discharge connections shall be provided which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge connecting flange without need of adjustment, fasteners, clamp, or similar devices.

The guide rails shall not support any portion of the weight of the pump.

The pump discharge connections shall incorporate a sealing face and connection yoke to allow for automatic coupling to fixed discharge connection pipe work.

Pump Shafts shall be fabricated as follows:

- pump shafts shall be of such diameter that they will not deflect more than 0.05 mm measured at the mechanical seal, whilst operating at full driver output
- the shaft shall be turned, round and polished

- the shaft shall be key-seated for securing the impeller.

Shaft Seals shall be fabricated as follows :

- the drive motor and pump/motor bearings shall be sealed along the shaft with tandem mechanical seals operating in an oil filled chamber. The seals shall require neither routine maintenance nor adjustment, but shall be capable of being easily inspected and replaced.
- two back to back mechanical seals shall seal the motor off from the pump.
- the upper seal shall be oil lubricated with a carbon rotating component and fixed tungsten carbide component.
- the lower seal shall have both parts in tungsten carbide.
- a detector shall indicate when moisture is leaking past the first seal.

Bearings shall be fabricated as follows :

- bearings shall be capable of taking the static weight of the rotating parts and any thrust generated by the operation of the pump
- the upper bearing(s) shall be of the grease lubricated sealed for life type; the lower bearing(s) shall be lubricated by the internal oil supply
- the bottom bearing(s) shall be of the angular contact ball bearing type in combinations with roller bearing(s)
- if required in the project specification, remote indication shall be provided for bearing high temperature-, using a thermistor at the lower bearing, to provide a signal at 95 °C.

Motors shall be fabricated as follows :

- Motors shall be 415 V, phase, 50 Hz, rated at 10 % above the maximum power requirement
- Motors shall be squirrel cage, induction, air filled, totally sealed to IP 68, suitable for the maximum immersion depth to be encountered, rated for zone 2 use with group 1 gases, to BS 5345
- Motor insulation shall be Class F, limited to a Class B temperature rise
- Motor temperature shall be monitored using a thermistor, in each phase of the winding, set to stop the motor when the monitored absolute temperature reaches 130 °C
- A watertight cable junction box sealed from the motor shall be provided for the motor power and control cables shall be EPR insulated, Niplas sheathed flexible 450/750 volts grade, oil and grease resistant, with tinned annealed copper conductors in accordance with BS 6007. The cable shall be brought directly out of the submersible motor without joints, and shall be of sufficient length, minimum 20 m to be terminated in an IP67 junction box outside adjacent to the wet well. They shall be sized in accordance with the electricity utility regulations and BS 7671. The cable

must be leak tight in respect of liquids and firmly attached to the terminal box. The should be laid in a suitable PVC encasing pipe from control panel upto suction well .

- Motors shall be capable of startup and operation in the event of a completely flooded wet well. Motors shall be selected to meet the maximum power required for the selected impeller at all operating conditions
- Motor cooling shall either be by means of the pumped medium or by oil. The use of external cooling water is not acceptable
- motors shall be derated for dry well and/or variable speed operation
- all parts of the pump and motor shall be 100% holiday free fusion bonded epoxy coated to a minimum thickness of 300 microns.

24.5 Control Panel

The control panel shall be made of 12 SWG (2.6mm) sheet steel for the front side and 14 SWG (2.0mm) sheet steel for bottom and other sides with powder coating for long life. It should have suitable starter. The control panel consists of multi section unit containing one pump and one incomer/control. The sections are interfaced, via, cable way/marshalling section. All wires and links are of electric grade copper conductor. The control of the pumps viz., Mercury/magnet activated/ any other float switch with auto for duty pump.

Power circuit is operating at 3 phase ,415 Volts, 50 Hz supply and for control circuit it is single phase 230 V, 50 Hz supply.

Type of starter shall be as under :

upto 10 HP - DOL

From 12 HP to 40 HP - Star - Delta.

50 HP and upto 90HP– Auto Transformer Starter

100 HP and above Soft Starter

The following protections should be provided in the panel: short circuit protection, over load protection, over temperature protection for motors, single phasing preventer, reverse rotation protection, dry run failure protections to be made. Suitable range ammeter, voltmeter, selector switch, auto-manual switch, pump running lamp, pump fault lamp, fault reset push button, phase indicating lamps, indication of high level in the well, hours run counter should also be provided.

The control panel wiring circuit should be furnished in triplicate.

The pump should be controlled by the magnetic/mercury float switches while the pumps run in auto. The floats with switches should be available in the wet wells and the connections from float should be made to the individual control panel through the

cable duct. Necessary control sensor wiring should be made to convert the signals of mercury/magnet float switches while the level is high/low so that the pump starts/stops on auto mode.

The necessary push button stations with control wiring should be made on the wells for each pumpset each stations as per std. rules.

The control panel, pumpset and accessories for pumps should be manufactured by same manufacturer. The pump and motor shall be accordance with the relevant standards.

24.6 Automatic Control

The automatic level control shall be arranged such that when level rises in the well the pumps starts successively at the different pre-determined levels. When the level drops the pumpset stop in the same order as that in which they have started. The different start and stop levels for several pumps/single pump have to be chosen according to the sewerage and as desired by the Engineer. Magnetic/mercury float switches have to be used for this purpose.

