



**CHENNAI METROPOLITAN WATER SUPPLY AND SEWERAGE BOARD
CHENNAI- 600 002**

NATIONAL COMPETITIVE BIDDING

BID DOCUMENT

FOR

**SHIFTING OF EXISTING 800MM DIA M.S. WITH 800MM DIA D.I.,
450MM DIA D.I. AND 100MM DIA D.I. WATER MAINS FOR THE PROPOSED
CONSTRUCTION OF GRADE SEPARATOR IN G.N.T. ROAD
(MOOLAKADAI JUNCTION), DEPOT – 2, AREA – I**

CONTRACT NO: CNT / WSS / MWB / DEP / 2000 / 2010-11

BID DOCUMENT

VOLUME - I

**INVITATION FOR BIDS
INSTRUCTIONS TO BIDDERS
CONDITIONS OF CONTRACT
CONTRACT DATA**

**SUPERINTENDING ENGINEER (CONTRACTS & MONITORING)
CHENNAI METROPOLITAN WATER SUPPLY & SEWERAGE BOARD
No.1, Pumping Station Road, Chintadripet, Chennai 600 002.
Telephone: 044 – 28451300 Fax : 044 – 28458181
E-mail : cmwssb@md2.vsnl.net.in**

NAME OF WORK	SHIFTING OF EXISTING 800MM DIA M.S. WITH 800MM DIA D.I., 450MM DIA D.I. AND 100MM DIA D.I. WATER MAINS FOR THE PROPOSED CONSTRUCTION OF GRADE SEPARATOR IN G.N.T. ROAD (MOOLAKADAI JUNCTION), DEPOT – 2, AREA – I
CONTRACT NO	CONTRACT NO: CNT / WSS / MWB / DEP / 2000 / 2010-11
PERIOD OF SALE OF BIDDING DOCUMENT	FROM 06.05.2010 TO 20.05.2010.
DATE OF PRE BID MEETING	14.05.2010 AT 11.00 A.M
LAST DATE AND TIME FOR RECEIPT OF BIDS	21.05.2010 UPTO 15.00 HOURS
DATE AND TIME OF OPENING OF TECHNICAL BID	21.05.2010. AT 15.30 HOURS
COMPLETION PERIOD OF CONTRACT	180 DAYS
OFFICER INVITING BIDS	SUPERINTENDING ENGINEER (CONTRACTS & MONITORING) CMWSS BOARD No.1, PUMPING STATION ROAD CHINTADRIPET CHENNAI-600 002
PLACE OF OPENING OF BIDS	OFFICE OF THE SUPERINTENDING ENGINEER (CONTRACTS & MONITORING) CMWSS BOARD No.1, PUMPING STATION ROAD CHINTADRIPET CHENNAI-600 002
ADDRESS FOR PURCHASE OF BID DOCUMENT.	INFORMATION FACILITATION OFFICER, CMWSS BOARD, NO:1, PUMPING STATION ROAD CHINTHADRIPET, CHENNAI-2

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1. NOTICE INVITING TENDERS (NIT)

**CHENNAI METROPOLITAN WATER SUPPLY AND SEWERAGE BOARD
NO.1, PUMPING STATION ROAD,
CHINTADRI PET, CHENNAI-600 002.**

NOTICE INVITING TENDER

NATIONAL COMPETITIVE BIDDING

Sealed Bids are invited from the eligible bidders for the following work. Bidding will be conducted through National Competitive Bidding procedures of CMWSSB under two cover system conforming to the Tamil Nadu Transparency in Tenders Act, 1998 and Rules 2000.

1. Name of the work:

Sl. No.	Name of the work	Bid security (Rs.)	Sale period	Due date & time for opening of tenders	Contract period
1)	Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I CONTRACT NO: CNT / WSS / MWB / DEP / 2000 / 2010-11	91,500	06.05.2010 to 20.05.2010	21.05.2010 at 3.30 p.m.	180 Days
2.i	Date of Pre-bid meeting	14.05.2010 at 11.00 A.M.			
2.ii	Due date for submission of Bids	On or before 3.00 P.M. on 21.05.2010			
3.i	Availability of Bid Document in person	Information & Facilitation Officer, CMWSS Board, No.1, Pumping Station Road, Chintadripet, Chennai 600 002. (Telephone: 044-28451300, Extn. 227)			
3.ii	Through Website	www.chennaietrowater.tn.nic.in & www.tenders.tn.gov.in			
4	Cost of Bid Document	Rs.5,200/- per set payable in the form of cash or DD / Pay order drawn from a Nationalised / Scheduled Bank in favour of Managing Director, CMWSSB.			
5	Address for information and clarifications and receipt of bids / tenders	Office of Superintending Engineer, Contracts & Monitoring, 4 th Floor, CMWSS Board, Chennai 600 002. Phone No.044-2845 1300 Extn.253 FAX:044-2845 8181			

SUPERINTENDING ENGINEER
CONTRACTS & MONITORING

SECTION 2: INSTRUCTIONS TO BIDDERS
(ITB)

2: Instructions to Bidders

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A. General

1. Scope of Bid

- 1.1 The Chennai Metropolitan Water Supply and Sewerage Board** invites bids Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I (as defined in these documents and referred to as "the works") detailed in the table given in Invitation for Bids.
- 1.2** The successful bidder will be expected to complete the works by the intended completion date specified in the Contract data.
- 1.3** Throughout these Bidding documents, the terms bid and Tender and their derivatives (bidder/Tenderer, bid/tendered, bidding/Tendering, etc) are synonymous and day means calendar day. Singular also means plural.

2. Source of Funds

- 2.1** The Ministry of Urban Development, Government of India has approved 35% Grant and Govt. of Tamil Nadu has approved 15% Grant towards this Project under Jawaharlal Nehru National Urban Renewal Mission funding and the balance funds by the Local Body.

3. Eligible Bidders

- 3.1** This *Invitation for Bids* is open to all eligible bidders. Payments will be made only in Indian Rupees.
- 3.2** All bidders shall provide in Section 3, Forms of Bid and all Qualification Information required under this contract.
- 3.3** Deleted.
- 3.4** Bidders shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by the Bank in accordance with sub-clause 37.1.

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** Pre-qualification was not undertaken for this contract.
- 4.3** All bidders shall include the following information and documents with their bids in Section 3:
- (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 construction work performed for each of the qualifying period.
 - (c) Experience in works of a similar nature and details of the work completed successfully during the qualifying period, and details of works under way or contractually committed; and clients who may be contacted for further information on those contracts;
 - (d) Major items of construction equipment proposed to carry out the Contract;
 - (e) Qualifications and experience of key site management and technical personnel proposed for the Contract;
 - (f) Reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past five years;
 - (g) Evidence of adequacy of working capital for this contract (access to line (s) of credit and availability of other financial resources);
 - (h) Authority to seek references from the Bidder's bankers;
 - (i) Information regarding any litigation or arbitration resulting from contracts executed by the Bidder in the last eight years or currently under execution. The information shall include the names of the parties concerned, the disputed amount, cause of litigation, and matter in dispute;
 - (j) Proposals for subcontracting components of the Works which in aggregate add to more than 20 percent of the Bid Price (for each, the qualifications and experience of the identified sub-contractor in the relevant field should be annexed); and

- (k) the proposed methodology and program of construction including Environmental Management Plan, backed with equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications within the stipulated period of completion as per milestones.
- (l) All the credentials furnished by the bidder towards satisfying the qualification criteria shall be duly certified by a “Notary Public”.
- (m) The credentials to meet the qualification criteria for sl nos (2) to (3) of 4.5A shall be from the client /Employer. No Self-certification will be accepted.

4.4 Bids submitted from a consortium not accepted.

4.5 A. To qualify for award of the contract, each bidder in its name should have performed / executed the following during the period 1.04.2004 to 31.03.2009

Sl. No.	Qualification Criteria	Minimum required qualification
1	Annual financial turnover achieved in any one financial year during 2004-2005 to 2008 -2009 not less than the amount given (Rs. in Lakh). Only audited financial statement will be considered.	163
2	Satisfactorily completed any single work of value not less than the amount given (Rs. in Lakh)	66
3	Should have supplied, laid and satisfactorily commissioned DI pipeline of dia not less than 400mm dia to a minimum length in any one year (Length in meter).	80

For Sl. Nos. (2) & (3) above, the experience of the bidders up to the date of bid submission will be considered for evaluation.