The tenderer should also furnish the list of authorized dealers for the supply of spares for submersible pumps and list of authorized workshop to carry out repairs to the submersible pumps along with the address while tendering.

Labels. Each pump shall have a stainless steel label permanently fixed to the pump and an identical label fixed to the pump starter compartment.

24.7 Factory Inspection and Testing

The Contractor shall secure from the pump manufacturer certification that the following inspections and tests have been conducted on each pump at the factory, and submit to the Engineer prior to shipment:

- the pump casing has been tested hydrostatically to 1.5 times the maximum closed valve pressure
- impeller, motor rating and electrical connections checked for compliance with the Specifications
- motor and cable insulation tested for moisture content or insulation defects
- prior to submergence, the pump has been run dry to establish correct rotation and mechanical integrity
- the pump has been run for 30 minutes submerged under a minimum of 2 m water after the operational test and the insulation tests above and after the performance test below

Each pump shall be tested at the factory for performance according to BS 5316 Part 1, including:

- flow
- inlet pressure
- outlet pressure
- motor power
- torque
- efficiency

The Contractor shall secure from the pump manufacturer the following certification and submit to the Engineer prior to shipment:

- certified copies of the pump characteristic curves and reports generated by the tests described above
- foundry composition certificates for all major castings (pump case, impeller, motor housing) showing exact material composition and tests conducted to ensure compliance with the pump manufacturer's material specifications.

24.8 Site Inspection and Testing

The equipment delivered to the Site shall be examined by the Contractor to determine that it is in good condition and in conformance with the approved working drawings and certifications. All equipment shall be installed in strict conformance with the Specification and the manufacturer's instructions.

The Contractor shall provide the services of the pump manufacturer's representative to supervise the installation, commissioning and start-up of the pumping equipment.

The commissioning tests shall be performance and reliability trials, mainly for the purpose of satisfying the Engineer that the pump sets have been correctly assembled and installed and that their performance matches that obtained during the manufacturer's works tests. In the event of an unwarranted change in the pump performance characteristics or power consumption, all necessary steps shall be taken as soon as possible to establish the cause and remove the fault. Similar action shall be taken for an undue increase in bearing or gland temperature, increased gland leakage rates, unsatisfactory vibration levels or any other fault or defect in the operation of the pumpset.

The site reliability trials shall include the following:

- A record of bearing and coupling clearance and alignments shall be tabulated to show the "as-built" condition of each pump
- A record of all overload, timing relay and oil pressure relays shall be tabulated to show the "as-built" condition of each motor starter

- All cables shall be 'megger' tested to confirm the integrity of the insulation. A tabulated record of results shall be made
- The control panel shall be statically tested with motors disconnected to confirm the correct sequence of operation
- Each pump shall be operated individually over the range from closed valve to maximum emergency top water level, on a recirculation basis, using fresh water, and for a minimum of four hours continuously. During this test the following parameters will be recorded: -
 - motor phase currents
 - pump output
 - ambient and test water temperatures
 - motor/pump casing temperature (dry well submersible only)
 - power consumed
 - power factor
 - vibration (dry well submersible only)

The commissioning trials shall extend until each pump unit has run 'continuously' for at least 3 days under all operating conditions. The term 'continuously' shall include running at various speeds or on a start/stop basis as determined by the control system

The Contractor's supervisory staff, and the pump manufacturer's representative shall be present during the period of the tests and trials. The Contractor shall be responsible for any failure of the whole equipment or any part thereof, whether such failure shall be determined by the methods detailed herein or otherwise. If the Contractor interrupts the pump test or trial, or through negligence on the part of the Contractors staff, it shall be completely repeated for the pumpset concerned.

24.9 Motors

All motors shall be suitable for operation on a 415v, 50 Hz, 3 phase, AC supply.

Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions.

I	Variation of supply voltage from the rated motor voltage	:	+ / - 10%
i	Variation of supply frequency from the rated frequency	:	+ / - 5%
i	Combined voltage and frequency Variations	:	+ / - 10%

All motors shall be capable of starting 6 times per hour. Starting current of motor shall not exceed 200% of the rated full load current for star - Delta starting and 600%

of rated full load current for DOL Starting and also be limited below the maximum limit specified by the electricity supplying authority under any circumstances.

Motor shall be capable of starting and accelerating the load with the applicable method of starting without exceeding the acceptable winding temperatures, when the supply voltage is in the range of 10% above of the rated motor voltage.

Motor shall be designed to withstand 120% of the rated speed for two minutes without any mechanical damage in either direction or rotation.

The insulation class of motor winding shall conform to class - F and the maximum temperature rise shall not exceed 95⁰C, when measured by winding resistance method and 85⁰C, when measured by thermometer method for an ambient temperature of 45⁰C.

Motor shall be offered for routine and type tests in accordance with IS: 4029 and IS: 325 at the manufacturers works. Test certificates shall be endorsed to the effect that they are properly balanced and free from vibration. In addition, a test shall be required to establish the maximum transient starting current.

Pump motors shall be of the squirrel cage submersible type, protected to IP. 58 and rated at 10 per cent above the calculated maximum power required on site.

The motor shaft shall be of large diameter, lightly stressed to ensure rigidity, with impeller and bearing location shoulders and a keyway for location of the impeller.

The motor windings shall be protected with a waterproof material and shall incorporate a thermostat in each phase to safeguard against high winding temperatures. The thermostat shall be connected into the control circuit of the starter and arranged for hand reset only.

The motor shall incorporate a cut-out device to detect the presence of any liquid in the motor enclosure.

The motor frame shall incorporate lifting points and shall be fitted with a galvanized lifting chain, reaching to, and secured at the access point.

The terminal connections for the power and protective circuits shall be housed in a completely sealed and waterproof junction box, complete with all external corrosion resistant cable glands.

The pump units shall be provided with power and protection circuit cables of sufficient length to reach from the motor junction box to the local isolator, located at the access level.

The power cable shall be 600/1000V grade flexible stranded copper wire, insulated and overall sheathed with under-water grade compound flexible insulation. The cable shall be rated to take the full motor current under the prevailing liquid and ambient temperature conditions.

24.10 Characteristic Curves

Characteristic and system curves for the pumps shall be supplied to a reasonably large scale which shall show the capacity of the pumps under single and multi-pump operation at the duty point.

When tested through their complete range of workable heads at the maker's works, all the pumps shall give results which conform to the curves submitted with the Tender. Curves showing pump efficiency and kW. loading shall also be included.

24.11 Performance Test

Each pump shall be tested at the manufacturer's premises for the full operating range of the pump. Pump performance shall be within the tolerance limits specified in the relevant standards. The contractor shall furnish the guaranteed values of discharge and efficiency for the total head at duty point for each pump.

25. Diesel Generator

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25.1 General

Electrical power supply for each pumping station will be availed from nearby TNEB supply point. According to the load requirement HT at 11kV or LT at 415V - 3Phase shall be availed from EB authorities.

One Diesel driven alternator set of capacity as specified in the schedule of works shall be provided to permit operation of the Pumping Station in the event of failure of the TNEB electricity supply, complete with all equipment like Control gear, circuit breakers, cabling, synchronizing equipment etc. The DG Set shall conform to latest version of IS:13364 - 1992.

The Contractor shall also make his own calculations with regard to the rating of the generating set(s), which shall each be large enough to start and run the smaller capacity sewage pump(s) (not the grit pump) and withstand other essential load along with lighting load but which shall not be less than that stated in the schedule, at a power factor of 0.8. The de-rating factors corresponding to the temperature, humidity and pressure should be considered. The continuous rating of the motors shall be used to calculate the maximum demand.

A 10 per cent margin of the capacity of the total load shall be allowed for contingencies and spare capacity.

The engine alternator sets shall be designed such that the starting power peak shall not exceed 10 per cent of the continuous engine rating and the voltage dip shall not exceed 15 per cent whilst starting the connected load under the worst conditions.

The Contract Drawings show the building, floors and other details as they will be constructed and the space allocated for the generating plant, control gear and circuit breakers. If any departures from the proposed layout are necessary, the Contractor shall show the modifications required on the drawings, and shall call the Engineer's attention to these proposed alterations.

Contractor's attention is specifically drawn to the operating conditions whereby generator sets could be running at little or no load due to the intermittent and differing flow rates and pump capacities. The diesel generator shall be capable of working at safe minimum working levels.

The D.G. Set shall be enclosed in a acoustic enclosure and the noise levels while operation shall be restricted to the levels as per the Pollution Control Board Norms.

25.2 Detailed Description of Generator Engine

Each engine shall be four stroke, naturally aspirated or pressure charged, water-cooled, vertical diesel type, of the airless injection principle with all cylinders and valve gear totally enclosed.

Each engine shall run at a speed not exceeding 1500 rpm. and be suitable for remote operation provided with forced feed lubrication to all working parts including the camshaft, rocker gear, valve guides etc. A strainer shall be located in a suitable position in each system. The whole of the lubricating oil shall be cooled by means of an inter-cooler situated adjacent to the engine with circulating water dissipating the heat taken from the oil. The necessary circulating pumps shall be provided which shall be integral with the engine together with all the appropriate pipework and appurtenances. Individual flow indicators shall be provided for the jacket and lubricating oil circuits.

A sensitive Class A2 governor or a superior type shall be incorporated and this shall be capable of maintaining a constant speed under all conditions of load. Motor operated speed regulating gear shall be provided to enable the speed of the engine to be varied by 5 per cent up or down from normal speed while in operation. The remote control for this regulating gear is to be operated from the switchboard.

Over-speed protection shall be provided so that in the event of the engine speed exceeding 10 per cent above the maximum operating speed an audible warning and indicator light shall be brought into operation, but should the speed still continue to

rise to a figure of 15 per cent above normal speed the fuel supply shall be automatically cut off and the engine brought to rest. The audible warning and indicator light, together with the other indicating lights and alarms specified hereafter, shall indicate on the monitoring panel in the alternator switchboard.

A heavy type of flywheel shall be provided so that there will be a minimum of cyclic irregularity throughout the working range of the engine. Distortion or vibration and oscillation of the crankshaft shall be obviated under all normal working conditions.