The bids of the Contractors whose previous performance is found to be poor / not satisfactory, will not be taken up for evaluation

- Financial turnover and cost of completed works of previous years shall be given weightage of 6% per year based on rupee value to bring them to 2010-2011 price level and that will be considered for the qualifying criteria.

4.5 B. Each bidder should further demonstrate:

- (a) Availability (either owned or leased or by procurement against mobilization advances) of the following key and critical equipment for this work:

Civil

Earth mover (J.C.B.)	2 nos.	0.5 Cu. M. each
Trucks/tippers/dumpers	5 nos.	6 - 10 Tonnes, each
Dewatering pumps 1 HP, 2 HP, 5HP & 10 HP	2 nos. each	
Mobile DG set	2 nos.	100 KVA

Mechanical

Hydraulic mobile crane	2 nos.	Boom height 6 m (10 T)
Chain pulley block	2 nos.	5T Capacity
Tools and plants for jointing pipes	3 nos.	
Pipe cutting machinery	3 nos.	
Welding Transformers	5 nos.	
Drilling Machines	5 nos.	

NOTE:

Based on the studies, carried out by the Engineer the minimum suggested major equipment to attain the completion of works in accordance with the prescribed construction schedule are shown in the above list.

The bidders should, however, undertake their own studies and furnish with their bid, a detailed construction planning and methodology supported with layout and necessary drawings and calculations (detailed) as stated in clause 4.3 (k) above to allow the Employer to review their proposals. The numbers, types and capacities of each plant/equipment shall be shown in the proposals along with the cycle time for each operation for the given production capacity to match the requirements.

- (b) Availability for this work of a Project Manager with minimum of 5 years experience in a Project of size similar to the present work and other key personnel with adequate experience as indicated in the Contract Data; and
- (c) Liquid assets and/or credit facilities of not less than **Rs.33 lakhs.**
(Credit lines/letter of credit/certificates from Banks for meeting the funds requirement etc.)

4.5 C. Deleted

4.6 Sub-contractor's experience and resources will not be taken into account in determining the Bidder's compliance with the qualifying criteria. The experience of the bidder to the extent of work done as a Sub Contractor in past and duly certified by the owner of the project will be considered.

4.7 Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity is more than the value put to Tender. The available bid capacity will be assessed at the time of Technical evaluation of Bids itself with reference to value Put to Tender. In case of the Bidders who do not satisfy the requirement of the Bid Capacity, their bids will be treated as non-responsive and their price bids will not be opened.

$$\text{Assessed Available Bid capacity} = (A * N * 1.5 - B)$$

Where

A = Maximum value of engineering works executed in any one year during the last five years (updated to 2010-2011 price level) 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 = 6 months (0.5 year.)

B = Value at 2010-2011 price level of existing commitments and on-going works to be completed during the next 6 months (180 days)

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.

4.8 Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:

-made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or

-record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.; and/or participated in the previous bidding for the same work and had quoted unreasonably high bid prices and could not furnish rational justification to the employer.

5. One Bid per Bidder

Each bidder shall submit only one bid individually. A bidder who submits or participates in more than one Bid (other than as a subcontractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Bidder's participation to be disqualified.

1. 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 and liable for those costs.

7. Site visit

7.1 The Bidder, at the Bidder's own responsibility and risk is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The bidder shall also give a certificate to the effect that he has inspected the site. The costs of visiting the Site shall be at the Bidder's own expense.

B. Bidding Documents

8. Content of Bidding Documents

8.1 The set of bidding documents comprises the documents listed in the table below and addenda issued in accordance with Clause 10:

Section 1	Invitation for Bids
2	Instructions to Bidders
3	Forms of Bid and Qualification Information
4	Conditions of Contract
5	Contract Data
6	Forms of Securities
7	Specifications
8	Drawings
9	Bill of quantities

8.2 Of the three sets of the bidding documents supplied, two sets should be completed and returned with the bid.

9. Clarification of Bidding Documents

9.1 A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by mail/ e-mail/telex/facsimile at the Employer's address indicated in the invitation to bid. The Employer will respond to any request for clarification, which he received earlier than 7 days prior to the deadline for submission of bids. 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 Pre-bid meeting

9.2.1 The bidder or his official representative is invited to attend a pre-bid meeting, which will take place at **Chennai Metropolitan Water Supply and Sewerage Board, No.1 Pumping station Road, Chintadripet, Chennai – 600002** on 14.05.2010 at 11.00 Hours.

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

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

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

9.2.5 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.
- 10.2** Any addendum thus issued shall be part of the bidding documents and shall be communicated in writing/e-mail/facsimile to all the purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each addendum by cable to the Employer.
- 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 Sub-Clause 20.2 below.

C. Preparation of Bids

11. Language of the Bid

- 11.1** All documents relating to the bid shall be in the English language.

12. Documents comprising the Bid

- 12.1** The bid submitted by the bidder shall comprise the following:

First Cover – Technical Bid

- (a) Bid Security.
- (b) Technical Bid;
- (c) Qualification Information Form and Documents;
- (d) The Bid (in the format indicated in Section 3)

Second Cover – Financial Bid

- (e) Priced Bill of quantities

and any other materials required to be completed and submitted by bidders in accordance with these instructions. The documents listed under Sections 3 and 9 of Sub-Clause 8.1 shall be filled in without exception.

The Bids must be accompanied with the prescribed Bid security amount in a separate envelope kept in the Technical bid envelope. The first cover with Bid Security cover and Technical Bid cover shall be written on the cover as "Technical Bid" and "Bid Security". The second cover with the Financial Bid shall be written on the cover as "Financial Bid".

- 12.2** Bidders bidding for this contract together with other contracts stated in the IFB/NIT to form a package will so indicate in the bid together with any discounts offered for the award of more than one contract.

13. Bid Prices

13.1 The contract shall be for the whole works as described in Sub-Clause 1.1, based on the priced Bill of Quantities submitted by the Bidder.

13.2.1 The bidder shall fill in rates and prices and line item total (both in figures and words) for all items of the Works described in the **Bill of Quantities** along with total bid price (both in figures and words). *Items for which no rate or price is entered by the bidder will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities.* Corrections, if any, shall be made by crossing out, initialing, dating and rewriting.

13.3 All duties, taxes, 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. However, the bidders are informed that, as per the Govt. of India Central Excise notification No.26/2009 dated 04.12.2009, the pipes of outer diameter exceeding 20cm and when such pipes are integral part of the water supply projects are exempted from payment of Excise Duty. In consideration of the above notification, the bidders have to quote the bid prices for pipes outer diameter exceeding 10 cm, without Excise Duty. Any statutory variations in duties / taxes, which takes effect from a date subsequent to the due date for receipt of tender, shall be to CMWSS Board's Account.

13.4 The rates and prices quoted by the bidder are fixed.

14. Currencies of Bid and Payment

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 not less than (120 days) **one hundred and twenty days** after the deadline date for bid submission specified in Clause 20. 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 bid security. 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 bid security for a period of the extension, and in compliance with Clause 16 in all respects.

15.3 Deleted

16. Bid Security

16.1 The Bidder shall furnish, as part of his Bid, a Bid security in the amount as shown in column 4 of the table of IFB for this particular work. This bid security shall be in favour of **Managing Director, CMWSSB** and may be in one of the following forms:

- Certified Bankers Cheque, Bank draft or Pay order in favour of **Managing Director, CMWSSB** payable at **Chennai** from any Nationalised / Scheduled Bank
- Bank guarantee will not be accepted for bid security.

16.2 Deleted

16.3 Any bid not accompanied by an acceptable Bid Security and not secured as indicated in Sub-Clauses 16.1 above shall be summarily rejected by the Employer.

16.4 The Bid Security of unsuccessful bidders will be returned as promptly as possible upon the award of contract and on written request from the unsuccessful bidder. The bid security of the bidder who has refused to extend the bid validity as provided in 15.2 shall be refunded after the initial bid validity based on written request from the bidder. Employer shall pay no interest on the bid security.