The crankshaft shall be of solid forged steel statically and dynamically balanced to very close limits. Hand operated barring gear shall be provided for each engine.

Aspiration air filters shall be mounted directly on each engine and shall be of the heavy duty type, suitable for a sand laden atmosphere.

Protected thermometers in suitable pockets shall be provided for measuring the temperature of the inlet and outlet cooling ion water and lubricating oil. Each engine shall be provided with a temperature indicator on each exhaust branch. Lubricating oil and circulating water pressure gauges shall be provided on the local panel.

A positive driven tachometer and hours counter shall be provided and fixed in a convenient place on each engine and the tachometer shall be connected to an engine speed indicator mounted on a local panel to be mounted on each engine.

In addition to the over-speed alarm, protection devices shall be provided in the lubricating oil circuits and cooling water circuits to operate alarms and indicator lights, in the event of abnormal running conditions prevailing. These lights shall indicate on the remote monitoring panel. The engine shall shut down under alarm conditions.

The whole of the design, rating and testing of each engine shall be in accordance with IS:13364 for solid injection liquid fuel engines.

Each engine shall be designed to operate with an ambient air temperature of 45⁰C and be capable of satisfactorily providing an output 10 per cent in excess of the BHP rating at the same speed for any one hour in the duration of 12 hours of consecutive operation.

Each engine with flywheel and alternator shall be mounted and aligned on a common under bed. Anti-vibration mountings shall be provided between the under bed and the concrete foundation. Each cylinder shall have renewable wet liners, and be fitted with individual cylinder heads. Wet liners shall be treated on the water jacket side with a rust inhibitor. Immersion heaters and thermostat control shall be incorporated in each engine oil sump and water jacket to ensure rapid warm up on starting.

Each engine shall be provided with an oil drip tray complete with plugged outlet. The engine shall be painted in accordance with the Manufacturer's recommendations, color finish as advised by the Engineer.

25.3 Engine Cooling Equipment

Each engine shall be cooled by a bed-plate mounted tropical rated radiator and cooling fan, adequately rated to maintain the normal working temperature, under continuous, full load operation, working in conjunction with a pressurized water system, thermostatically controlled with centrifugal water circulating pump, valves and pipework.

- **25.4 Exhaust System**

A complete engine exhaust system shall be provided for each engine and shall incorporate a highly efficient residential quality silencer, expansion box, tubular lengths of exhaust piping and all necessary flexible connections to lead the exhaust fumes to the open atmosphere as per the recommendations of TNPCB.

The exhaust piping shall be adequately lagged and clad within the station with polished aluminum sheeting. All the necessary supports shall be included. Closing plates to apertures in walls shall also be provided. Very special attention shall be paid to the preparation and protection of the exhaust system.

- **25.5 Bed-plates and Couplings**

A rigidly constructed, fabricated steel combined bed-plate shall be provided for each generator set to withstand the weight and shall be suitably machined on top for the reception of the engine and alternator. The bed-plate design shall incorporate anti-vibration mountings to provide complete isolation of vibration from the concrete foundations.

Each alternator shall be directly coupled to its associated engine by means of an adequately rated, flexible, multi-pin, balanced coupling in accordance with section 3 securely keyed to the shaft or close coupled to the engine. Each coupling, flywheel and any other moving part on the generator set shall be fitted with close mesh guards which shall allow access to all greasing and lubrication points. Guards shall be readily removable for maintenance purposes.

- **25.6 Enclosure of the DG Set**

The entire assembly of engine, alternator and controlling equipment shall be housed in an acoustic enclosure as per the notification of the Pollution Control Board. The noise level of the DG Set shall be limited to the prescribed levels as per by the PCB. The enclosure shall be suitable for outdoor erection with relevant IP.

- **25.7 Starting Equipment**

Each of the generator sets shall be started by means of a heavy duty, axial, starter motor, fitted with automatic disengaging mechanism on engine start-up, operating in conjunction with a 24 volt battery panel, installed locally to each generator set.

Batteries shall be of the heavy duty, 24 volt, sealed maintenance free lead acid, and be complete with charger, housing cabinet and necessary interconnecting cable. The capacity of each battery set shall allow for not less than 10 consecutive starts, each of 15 second duration.

Each battery charger shall be connected to the main motor control centre board in the control room.

The first charging of the batteries shall be carried out as per the recommendations of the manufacturer with a suitable battery charger.

- **25.8 Detailed Description of Alternators**

The alternators shall be continuously rated for continuous operation and generate at 415volts, 3 phase 50Hz., with the neutral point connected to a common earth bed. The alternator neutral contactor shall be closed when the alternator is running.

The alternator enclosures shall be protected to IP.23. They shall be suitable in all respects for operating in the climate as detailed elsewhere.

The alternator excitation equipment shall be of the quick response self-exciting, self regulating brush-less type, suitable for starting the motors.

The insulation of the stator and rotor shall be in accordance with British Standard Class 'F' but the alternator shall be designed for a Class 'E' temperature rise. The efficiencies of the alternator shall be stated in the Schedules and shall be determined in conformity with the procedure laid down in IS:269 and shall be manufactured in accordance with BS.2613.

Each alternator shall be capable of satisfactorily providing an output 10 per cent in excess of the BS rating for one hour in any period of 12 hours' consecutive running.

The rotating parts shall be statically and dynamically balanced to close limits.

Each alternator shall be fitted with anti-condensation heaters of a size to maintain the temperature of the windings 5° above ambient. Each heater shall be provided with a switch and automatic control to disconnect the heater when the alternator is running.

Terminal boxes shall be provided and arranged with sealing chambers for the reception of the cables detailed in the relevant sections of the Specification. Terminals shall be clearly marked to give phase identification.

The alternator shall be painted in accordance with Manufacture's recommendations, finished colour as instructed by the Engineer.

- **25.9 Daily Storage Tanks**

Each engine shall be provided with a free standing daily tank of sufficient capacity to allow 12 hours of continuous operation at full load. For permanent mounted sets each daily tank shall be provided with the following fittings:-

- Air vent of not less than 50mm. diameter.
- Overflow piping of not less than 150 per cent diameter of the Fuel Delivery line.
- Cleaning hand hole and cover of not less than 300mm. diameter.
- Contents gauge graduated in Hindi and English to read "Full - 1/2 Full - Empty". The gauge shall be of the magnetically operated type and shall be complete with low and high level control contacts
- Outlet connection to engine not less than 50mm. above tank base
- Fuel outlet isolating valve lockable in open position
- Drain plug
- Excess fuel return connection.
- Inlet connection from bulk fuel supply system including pipework and connections.
- There shall be allowed a minimum of 5 per cent of the volume of the tank contents as sullage. The top oil level of the tank shall not be less than 75mm from top of the tank.
- Tanks prior to dispatch from manufacturers works shall be tested hydraulically to a pressure 0.5 bars.
- Daily tanks shall be complete with all supports and fixing bolts for mounting remote from engine. Base or skid mounted tanks will not be accepted.
- There shall be provided all necessary fuel oil pipework, unions and valves between the day tank and the engine.
- Fuel connecting pipework to engine shall be seamless steel and all pipes shall incorporate flexible section if not less than 250mm. long (plastic pipes or fittings are not acceptable).

- **25.10 Warning and Safety Notices**

The following warning notice shall be supplied and fixed in a prominent position in the vicinity of each bulk fuel tank with 50mm. plain block black letters on a yellow background, printed in Hindi and English.

**NO SMOKING
DIESEL FUEL - HIGHLY INFLAMMABLE**

Additional notices shall be provided is required. The wording of the notices shall be subject to the Engineer 's approval.

25.11 Performance Requirement

The diesel generator and accessories shall be so designed as to meet the following performance requirements:

- The unit shall be capable of starting from cold condition, reaching operating speed and taking up load within the shortest possible period.
- The unit shall be capable of delivering continuously at the generator terminals a net output specified. This net output shall be obtained after necessary derating of engine due to site conditions and unit auxiliary power requirements have been taken into consideration.
- The unit shall be capable of a peak output of 10% in excess of the rated output for a period of one hour out of a total of twelve consecutive hours of operation, without exceeding permissible temperature limits and with a fairly visible exhaust.
- The unit shall be continuously rated to supply power for the periods.

The following items of performance shall be guaranteed during site performance tests by the supplier in respect of the diesel generator and the auxiliary for the specified site conditions:

- Net electrical output
- Fuel oil consumption at 1/2, 3/4 and full load
- Jacket water temperature to and from engine
- Lubricating oil temperature to and from engine
- 10% overload for one hour out of a total of twelve consecutive hours of operation without overheating or showing signs of undue stress and within specified frequency variations
 - Freedom from vibration and noise
 - Governor response, over speed trip and speed gear capability
- Voltage regulator response
- Excitation at full load and under specified variation of voltage and speed

Window type annunciators shall be supplied and mounted on generator control panel to give visual and audible indication for the following conditions.

- High jacket cooling water temperature
- High lubricating oil temperature
- Low lubricating oil pressure
- Low fuel oil tank level
- Engine over speed and trip
- Over current
- Earth fault
- Contactor on & off indication
- Voltage out of limit
- Excitation failure
- Generator fault

25.12 Drawings And Data

The BIDDER shall furnish the following drawings/data in the Technical Bid.

- Control panel dimensions and drawing showing plan, front view, foundation details, inside view, terminal block location etc.
- Schematic diagrams of the electrical circuitry
- General arrangement of the complete DG Set.

25.13 Testing and Commissioning

The supplier shall perform all the standard shop tests to ensure that the equipment conforms to the specifications and meets the performance guarantees.

The installation / commissioning of the D. G set shall be as per the applicable code of practice and the MANUFACTURER'S instructions.

schedule of Particulars

General Notes

At the time of bidding, the Bidder is required to furnish the relevant details for each pumping station with respect to all the plant and equipment proposed to be installed as required in the schedule- I below and to be annexed with BOQ.

Particulars given in these Schedules will be binding on the Contractor and may not be varied, except with the consent in writing of the Engineer. The approval or otherwise of the particulars given, shall be deemed in no way to relieve the Contractor of any of his obligations under the Contractor.

The Contractor shall supply, install and connect all cables for the installation of the

equipment included in these Schedules. The sizes of these cables will be determined by the contractor and be subject to approval by the Engineer.