16.5 The Bid Security of the successful bidder will be discharged when the bidder has signed the Agreement and furnished the required Performance Security.

16.6 The Bid Security may be forfeited

- (a) if the Bidder withdraws the Bid after opening of technical Bid during the period of Bid validity;
- (b) if the Bidder does not accept the correction of the Bid Price, pursuant to Clause 27; or
- (c) in the case of a successful Bidder, if the Bidder fails within the specified time limit to
 - (i) sign the Agreement; or
 - (ii) furnish the required Performance Security.

17. Alternative Proposals by Bidders

17.1 Alternative proposal will not be considered.

18. Format and Signing of Bid

18.1 The Bidder shall prepare one original and one copy of the documents comprising the bid as described in Clause 12 of these *Instructions to Bidders*, bound with the volume containing the Form of Bid, and clearly marked "**ORIGINAL**" and "**COPY**" as appropriate. In the event of discrepancy between them, the original shall prevail.

- 18.2** The original and copy of the Bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder, pursuant to Sub-Clauses 4.3. All pages of the bid where entries or amendments have been made shall be initialed by the person or persons signing the bid.
- 18.3** The Bid shall contain no alterations or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the bidder, in which case such corrections shall be initialed by the person or persons signing the bid.
- 18.4** The Bidder shall furnish information as described in the Form of Bid on commissions or gratuities, if any, paid or to be paid to agents relating to this Bid, and to contract execution if the Bidder is awarded the contract.

D. Submission of Bids

19. Sealing and Marking of Bids

- 19.1** The bid shall be submitted in two (2) parts viz. **PART – A and PART - B**. Each part shall be placed in an independent sealed envelope. Each part shall be labeled as follow

PART - A : TECHNICAL BID ENVELOPE

Contract No. : CNT / WSS / MWB / DEP / 2000 / 2010-11

Name of work : Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I

Due date/time : 21.05.2010 @ 15.00 HRS.

PART - B : PRICE BID ENVELOPE

Contract No. : CNT / WSS / MWB / DEP / 2000 / 2010-11

Name of work : Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I

19.2 The contents of each of the two (2) envelopes shall be as described in the subsequent clauses. For all further references, these envelopes will be referred to briefly as:

- Technical bid Envelope
- Price bid Envelope
- The envelope containing Part A and the envelope containing Part B shall be placed inside an outer envelope and shall be labeled as follows:

Bid for: Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I

PART - A : Technical Bid Envelope

PART - B : Price Bid Envelope

Contract No. : CNT / WSS / MWB / DEP / 2000 / 2010-11

Due date & time : 21.05.2010 @ 15.00 HRS.

19.3 The envelope shall be addressed to

**The Superintending Engineer (Contracts & Monitoring)
Chennai Metropolitan Water Supply and Sewerage Board
No.1, Pumping Station Road
Chintadripet, Chennai 600 002**

Each envelope shall carry the name and address of the Bidder prominently.

19.4 The Technical Bid Envelope shall contain the following in the sequence indicated below. The technical bid shall be submitted in two copies.

- i. Covering letter
- ii. Performance Certificate obtained from the clients as per Qualification Information
- iii. The Bid Security
- iv. Letter of Tender / Contractor's Bid with full signature of the Authorized signatory and Seal
- v. Declaration by the Bidder that his Bid is without any technical and commercial deviations in the format of the letter enclosed with the Bid.
- vi. Certified Power of Attorney authorizing a representative or representatives of the Firm to sign the Bid and all subsequent communication
- vii. Documentary evidence of unambiguous fulfillment of eligibility criteria for Bidding.

- viii. Latest Income Tax Clearance Certificate and Sales Tax Clearance Certificate.
- ix. Bid document signed by the authorized signatory.
- x. Full technical description of the items and services proposed by the Bidder including makes.
- xi. Details of Construction Equipment proposed for the execution of the works and makes.
- xii. Details of manpower proposed for the Project Management and Site Management including qualification and experience of the personnel.
- xiii. Work methodology and plan.
- xiv. Bar Chart and PERT charts for the execution of the works
- xv. Confirmation of performance guarantee and Defects Liability Period in accordance with Clause 35 of the Conditions of Contract.
- xvi. Confirmation of the commercial terms and conditions. **There shall be no reference to the price****
- xvii. List of concurrent commitments including a schedule of contracts under execution including values, percentage of works completed and the schedule date of completion of the work.
- xviii. Any other technical details

19.5 The "Technical Bid Envelope" shall **NOT** contain the following:

- i. Schedule of Prices of the Bid Document constituting the Lump Sum Bid Price.
- ii. Any indication either direct or indirect or implicit or explicit or implied regarding the Bid Price or its break up details or any other related price indication etc. shall be a cause for outright disqualification of the entire Bid.

19.6 The envelope labeled, as "Price Bid Envelope" shall contain the following in the sequence indicated below. This shall be submitted as two copies – 1 original and 1 copy.

- i. Covering letter
- ii. The Bid Price for the work with each page signed, dated and stamped with the seal of the Firm.
- iii. Apart from the Schedule of Prices and Annexure duly filled in, Bidders shall not enclose any other documents or statements that influence the price. In such an event the Board shall summarily disqualify the Bidder and reject the Bid.

19.7 The Bidder shall seal the original and copy of the Bid in separate envelopes, duly marking the envelopes as "**ORIGINAL**" and "**COPY**". These envelopes (called as inner envelopes) shall then be put inside one outer envelope.

19.8 The **inner and outer** envelopes shall

(a) be addressed to the Employer at the following address:

**The Superintending Engineer (C & M)
CMWSSB, No.1, Pumping Station Road,
Chintadripet, Chennai -600 002**

(b) Bear the following identification:

- Bid for[name of contract]
- Bid Reference No.....[insert number]
- Do not open before ...[time and date for bid opening, as per Clause 20]

19.9 In addition to the identification required in Sub-Clause 19.2, the inner envelopes shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared late, pursuant to Clause 21.

19.10 If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the bid.

20. Deadline for Submission of the Bids

20.1 Bids must be received by the Employer at the address specified above not later than **15 hours on 21.05.2010**. In the event of the specified date for the submission of bids declared a holiday for the Employer, the Bids will be received up to the appointed time on the next working day.

20.2 The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10, 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 Any Bid received by the Employer after the deadline prescribed in Clause 20 will be returned unopened to the bidder.

Any bid submitted in person after 3.00 p.m on the due date will not be accepted. Similarly, any bid received by post after 3.00 p.m on the due date will not be accepted and will be returned unopened to the bidder. Hence the bidders are requested to submit their bid well in advance i.e., before 3.00 p.m as per the office clock on the dead line / extended dead line date and time of bid submission. The bidders can submit their bids on any day during the bid submission period.

22. Modification and Withdrawal of Bids

22.1 Bidders may modify or withdraw their bids by giving notice in writing before the deadline prescribed in Clause 20.

- 22.2** Each Bidder's modification or withdrawal notice shall be prepared, sealed, marked, and delivered in accordance with Clause 18 & 19, with the outer and inner envelopes additionally marked "**MODIFICATION**" or "**WITHDRAWAL**", as appropriate.
- 22.3** No bid may be modified after the deadline for submission of Bids.
- 22.4** Withdrawal or modification of a Bid between the deadline for submission of bids and the expiration of the original period of bid validity specified in Clause 15.1 above or as extended pursuant to Clause 15.2 may result in the forfeiture of the Bid security pursuant to Clause 16.
- 22.5** Bidders may only offer discounts to, or otherwise modify the prices of their Bids by submitting Bid modifications in accordance with this clause, or included in the original Bid submission.

E. Bid Opening and Evaluation

23. Bid Opening

- 23.1** The Employer will open all the Technical Bids received (except those received late), in the presence of the Bidders or their representatives who choose to attend at **15.30** hours on the date and the place specified in Clause 20. In the event of the specified date of Bid opening being declared a holiday for the Employer, the Bids will be opened at the appointed time and location on the next working day.
- 23.2** Envelopes marked "**WITHDRAWAL**" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 22 shall not be opened. Subsequently all envelopes marked "Modification" shall be opened and the submissions therein read out in appropriate detail.
- 23.3** The Bidders' names, Bid modifications and withdrawals, the presence or absence of Bid security, and such other details as the Employer may consider appropriate, will be announced by the Employer at the Technical Bid opening. Bids [and modifications] sent pursuant to Clause 22 that are not opened and read out at bid opening will not be considered for further evaluation regardless of the circumstances. Late and withdrawn bids will be returned un-opened to bidders. The Price bid envelope will not be opened on the same day but on another day in the presence of the qualified Bidders or their authorized representatives. The date and time of opening the Price bid envelope will be advised to the qualified Bidder in writing.
- 23.4** The Employer shall prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Sub-Clause 23.3.

- 23.5** Two cover bidding procedure will be adopted and will be processed as detailed below:

Bids (in two covers) must be delivered to the address below at or before **15.00** hrs. office time on **21.05.2010**. The first cover with Bid Security cover and Technical Bid cover shall be written on the cover as "Technical Bid" and "Bid Security" without any reference to the price. The second cover with the Financial Bid shall be written on the cover, as "Financial Bid" will consist of Price Bid only.

Late bids and Bids without Bid security will be summarily rejected.

First cover will be opened in the presence of bidders' representatives who choose to attend at the address given below at **15.30** hrs. office time on **21.05.2010** After technical evaluation of the Bids, the employer will satisfactorily open the second cover (price Bid) of the bidders who meet the minimum acceptable qualification criteria and who has submitted a technically responsive bid. Only the price bids of those bidders whose bids are found technically responsive and acceptable will be opened on the date and time to be intimated later and the price bids will be evaluated.

24 Process to Be Confidential

- 24.1** 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 effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of his Bid.

25 Clarification of Bids

- 25.1** To assist in the examination, evaluation, and comparison of Bids, the Employer may, at his discretion, ask any Bidder for clarification of his Bid, including breakdowns of the unit rates. The request for clarification and the response shall be in writing or by cable, but no change in the price or substance of the Bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Bids in accordance with Clause 27.
- 25.2** Subject to sub-clause 25.1, 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. If the Bidder wishes to bring additional information to the notice of the Employer, it should do so in writing.
- 25.3** Any effort by the Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decisions may result in the rejection of the Bidders' bid.

26 Examination of Bids and Determination of Responsiveness

- 26.1** Prior to the detailed evaluation of Bids, the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clause 3; (b) has been properly signed; (c) is accompanied by the required securities and; (d) is substantially responsive to the of the Bidding documents.
- 26.2** A substantially responsive Bid is one, which 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.
- 26.3** If a 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 non-conforming deviation or reservation.

27 Correction of Errors

- 27.1** 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 lower of the two will govern; and
 - (b) where there is a discrepancy between the unit and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.
- 27.2** The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the Bidder, be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount the Bid will be rejected, and the Bid security may be forfeited in accordance with Sub-Clause 16.6 (b).

28 Deleted

29 Evaluation and Comparison of Bids

- 29.1** The Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with Clause 26 and as per Tamil Nadu Tender Transparency Act 2000.

- 29.2** In evaluating the Bids, the Employer will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:
- (a) making any correction for errors pursuant to Clause 27; or
 - (b) making an appropriate adjustments for any other acceptable variations, deviations; and
 - (c) making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Sub Clause 22.5.
- 29.3** The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors, which are in excess of the requirements of the Bidding documents or otherwise result in unsolicited benefits for the Employer shall not be taken into account in Bid evaluation.
- 29.4 Deleted**
- 29.5** 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 34 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.
- 30 Deleted**

F. Award of Contract

31 Award Criteria

- 31.1** Subject to Clause 32, the Employer will award the Contract to the Bidder whose Bid has been determined 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, and (b) qualified in accordance with the provisions of Clause 4.
- 31.2** If, pursuant to Clause 12.2 this contract is being let on a "slice and package" basis, the lowest evaluated Bid Price will be determined when evaluating this contract in conjunction with other contracts to be awarded concurrently, taking into account any discounts offered by the bidders for the award of more than one contract.

32 Employer's Right to Accept any Bid and to Reject any or all Bids

32.1 Notwithstanding Clause 31, 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.

33 Notification of Award and Signing of Agreement

33.1 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 *Conditions of Contract* called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").

33.2 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 34.

33.3 The Agreement will incorporate all agreements between the Employer and the successful Bidder. On payment of the performance security (as per clause 34.1) by the successful bidder, the Employer will issue an unfilled document to the bidder who has to arrange for affixing the special adhesive stamp for a value not less than Rs.20/- and produce it back to the Employer. The Employer will then prepare complete set of document in which the Employer and successful bidder will sign. This exercise of signing the agreement should be completed within 10 days from the date of receipt of the performance security from the successful bidder.

33.4 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.

34 Performance Security

34.1 Within 15 days of receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Security in any of the forms given below for an amount to be calculated as per Clause 34.5 plus additional security for unbalanced Bids in accordance with Clause 29.5 of ITB and Clause 52 of CC.

- 34.2**
- i) An irrevocable bank guarantee in the form given in Forms of Securities
 - ii) In the shape of NSC/NSS/KVP/Post Office Time Deposits valid for the required Contract period and pledged in favour of Managing Director, CMWSS Board and shall have the necessary transfer endorsement of the Post Office.
 - iii) Fixed Deposit for the required period from Nationalized/Scheduled Bank/TNSC Bank in favour of Managing Director, CMWSS Board. Certified cheque/Bank Draft in favour of CMWSS Board payable at Chennai.

- 34.3** If the performance security is provided by the successful Bidder in the form of a Bank Guarantee, it shall be issued either (a) at the Bidder's option, by a Nationalized / Scheduled Indian bank or (b) by a foreign bank located in India and acceptable to the Employer.
- 34.4** Failure of the successful Bidder to comply with the requirements of Sub-Clause 34.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Bid Security.
- 34.5** The value of performance security to be remitted for construction activity will be calculated by adopting the following formula:

a)	For contracts within any plus percentage and upto minus 5% of the contract value for construction compared to the departmental estimated value for construction	2% of contract value
b)	For contracts above minus 5% and upto minus 15% compared to the departmental estimated value for construction	4% of contract value
c)	For contracts which are more than minus 15% compared to the departmental estimated value for construction	5% of contract value

35 Advance Payment and Security

- 35.1** The Employer will provide an Advance Payment on the Contract Price as stipulated in the Conditions of Contract, subject to maximum amount, as stated in the Contract Data.

36 Adjudicator

- 36.1** The Employer proposes that **Thiru. V. RAJAGOPAL** be appointed as Adjudicator under the Contract, at a daily fee of Rs.2000/- plus boarding, lodging, traveling expenses at actual. If the Bidder disagrees with this proposal, the Bidder should so state in the Bid. If in the Letter of Acceptance, the Employer has not agreed on the appointment of the Adjudicator, the Adjudicator shall be appointed by The President, Institution of Engineers (Tamilnadu State Center) Chennai at the request of either party.

37. Corrupt or Fraudulent Practices

- 37.1** The Employer requires that Bidders observe the highest standard of ethics during the evaluation and execution of such contracts. In pursuance of this policy, the Employer:

- (a) defines, for the purposes of this provision, the terms set forth below as follows :
- (i) "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the evaluation process or in contract execution; and

- (ii) “fraudulent practice” means a misrepresentation of facts in order to influence the evaluation 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 prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.
- (b) will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;
- (c) will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing a contract.

37.2 Further more, Bidders shall be aware of the provision stated in sub-clause 59.2 of the Conditions of Contract.

3. FORMS OF BID AND QUALIFICATION INFORMATION

Table of Forms:

- **CONTRACTOR'S BID**
- **QUALIFICATION INFORMATION**
- **NOTICE TO PROCEED WITH THE WORK**
- **AGREEMENT FORM**

Contractor's Bid

Description of the works : **Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I**

To Address : The Superintending Engineer (C & M)
CMWSSB
No.1, Pumping Station Road,
Chintadripet, Chennai.-600 002

GENTLEMEN,

We offer to execute the Works described above in accordance with the Conditions of Contract accompanying this Bid for the Contract Price stated in the Financial Bid.

We accept the proposal of advance Payment up to a maximum of **10%** of contract value for construction activities as per the Conditions prescribed by the Employer.