The Contractor shall be responsible for accurately estimating length and rating of all cables, in accordance with the Specification.

The Contractor will be required to furnish a comprehensive schedule of all cables showing core numbers, termination numbers etc. for approval.

SCHEDULE - I

S.No.	Description	Unit
	Pumping Station -	
	Submersible pumps	
1	Manufacturer	
2	Model No.	
3	Net positive Suction head required	m
4	Maximum flow	lps
5	Total head at Maximum flow rate	m
6	Guaranteed efficiency of pump at duty point	%
7	Impeller size	mm
8	Solid handling capacity	mm
9	Full load current	Amp
10	Motor speed	rpm
11	Thermostat fitted	Y/N
12	Cable length attached (minimum 10 m)	m
13	Material:	
a	- Casing	
b	- Impeller	
c	- Shaft	
14	Continuous Motor rating	KW
15	Type of thrust bearing Type of journal bearing	
16	Pump Performance Curves supplied (Q vs H, P, n & NPSH)	Y/N

Description	Unit
Pumping Station -	
Bus Bars	
Material	
Cross section	mm
Continuous current rating	Amp
Type of insulation	
Current Transformer	
Make	
Type	
C T Ratio	
Voltage Transformer	
Make	
Type	
Ratio	
Over voltage vector	
Power Capacitor	
Make	
Type	
Capacity of the Bank	kVAR
Capacitor element	
Type of insulation used	
Automatic power factor correction unit installed	Y/N

ABBREVIATIONS AND ACRONYMS

S.W	Stoneware
C.I.	Cast Iron
C.M.	Cement Mortar
Cm	Centimetre
UP Jal Nigham	Uttar Pradesh Jal Nigham Ltd.,
Cum	Cubic meter
Dia.	Diameter
D.I.	Ductile Iron.
Km	Kilometer
M.H.	Manhole
M.S.	Mild steel
m	Meter
mm	Millimeter
R.C.C.	Reinforced Cement Concrete
sq.cm	Square centimeter
W.C. (ratio)	Water Cement (ratio)

Annexure -1

Annexure-1 (Part-C-Table 5-1) Establishment charges towards maintenance of sewer system		
Establishment Cost Calculation in Rs Lakhs for Illustrative Capacities of Sewer Systems		
The numbers in the cells bound by columns B to J and rows from 5 to 26 are considered reasonable		
The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time		
	Agra UGSS	
Length of sewers in km	142	monthly pay
Executive Engineer		
Portion of time charged for Sewers		
Assistant Executive Engineer	1	
Portion of time charged for Sewers	1	
Assistant Engineer	2	
Portion of time charged for Sewers	1	
Junior Engineer		
Portion of time charged for Sewers		
IIT qualified plumber	2	
semi-skilled labourers	2	
unskilled labourers	4	
watchman & security	3	
Office assistant	1	
Office computer operator	1	
Office driver		
tapal messenger	1	
Monthly salary in Rs lakhs	3.09	
Leave salary allowances as %	0.15	
Administrative overheads as %	0.1	
Margin for emergencies at %	0.05	
Margin for retirement benefits	0.10	
Monthly salary in Rs lakhs	4.33	
Monthly salary, Rs Lakhs /km sewer	0.030	
Annual Charges towards establishment charges		

Annexure – 2

annexure-2 (Part-C-Table 5-2) Establishment charges towards pumping plants

Establishment Costs in Rs Lakhs Calculation for Illustrative Capacities of Sewage Pumping Stations (SPS)			
The numbers in the cells bound by columns B to J and rows from 5 to 26 are considered reasonable			
The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time			
Installed Kw of pump sets	789.2		monthly pay
Executive Engineer			
Portion of time charged for SPS			
Assistant Executive Engineer	1		
Portion of time charged for SPS	1		
Assistant Engineer	2		
Portion of time charged for SPS	1		
Junior Engineer			
Portion of time charged for SPS			
IIT qualified plumber	4		
semi-skilled labourers	2		
unskilled labourers	2		
watchman & security	3		
Office assistant	1		
Office computer operator	1		
Office driver			
tapal messenger	1		
Monthly salary in Rs lakhs	3.19		
Leave salary allowances as %	0.15		
Administrative overheads as %	0.1		
Margin for emergencies at %	0.05		
Retirement benefits	0.10		
Monthly salary in Rs lakhs	4.47		
Monthly salary in Rs Lakhs per 1000Kw	5.66		
Annual Charges			

Annexure -3

annexure-3 Part-C-Table 5-3 Establishment charges towards STP

Establishment Cost in Rs Lakhs Calculation for Illustrative Capacities of Mechanized Sewage Treatment Plants (STPs)			
The numbers in the cells bound by columns B to J and rows from 5 to 29 are considered reasonable			
The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time			
Operating MLD of STP	28	15	monthly pay
Executive Engineer			
Portion of time charged for STP			
Assistant Executive Engineer	1	1	
Portion of time charged for STP	0.5	1	
Assistant Engineer	3	3	
Portion of time charged for STP	0.5	1	
Junior Engineer			
Portion of time charged for STP			
Diploma qualified electrician	1	1	
IIT qualified electrician	2	2	
IIT qualified plumber	1	1	
semi-skilled labourers	2	2	
unskilled labourers	2	4	
watchman & security	3	3	
Office assistant	1	1	
Office computer operator	1	1	
Office driver			
Chemist	1	1	
microbiologist			
lab assistant	1	2	
tapal messenger	1	1	
Monthly salary in Rs lakhs	3.11	4.33	
Leave salary allowances as %	0.15	0.15	
Administrative overheads as %	0.1	0.1	
Margin for emergencies at %	0.05	0.05	
Retirement benefits	0.10	0.10	
Monthly salary in Rs lakhs	4.35	6.06	
Annual Charges		I	