We accept the appointment of **Thiru. V.RAJAGOPAL** as the Adjudicator. (OR)

We do not accept the appointment of **Thiru. V.RAJAGOPAL** as the Adjudicator and propose instead that _____ be appointed as Adjudicator whose daily fees and biographical data are attached.

This Bid and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Bid you receive.

We undertake that in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely, "Prevention of Corruption Act, 1988).

Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded the contract, are listed below:

<u>Name and address of agent</u>	<u>Amount</u>	<u>Purpose of Commission or gratuity</u>
----------------------------------	---------------	--

_____	_____	_____
_____	_____	_____

(if none, state "none")

We hereby confirm that this Bid complies with the Bid Validity and Bid Security required by the Bidding documents.

We attach herewith our current income tax and sales tax clearance certificates.

Yours faithfully,

Authorized Signature:

Name & Title of Signatory:

Name of Bidder : _____
Address : _____

Qualification Information

The information to be filled in by the Bidder in the following pages will be used for purposes of pre-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: _____

Power of attorney of signatory of Bid
[Attach]

1.2 Annual financial turnover achieved in the last five years. (in Rs. Crores)

Sl.No.	Year	Financial turnover (Rs. in Crores) *
	2004-2005	
	2005-2006	
	2006-2007	
	2007-2008	
	2008-2009	

- *Attach a Certificate from Chartered Accountant along with Audited Balance Sheet.*

1.3.1 Works performed by the Bidder on works of a single Contract during the period from 01.04.2004 and upto the date of bid submission as detailed below:-

Project Name	Name of the Employer *	Description of work	Contract No.	Value of contract (Rs. Lakhs)	Date of issue of work order	Stipulated period of completion	Actual date of completion*	Remarks explaining reasons for delay, if any and work completed

* *Enclose certificate(s) from Engineer(s)- in- charge.*

* *The experience of the bidder to the extent of work done as a sub contractor in past and duly certified by the owner of the project will be considered.*

1.3.2 Quantities of work executed by the Bidder during the period from 01.04.2004 and upto the date of bid submission as detailed below:

a) Pipe laying works

Year	Name of work	Name of Employer *	Quantity of work executed			Remarks (Indicate contract Ref.) *
			Material DI/HDPE Pipe	Dia	Length	
2004-05						
2005-06						
2006-07						
2007-08						
2008-09						
Upto the date of bid submission						

@ *The item of Work for which data is requested should fully satisfy with that specified in ITB clause 4.5*

* *Enclose certificate(s) from Engineer(s)- in- charge.*

* *The experience of the bidder to the extent of work done as a sub contractor in past and duly certified by the owner of the project will be considered.*

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.

1.4A) Existing commitments and on-going works

Description of work (1)	Place and state (2)	Contract No. & Date (3)	Name and Address of the Employer (4)	Value of Contract (Rs. Lakhs) (5)	Stipulated period of completion (6)	Value of works remaining to be completed * (7) (Rs.Lakhs)	Anticipated date of completion. (8)

* *Enclose certificate(s) from Engineer(s)- in- charge.*

1.4 B) Works for which Bids already submitted

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

1.4 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 Instruction to Bidders.

Item of equipment	Requirement		Availability Proposals			Remarks regarding condition and from whom to be purchased/ or leased
			Owned / leased/ to be procured	Nos. / Capacity	Age/ Condition	
	Nos.	Capacity				
Civil						
Earth mover (J.C.B.)	2 nos.	0.5 Cu. m. each				
Trucks/tippers/dumpers	5 nos.	6 - 10 Tonnes, each				
Dewatering pumps 1 ,2,3, 5 & 10 HP	2 nos each					
Mobile DG set	2 nos.	100 KVA				
Mechanical						
Hydraulic mobile crane	2 nos.	Boom height 6 m (10 T)				
Chain pulley block	2 nos.	5T Capacity				
Tools and plants for jointing pipes	3 nos.					
Pipe cutting machinery	3 nos.					
Welding transformers.	5 nos.					
Drilling Machines	5 nos.					

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 Conditions of Contract.

Position	Name	Qualifications	Years of experience (general)	Years of experience in the proposed position
Project Manager				
Key personnel				
1. Civil Engineer				
3. Mechanical Engineer				

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

Sections of the works	Value of subcontract	Subcontractor (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/corporations) etc. List them below and attach copies of documents.

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 enclosed)*

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 showing present status

1.12 DELETED

1.13 Proposed work method and schedule. The Bidder should attach descriptions, drawings and charts as necessary to comply with the requirements of the Bidding documents. (Refer ITB Clause 4.1 and 4.3(k)).

2.0 CONSORTIUMS -- DELETED

3.0 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.
-
-

**SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF
CREDIT FACILITIES –**

CLAUSE 4.5 (B) (c) OF ITB

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.

Sd/
Name of Bank
Senior Bank Manager
Address of the Bank

Issue of Notice to proceed with the work
(Letterhead of the Employer)

_____ (Date)

To

_____ (Name and address of the Contractor)

Dear Sirs:

Pursuant to your furnishing the requisite security as stipulated in ITB clause 34.1 and signing of the contract for the construction of _____ @ a Bid Price of Rs. _____, you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully,

(Signature, name and
title of signatory
authorized to sign on
behalf of Employer)

- vii) Drawings;
- viii) Bill of Quantities; and
- ix) Any other document listed in the Contract Data and replies to queries, clarifications issued by the employer, such confirmations given by the bidder which are accepted by the employer and all the Addendum issued as forming part of the contract with the most recent documents taking precedence.
- x) Instruction to bidders
- xi) Safety and preventive measures and digest of labour laws (CMWSSB)
- xii) Consortium agreement

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of

was hereunto affixed in the presence of:

Signed, Sealed and Delivered by the said

in the presence of:

Binding Signature of Employer _____

Binding Signature of Contractor _____

4. CONDITIONS OF CONTRACT

Conditions of Contract

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Conditions of Contract

A. General

1. Definitions

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

The **Adjudicator** is the person appointed jointly by the Employer and the Contractor to resolve disputes in the first instance, as provided for in Clauses 24 and 25. The name of the Adjudicator is defined in the Contract Data.

Bill of Quantities means the priced and completed Bill of Quantities to be submitted by the Bidder.

The **Completion Date** is the date of completion of the Works as certified by the Engineer in accordance with Sub Clause 55.1.

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 below.

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 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 Period** is the period named in the Contract Data and calculated from the Completion Date.

The **Employer** is the party who will employ the Contractor to carry out the Works.

The **Engineer** is the person named in the Contract Data (or any other competent person appointed and notified to the contractor to act in replacement of the Engineer) who is responsible for supervising the Contractor, administering the Contract, certifying payments due to the Contractor, issuing and valuing Variations to the Contract, awarding extensions of time, and valuing the Compensation Events.

Equipment 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, which is to have a mechanical, electrical, electronic, or chemical or biological function.

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

Site Investigation Reports are those, which were included in the Bidding documents and are factual interpretative reports about the surface and sub-surface conditions at the site.

Specification means the Specification of the Works to be submitted by the Bidder 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 **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.

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

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

The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

2. Interpretation

- 2.1 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 the Conditions of Contract.

2.2 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).

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

- (1) Agreement
- (2) Letter of Acceptance, Notice to proceed with the works
- (3) Contractor's Bid
- (4) Contract Data
- (5) Conditions of Contract (General and Special)
- (6) Specifications (General and Special)
- (7) Drawings
- (8) Bill of Quantities and
- (9) Any other document listed in the Contract Data and replies to queries, clarifications issued by the employer, such confirmations given by the bidder which are acceptable to the employer and all the Addendum issued as forming part of the contract.
- (10) Instructions to bidders
- (11) Safety and preventive measures and digest of labour laws (CMWSSB)
- (12) Consortium agreement

3. Language and Law

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

4. Engineer's Decisions

4.1 Except where otherwise specifically stated the Engineer will decide contractual matters between the Employer and the Contractor in the role representing the Employer.

5. Delegation

5.1 The Engineer may delegate any of his duties and responsibilities to other people except to the Adjudicator after notifying the Contractor and may cancel any delegation after notifying the Contractor.

6. Communications

6.1 Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

7. Subcontracting

7.1 The Contractor may subcontract with the approval of the Engineer but shall not assign the Contract without the approval of the Employer in writing. Subcontracting does not alter the Contractor's obligations.

8. Other Contractors

8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors. The Contractor shall as referred to in the Contract Data, also provide facilities and services for them as described in the Schedule. The Employer may modify the schedule of other Contractors and shall notify the Contractor of any such modification.

9. Personnel

9.1 The Contractor shall employ the key personnel named in the Schedule of Key Personnel as referred to in the Contract Data to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities, and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

9.2 If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or his 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 work in the Contract.

9.3 Non-employment of Project Manager and other Key Personnel shall be liable for a fine as specified in Contract Data.

10. Employer's and Contractor's Risks

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

11. Employer's Risks

11.1 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, hostilities, 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), 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.

12. Contractor's Risks

12.1 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, are the responsibilities of the Contractor.

13. Insurance

13.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects 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) loss of or damage to the Works, Plant and Materials;
- (b) loss of or damage to Equipment;
- (c) loss of or damage of property (except the Works, Plant, Materials and Equipment) in connection with the Contract; and
- (d) personal injury or death.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

13.3 If the Contractor does not provide any of the policies and certificates required, the Employer may effect the insurance which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

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

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

14. Site Investigation Reports

14.1 The Contractor, in preparing the Bid, shall rely on any site Investigation Reports referred to in the Contract Data, supplemented by any information available to the Bidder.

15. Queries about the Contract Data

15.1 The Engineer will clarify queries on the Contract Data.

16. Contractor to Construct the Works

- 16.1** The Contractor shall design, construct and install the Works in accordance with the Specification and Drawings.
- 16.2** The basic centerlines, reference points and benchmarks will be fixed by Employer.
- 16.3** The Contractor shall establish at his cost, at suitable points, additional reference lines, benchmarks as may be necessary. The Contractor shall remain responsible for the sufficiency and accuracy of all his benchmarks and reference lines. He shall take precautions to see that the lines, points and benchmarks fixed by Employer are not disturbed by his work and shall make good any such damage.

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

- 17.1** The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the program submitted by the Contractor, as updated with the approval of the Engineer, and complete them by the Intended Completion Date.

18. Approval by the Engineer

- 18.1** The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Engineer, who is to approve them if they comply with the Specifications and Drawings.
- 18.2** The Contractor shall be responsible for design of Temporary Works.
- 18.3** The Engineer's approval shall not alter the Contractor's responsibility for design of the Temporary Works.
- 18.4** The Contractor shall obtain approval of third parties to the design of the Temporary Works where required.
- 18.5** 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.

19. Safety

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

20 Discoveries

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

21. Possession of the Site

21.1 The Employer will give possession of all parts of the Site to the Contractor. However, if possession of a part is not given by the date stated in the Contract Data it cannot be taken as a reason for delay in start of the relevant activities and it will not be considered a Compensation Event.

22. Access to the Site

22.1 The Contractor shall allow the Engineer and any person authorized by the Engineer access to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured / fabricated / assembled for the works.

23. Instructions

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

23.2 The contractor shall permit the employer to inspect the Contractors accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the employer if so required by the employer

24. Disputes

24.1 If the Contractor believes that a decision taken by the Engineer was either outside the authority given to the Engineer by the Contract or that the decision was wrongly taken, the decision shall be referred to the Adjudicator within 14 days of the notification of the Engineer's decision.

25. Procedure for Disputes

25.1 The Adjudicator shall give a decision in writing within 28 days of receipt of a notification of a dispute.

25.2 The Adjudicator shall be paid daily at the rate specified in the Contract Data together with reimbursable expenses of the types specified in the Contract Data and the cost shall be divided equally between the Employer and the Contractor, whatever decision is reached by the Adjudicator. Either party may refer a decision of the Adjudicator to an Arbitrator within 28 days of the Adjudicator's written decision. If neither party refers the dispute to arbitration within the above 28 days, the Adjudicator's decision will be final and binding.

25.3 The arbitration shall be conducted in accordance with the arbitration procedure stated in the Special Conditions of the Contract.

26. Replacement of Adjudicator

- 26.1** Should the Adjudicator resign or die, or should the Employer and the Contractor agree that the Adjudicator is not fulfilling his functions in accordance with the provisions of the Contract, a new Adjudicator will be jointly appointed by the Employer and the Contractor. In case of disagreement between the Employer and the Contractor, within 30 days, the Adjudicator shall be designated by the Appointing Authority designated in the Contract Data at the request of either party, within 14 days of receipt of such request.

B. Time Control

27. Program

- 27.1** 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 forecast.
- 27.2** 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 work including any changes to the sequence of the activities.
- 27.3** The Contractor shall submit to the Engineer, for approval, an updated Program at intervals 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.
- 27.4** 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 is to show the effect of Variations.

28. Extension of the Intended Completion Date

- 28.1** The Engineer shall extend the Intended Completion Date if 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 work.
- 28.2** The Engineer shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Engineer for a decision upon the effect of a Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or 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.

29. DELETED

30. Delays Ordered by the Engineer

- 30.1** The Engineer may instruct the Contractor to delay the start or progress of any activity within the Works.

31. Management Meetings

- 31.1** Either the Engineer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.
- 31.2** The Engineer shall record the business of management meetings and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

32. Early Warning

- 32.1** The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work increase the Contract Price or delay in the execution of works. The Engineer may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate is to be provided by the Contractor as soon as reasonably possible.
- 32.2** The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Engineer.

C. Quality Control

33. Identifying Defects

- 33.1** 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

- 34.1** If the Engineer instructs the Contractor to carry out a test not specified in the Specification 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.

34.2 All pipes, specials, electrical and mechanical items shall be subjected to Third Party inspection at the cost of Employer. The Contractor shall provide all necessary details such as manufacturer's/supplier's address and location of the manufacturing site well in advance to the Employer for such purpose.

35. Correction of Defects

35.1 The Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion and is defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

35.2 Every time, notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Engineer's notice.

36. Uncorrected Defects

36.1 If the Contractor has not corrected a Defect within the time specified in the Engineer's notice, the Engineer will correct the defect, assess the cost of having the Defect corrected and the Contractor will pay this amount.

D. Cost Control

37. Bill of Quantities

37.1 The Bill of Quantities shall contain items for the Construction ,Installation,testing and commissioning work done by the contractor.

37.2 The bill of quantities is used to calculate the contract price. The contractor is paid for the quantity of work done at the rate in the Bill of quantities for each item.

38. Changes in the Quantities

38.1 If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item the payment will be made as per actual quantity executed.

38.2 The Engineer shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 10 percent, except with the Prior approval of the Employer.

38.3 If requested by the Engineer, the Contractor shall provide the Engineer with a detailed cost breakdown of any rate in the Bill of Quantities.

39. Variations

39.1 All Variations shall be included in updated Programs produced by the Contractor.

40. Payments for Variations

40.1 The Contractor shall provide the Engineer with a quotation for carrying out the Variation when requested to do so by the Engineer. The Engineer shall assess the quotation, which shall be given within seven days of the request or within any longer period stated by the Engineer and before the Variation is ordered.

40.2 DELETED

40.3 DELETED

40.4 DELETED.

40.5 The Contractor shall not be entitled to additional payment for costs, which could have been avoided by giving early warning.

41. Cash flow forecasts

41.1 When the Program is updated, the contractor is to provide the Engineer with an updated cash flow forecast.

42. Payment Certificates

42.1 The Contractor shall submit to the Engineer monthly statements of the estimated value of the work completed less the cumulative amount certified previously.