Annexure – 4

Annexure-4 charges towards Operating staff cost for pumping plants
Operating cost towards staff

SPS details	Pump operator	Helper/fitter	Electrician	Mechanic	Watchman
Kohlai SPS to STP	2	2	1	1	1
New SPS to STP	2	2	1	1	1
Dandupura LS to EMH-42	2	2	1	1	1
Mewati LS to EMH-134	2	2	1	1	1
Proposed LS at Kalalkeria	2	2	1	1	1
Total	10	10	5	5	5
Pay/day					
Amount/day					

Sewer Collection system					
Fitter 1 for 16km					
Helper 2 for 16km					

Grand Total/day		
Annual expenditure		

Annexure – 5

Annexure 5 Charges towards energy charges for Pumping stations

Core Area

Sl. No	Location	Installed capacity in kW/HP	Running load in kW	Energy Consumption in kWh/day	Energy Consumption in kWh/month	Energy Charges @ Rs.6.35/unit	kVA Charges 120/kW. month	Total Amount/month
A	Existing							
1	Kohlai SPS to STP							
2	New SPS to STP							
3	Dandupura LS to EMH-42							
4	Mewati LS to EMH-134							
5	Proposed LS at Kalalkeria							
	Total							
						Annual Charges		

Location	hm	Diesel consumption			Ave hrs run/day	Total Diesel consumption/day	Cost/lit	Total cost of diesel	Number of days run in an year	Cost/Annum	Cost of lub/annum	Total cost/Annum
Kolhai SPS												
New SPS												
											Total	

Total Energy & Fuel Charges (Core Area)



Annexure – 6

Annexure-6 Minor & major repair

Core area Pumps

Sl.No			Capital cost of Mechanical & electrical items		
1	Kohlai SPS to STP				
2	New SPS to STP				
3	Dandupura LS to EMH-42				
4	Mewati LS to EMH-134				
5	Proposed LS at Kalalkeria				
		Annual Expenditure			

Specification of Vacuum Sewerage System

Technical Specification

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1.2	Gravity Sewers.....	1
1.3	Isolation Valves	1
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1.4.1	Pre-cast Concrete Units.....	1
2	Vacuum Station Equipment	2
2.1	Sewage Collection Vessel	2
2.2	Vacuum Pumps	2
2.2.1	Rotary Vane.....	2
2.3	Sewage Discharge Pumps.....	2
2.4	Pipework and Valves	3
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1 Field Equipment

1.1 Vacuum Sewers and Fittings

The recommended material for vacuum sewers is polyethylene. The principal advantage of this material is its great resilient strength, which means that ground movements, settlement etc. do not cause cracks or breaks in the sewers. Also, the use of electro-fusion couplers creates joints that have even greater strength than pipe itself, as opposed to the situation with other jointing techniques which create a joint somewhat weaker than the pipe.

Polyethylene is manufactured in a wide range of pressure ratings. Generally PE100 PN10 is acceptable for vacuum sewers.

Electro-fusion couplers are the preferred method of pipe jointing.

1.2 Gravity Sewers

It is a requirement that the gravity pipes leading to vacuum interface valve chambers be constructed from PVC pipe of pressure rating 6 kg/cm².

1.3 Isolation Valves

Isolation valves enable each vacuum sewer to be individually isolated either as a whole using the station valves or in sections using the valves within the sewer network itself.

The preferred valves are resilient seated gate valves. Resilient seated gate valves should be capable of withstanding a vacuum pressure of -0.8 bar and passing a hard solid sphere with a diameter equal to 100% of the nominal bore of the valve. The body, bonnet, gate and bridge should be fabricated from ductile or cast iron. The stem should be stainless steel, and the gate should be encapsulated with EPDM.

1.4 Interface Valve Chambers

Many configurations and materials are successfully used worldwide for the interface valve collection chamber. The sections are made from pre-cast concrete units. The internal diameter of the sections for standard chambers may be as small as 900mm or as large as 1500mm. All these and other variants have been successfully employed in systems.

Once the basic requirements of the components are understood, the most suitable variant for a particular project may be determined by the engineer. Certainly there are no rigid standards relating to material, shape or size that cannot be adapted to best suit each project.

1.4.1 Pre-cast Concrete Units

Typically the pre-cast concrete units will be 1050mm or 1200mm internal diameter.

The units themselves must be of sufficient weight to require no anti-floatation measures which is an advantage in an area with a high water table.

Unit joints are made watertight by the use of an approved sealant and grommets used at the pipe penetrations. The units should be capable of withstanding compression and easily able to withstand all imposed loads.