42.2 Payments will be made to the Contractor, as detailed in contract data, under the certificates to be issued at reasonably frequent intervals by the Engineer. Based on the certificate of the Engineer, an intermediate payment will be made by the Engineer of a sum equal to 95 percent of the value of work subject to the conditions deducting all dues towards recovery of advances, interests, fines etc., as per terms of contract and for the cost of materials, if issued, at the term stipulated in the agreement. The balance of 5 percent will be withheld as Retention Money and retained as a security for the due fulfillment of the contract. Under the certificate to be issued by the Engineer on the completion of the entire works, the Contractor will receive the final payment of all the moneys due or payable to him under or by virtue of the Contract except performance security and a sum equal to 2.5% of the total value of the work done provided there is no recovery or forfeiture. No certificate of the Engineer shall be considered conclusive evidence as to the sufficiency of any work or materials or correctness of measurements to which it relates, nor shall it relieve the Contractor from his liability to make good defects as provided by the contract. The Contractor when applying for a certificate shall prepare a sufficiently detailed bill based on the original figures or quantities and rates in the Bill of Quantities to the satisfaction of the Engineer to check the claim and issue the certificate. The certificates as such of the claims mentioned in the application as are allowed by the Engineer shall be issued within fourteen days of the applications. No application for a certificate shall be made within fourteen days of a previous application.

42.3 The Engineer shall determine the value of work executed.

- 42.4** The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed.
- 42.5** The value of work executed shall include the valuation of Variation.
- 42.6** 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.
- 42.7** If for any reason, the Contractor or his authorized agent is not available and/or the work is suspended by Employer, recording of measurements will be done by Employer without the presence of the Contractor or his authorized representatives and the Employer shall not entertain any claim from the Contractor for any loss on this account. If the Contractor or his authorized agent or representative does not remain present at the time of such measurements, after the Contractor has been given a three day notice in writing, such measurements may be taken in his absence and shall be deemed to be accepted by the Contractor.
- 42.8** Payment for the work done by the Contractor will be based on measurements recorded at various stages of the Work. The Contractor or his authorized agent, or representative shall be present at the time of recording of each set of measurements and sign the measurement book or level/field book in token of their acceptance.

43. Payments

- 43.1** Payments shall be adjusted for deductions for advance payments, retention and other recoveries in terms of the contract and deduction at source of taxes as applicable under the law. The Employer shall pay the Contractor the amounts certified by the Engineer.
- 43.2** **DELETED**
- 43.3** Items of the Works for which no rate or price has been entered in the contract, will not be paid for by the Employer and shall be deemed to have covered by other rates and prices in the Contract.
- 43.4** Payment will be made by the Employer as indicated in the Contract Data

44. DELETED.

45. Tax

- 45.1** The rates quoted by the Contractor shall be deemed to be inclusive of the VAT, sales, services and other taxes and duties etc that the Contractor will have to pay for the performance of this Contract. The Employer will deduct such taxes and pother statutory levies at source as per applicable law. Any statutory variations in duties/taxes, which takes effect from a date subsequent to the due date for receipt of tender, shall be to CMWSS Board's Account.

However, the bidders are informed that, as per the Govt. of India Central Excise notification No.26/2009 dated 04.12.2009, the pipes of outer diameter exceeding 10cm and when such pipes are integral part of the water supply projects are exempted from payment of Excise Duty. In consideration of the above notification, the bidders have to quote the bid prices for pipes outer diameter exceeding 10 cm, without Excise Duty.

46. Currencies

46.1 All payments shall be made in Indian Rupees.

47. Price Adjustment – (Deleted)

48. Retention

48.1 The Employer shall retain from each payment due to the Contractor the proportion stated in the Contract Data until Completion of the whole of the Works.

48.2 On Completion of the whole of the Works, the total amount retained is repaid to the Contractor as detailed below in clause 48.3 after the Engineer has certified that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected.

48.3 2.50 % of the total value of the Works executed by the Contractor less deduction if any will be paid to the Contractor along with the final bill. The balance amount of 2.50 % of the total value of the Works will be retained for a period of 2 years reckoned from the date of completion without interest and this amount will be paid to the Contractor after obtaining an irrevocable Bank Guarantee for a further period upto the completion of defect liability period.

48.4 Any recovery advised by the Employer shall be recovered from any bill or money retained from this Contract.

49. Liquidated Damages

49.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the Contract Data for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the contract data). 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 does not affect the Contractor's liabilities.

49.2 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.

50. Bonus for advance completion of work.

Any work completed in advance by not less than 10% of agreement period can be considered and bonus of 1% on the value of actual quantum of works executed at tendered rate may be paid.

51 Advance Payment

51.1 The Employer shall make advance payment to the Contractor of the amounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an irrevocable Bank Guarantee in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment. 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 be charged on the advance payment at the rate of 13.5%. The advance payment shall be governed by Tamil Nadu Transparency in Tenders Act 1998 and Rules 2000.

51.2 The Contractor is to use the advance payment only to pay for Equipment, Plant and Mobilization expenses required specifically for execution of the Works. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Engineer.

51.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, or Liquidated Damages.

52. Securities

52.1 The Performance Security (including additional security for unbalanced bids) shall be provided to the Employer not later than the date specified and shall be issued in the amount and form and by a bank or surety acceptable to the Employer, and denominated in Indian Rupees. The Performance Security for construction activities shall be valid until Seven calendar months from the date of issue of Certificate of Completion and the additional security for unbalanced bids shall be valid until a date 28 days from the date of issue of the certificate of completion.

53. DELETED

54. Cost of Repairs

54.1 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 the Contractor's cost if the loss or damage arises from the Contractor's act or omissions. Contractor shall attend to the defect in the work noticed during defects correction period within 3 days from the date of issue of notice to attend to the defects, failing which the defect will be remedied by engaging other Contractors at any cost and that cost will be recovered from the Contractor's money available with the Employer and balance alone will be paid when it is due.

E. Finishing the Contract

55. Completion

55.1 The Contractor shall request the Engineer to issue a Certificate of Completion of the Works and the Engineer will do so upon deciding that the Work is completed.

56. Taking Over

56.1 The Employer shall take over the Site and the Works within seven days of the Engineer issuing a certificate of Completion.

57. Final Account

57.1 The Contractor shall supply to the Engineer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Engineer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final 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 56 days of receiving the Contractor's revised account.

58. 'As Built' Drawings / O&M Manuals

58.1 If "As Built" drawings and/ or O&M Manuals are required, the Contractor shall supply them by the dates stated in the Contract Data.

58.2 If the Contractor does not supply the Drawings and 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.

59. Termination

59.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract by giving seven days notice.

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

- (a) The Employer or the Contractor is made bankrupt or goes into liquidation
- (b) 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;
- (c) The Contractor does not maintain a security, which is required;
- (d) The Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined in the Contract data; and
- (e) If the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in the executing the Contract.
- (f) The Contractor (in case of Consortium) has modified the composition of the Consortium and /other responsibility of each member of the Consortium from what is stated in Consortium agreement without prior approval of the Employer.
- (g) Failure of the contractor to achieve two successive milestones.

For the purpose of this paragraph: "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the evaluation process or in contract execution. "Fraudulent practice" means a misrepresentation of facts in order to influence a evaluation 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 prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition."

59.3 When either party to the Contract gives notice of a breach of contract to the Engineer for a cause other than those listed under Sub Clause 59.2 above, the Engineer shall decide whether the breach is fundamental or not.

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

59.5 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.

60. Payment upon Termination

60.1 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 less advance payments received up to the date of the issue of the certificate, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law and less the percentage to apply to the work not completed as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.

60.2 If the Contract is terminated at the Employer's convenience or because of a fundamental breach of Contract by the Employer, 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.

61. Property

61.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a Contractor's default.

62. Release from Performance

62.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either 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 commitment was made.

F. Special Conditions of Contract

Part I

1. **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.

2. **COMPLIANCE WITH LABOUR REGULATIONS:**

During continuance of the contract, the Contractor and his sub contractors shall abide at all times by all existing labour enactment's and rules made thereunder, regulations, notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to construction industry are given below. 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 thereunder, 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.

Further, the contractor has to give a declaration for the following provisions:

- i) That in the capacity of Contractor, the contractor has to comply with the provisions of Contract Labour (Regulations & Abolition) Act, 1970 by obtaining a valid license under the Act and the Rules thereto and similarly under Factories Act wherever applicable.
- ii) The contractor has to pay the wages in accordance with the Minimum Wages Act to all his / their employees.
- iii) That the contractor has to abide to recover the Employees Provident Fund and the Employees' Insurance contributions (both Employees and employers contribution) from the payment of bills every month.