The benching in the wet sump should be designed to ensure that there is no hang up of solids, resulting in a clean and relatively odor free environment.

The floor slab of the valve chamber should have an access way to the wet sump section, complete with a loosely fitted cover. The use of correctly sealed joints between the units and a well fitted manhole cover will ensure no water ingress into the chambers. Minimum access through the manhole cover should be 600 mm unless otherwise specified.

2 Vacuum Station Equipment

2.1 Sewage Collection Vessel

The sewage collection vessel within the vacuum station should be manufactured from welded steel .

A steel vessel must be designed to the following criteria:

- Design pressure Full vacuum
 - Working pressure -0.8 bar G
 - Hydraulically tested to 1.5 bar G
 - Design temperature 0°C to 50°C
 - Corrosion allowance 1mm
 - Minimum Protective Finish Grit blast inside and outside
- One coat primer inside and outside

NOTE: Local codes for sewage containment may require additional internal protection.

2.2 Vacuum Pumps

Technology provider recommends the use of rotary vane (aqua) pump.

2.2.1 Rotary Vane

Sliding vane vacuum pumps produce vacuum pressures over considerable ranges.

The compressor consists essentially of a rotor mounted eccentrically inside a cylinder. Loose vanes are arranged to slide in slots in the rotor. As the rotor revolves the vanes are flung by centrifugal force against the cylinders wall to form a series of cells of varying volume. On one side the increase in volume creates a vacuum while on the other side the reduction in volume produces compression of the entrained air.

2.3 Sewage Discharge Pumps

Two identical sewage discharge pumps are required. Each must be capable of discharging sewage at a rate equal or greater to the calculated design peak flow against the head conditions within the system. Recommended pumps are horizontally mounted dry well centrifugal pump.

Pumps should be fitted with either roller or ball bearings housed within a cast iron casing. These bearings must be designed to carry all axial and radial thrust loads across the pump operating range.

The impeller is normally cast iron, non-clogging, statically and dynamically balanced. Pumps must be capable of passing at least a 50 mm sphere; other pumps must be capable of passing a 75 mm sphere as a minimum. The impeller should be attached to a high tensile steel drive shaft fitted with a renewable hardened steel sleeve.

The pump should be fitted with back to back oil seals with a backing washer fitted both at the front and the back of the glands. The impeller housing should be manufactured from cast iron and incorporate a covered hand hole for clearing the pump. The pumps should have cast iron extensions to carry direct mounted motors on fabricated steel stools.

2.4 Pipework and Valves

Generally, pipework within the vacuum station may be divided between the sewage discharge segment, which is formed from ductile iron, UPVC or polyethylene pipe and fittings and the vacuum segment which is formed from UPVC.

The discharge segment includes the pipework between:

- The collection vessel and sewage pump inlets.
- The sewage pump outlets and the discharge main.

The latter should be extended to 1 metre beyond the vacuum station wall from where it can be changed to the selected pumping main material.

Pipework and fittings should be jointed with standard flanges with plated bolt sets. EPDM rubber gaskets should be used between all flanges.

All pipework should be adequately supported by posts, brackets or concrete stools.

Isolation valves must be as described in Section 1.4 Isolation Valves. Non-return valves must be resilient seated flap valves with external weighted lever to assist closure or ball type.

The vacuum segment includes the pipework between:

- The pipework from the collection vessel to the vacuum pumps;
- The air exhaust from the vacuum pumps to atmosphere;
- The plumbing arrangement around the vacuum pumps; and
- The auxiliary suction pipe used for emptying the drainage sump in the station building.

The recommended pipework is UPVC. Ball stop valves and check valves must be used in the vacuum pipework. All pipework should be adequately supported with appropriate bracketry.

The auxiliary suction pipe is used to permit draining of the washdown sump within the station building. This sump is typically 400mm x 400mm x 300mm deep. It is not normally necessary to install an interface valve in the washdown sump. A manually operated valve is adequate, which should be a ball stop valve placed in a position to be easily accessible for operation.

2.5 Electrical Control Panel

The pumping equipment within the vacuum station is controlled by an electrical control panel. This is a custom made item and must comply with the local and national codes regarding construction and component standards.

3 Valve Monitoring

The interface valve monitoring system detects the status of each interface valve on a vacuum system and indicates whether the valve is open or closed on a PLC / HMI panel located within the vacuum station.

This is an essential operational tool as it pin points valves which have failed to close properly and are therefore causing a loss of pressure within the vacuum system. A loss of pressure is generally caused by a foreign object preventing the plunger inside an interface valve from properly sealing the sewer pipe and it is at this stage that the monitoring system becomes invaluable in locating the troublesome valve.

The method of operation is simple. A programmable proximity switch attached to the body of each interface valve detects whether the valve is open or closed. This information is relayed to the vacuum station via a special signal cable installed alongside the vacuum sewer pipes. Within the vacuum station a valve monitoring HMI touch screen display indicates the open and closed status of each valve.

A visit to the collection chamber housing the valve will then allow the problem to be rectified.

When pressure losses are occurring on the vacuum system, the speed at which problem valves can be identified is greatly increased using this system. This in turn significantly reduces the time required on site by maintenance crews and allows the vacuum system to be quickly returned to normal operation.