- iv) The contractor's Code Nos. for E.S.I. and E.P.F. are & and both the Employees, Employers contributions will be remitted by the contractor in his / their code numbers and copy of the remittance challans will be produced. In case, if the contractor is failing to remit, he / they will inform wage rates of employees to the Principal employer so that they can remit Employees' State Insurance Contribution & Employees Provident Fund contribution (both for employer and employee) and authorize them to make deductions from the payment of bills.
- v) That the contractor has to authorize to recover the contributions towards Tamil Nadu Manual Workers (Regulations of Employment and Conditions of work) Act, 1982 fund at the percentage prescribed by the Government from time to time.
- vi) That the contractor has to further declare and undertake that in case of any liability pertaining to his / their employees is to be discharged by the Principal Employer for his / their lapse, the contractor undertake to reimburse the same or the Principal Employer is authorised to deduct the same from the contractor's dues as payable.
- vii) That the contractor will maintain the Registers and records about the Contract Labour employed under Section 29 of Labour (Regulation & Abolition) Act wherever applicable.
- viii) That the contractor will take insurance policy under Workmen Compensation Act to meet out any untoward incident until the contract labourers are issued with ESI card.
- ix) (1) That no Child Labour shall be employed in a house / worksite / Establishment / Other places

(2) As per the Section 2(ii) of the Child Labour (Prohibition and Regulation) Act 1986.

Child means, a person who has not completed his fourteen years of age.

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK.

- a) Workmen Compensation Act 1923: - The Act provides for compensation in case of injury by accident arising out of and during the course of employment. The contractors shall also take out the Insurance under Workmen's Compensation Act, 1923 covering total number of workmen employed by him on any work pertaining to this contract or contractors. He shall also ensure that similar Insurance under Workmen's Compensation Act, 1923 covering the total number of workmen employed by his sub-contractor if any, also included in this policy.

- b) Payment of Gratuity Act 1972: - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.
- c) Employees P.F. and Miscellaneous Provision Act 1952: The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:
- (i) Pension or family pension on retirement or death, as the case may be.
 - (ii) Deposit linked insurance on the death in harness of the worker.
 - (iii) Payment of P.F. accumulation on retirement/death etc.
- d) Maternity Benefit Act 1951: - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.
- e) Contract Labour (Regulation & Abolition) Act 1970:- The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.
- f) Minimum Wages Act 1948: - The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, and Runways are scheduled employment.
- g) Payment of Wages Act 1936: - It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
- h) Equal Remuneration Act 1979 :- The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.
- i) Payment of Bonus Act 1965: - The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.
- j) Industrial Disputes Act 1947: - The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

- k) Industrial Employment (Standing Orders) Act 1946: - It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.
- l) Trade Unions Act 1926: - The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.
- m) Child Labour (Prohibition & Regulation) Act 1986: - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.
- n) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: - The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc.
- o) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996: - All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.
- p) Factories Act 1948: - The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.
- q) Employee State Insurance Act, 1948
- r) The Tamil Nadu Manual Workers (Regulation of Employment and Conditions of Work) Act, 1982.
Every Employer other than an Employer operating a motor transport for carrying passengers or goods by roads, employing manual worker in any scheduled employment, shall be liable to pay, within such time as may be prescribed, to the Board established under section 6, for the scheduled employments, other than the scheduled employment in construction or maintenance of dams, bridges, roads or in any building operations, every month a sum at such rate not exceeding three percent

of the wages payable by him to such manual worker, as may be fixed by the Government by notification;

- s) The Bonded Labour System (Abolition) Act, 1976
- t) The Employer's Liability Act, 1938

3. ARBITRATION

The procedure for arbitration will be as follows:

- (a) In case of Dispute or difference arising between the Employer and Contractor relating to any matter arising out of or connected with this agreement, such disputes or difference shall be settled in accordance with the Arbitration and Conciliation Act, 1996. The arbitral tribunal shall consist of 3 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, 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, this shall be done in accordance with the Arbitration and Conciliation act, 1996.
- (b) **DELETED**
- (c) 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 appointment of the Arbitrator shall be made as per the Arbitration and Conciliation act, 1996.
- (d) Arbitration proceedings shall be held at Chennai, (India) and the languages of the arbitration proceedings and that of all documents and communications between the parties shall be English.
- (e) The decision of the majority of arbitrators shall be final and binding upon both parties. The cost and expense 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 born by each party itself.
- (f) **DELETED**
- (g) Performance under the contract shall continue during the arbitration proceedings and payments due to the Contractor by the Employer shall not be withheld, unless they are the subject matter of the arbitration proceedings.

Special Conditions of Contract

Part - 2

1. Contractor's Responsibility

The information given hereunder and provided elsewhere is given in good faith but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim whatsoever will be entertained on the plea that information supplied by the Engineers is erroneous or insufficient.

2. Construction Water

The Contractor shall make his own arrangement for the fresh water required for the manufacturing of the pipes, construction of civil works and testing of pipeline as well as for the potable water required for his factory & labour camps.

3. Construction Power

The Contractor shall make his own arrangement for supply electrical energy required at his sites and the works from the Tamilnadu Electricity Board.

The Contractor is forewarned that there can be interruptions in power supply for reasons beyond the control of the Tamil Nadu Electricity Board 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.

4. Survey

The Contractor shall, at his own expense provide and maintain survey stations which he may require to carry out the works and shall remove the same on completion of the works. The Contractor shall, at his own expense, carry out all the necessary surveys, measurements and setting out of the works and shall for this purpose engage qualified and competent engineering surveyors whose names and qualifications shall be submitted to the Engineer for his approval.

The Contractor shall for the purpose of checking the survey and setting out, provide to the Engineer all the assistance, which he may require. The surveyor shall be selected having appropriate experience and as far as possible, the same surveyor shall be provided throughout the contract period. Before commencing any work at any locations, the Contractor shall give the Engineer not less than two days notice of his intention to set out or give levels for any part of the work in order that arrangements may be made for inspection. The Contractor shall provide for the sole use of the Engineer and his staff, all necessary survey instruments and other equipment and all technicians, labour and attendants which the Engineer may require for checking the setting out and marking of the works. The Contractor shall maintain in good working order at all time during the period of contract the instruments provided by him, for the proper setting out of the works. The Contractor shall make available at his own expense, any poles, staging templates.

5. 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 authorised 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.

6. Return of Labour And Plant

The Contractor shall supply to the Engineer by 9 a.m. every working day a return of the men employed by him and his sub-contractors on the previous working day and all of the work on which they were engaged specifying also the number employed in each trade. He shall also supply monthly any other returns which may be required as to the number of men and constructional plant employed and the nature and type of the work done.

7. Sanitary Facilities

The Contractor shall provide and maintain in a clean and sanitary condition adequate W.C.'s and wash places which may be required on the various parts of the site for 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.

8. Restricted Entry To Site

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

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. Should any damage be done by the Contractor on any mains, pipes, cables or lines (whether above or below ground), whether or not shown on the drawings, the Contractor must make good or bear the cost of making good the same without delay to the satisfaction of the Engineer and of the Employer.

10. Local Roads and Haul Roads

The approach roads and other public roads in the state may be used by the Contractor to haul construction materials and equipment subject to restriction of load carrying capacity on the roads in particular over bridges and culverts. However, the Contractor will have to pay customary vehicles license and permit fees for use of public roads.

The Contractor shall plan transportation of construction materials to site in such a way that road accidents are avoided.

11. Permission for Road Cuts

Wherever the Contractor considers that it is necessary to cut through an existing road or track he shall submit details to the Engineer for approval, a minimum of seven days before such work commences.

In the event of cutting a road by the Contractor without permission from the Engineer the Contractor shall pay compensation as claimed by the owner of the road until it is restored at the cost of the erring Contractor.

Trench Digging:

Digging of trench by the Contractor beyond the length than that is specified by the Engineer shall invite a fine of Rs.500/- per day till such time the damage is restored.

12. Temporary Diversion of Roads

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

13. Notice to Telephone, Railways & Electricity Supply Under Takings / Depts., etc.

The employer shall deposit an amount to the respective local bodies / highways department, for restoration of road surface after completion of the works. The employer shall obtain general permission to cut the road. Before commencing operations the Contractor has to obtain permission from local bodies/Highways Department 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 Contractor before taking up operations which involve cutting of roads, shifting utilities etc. during the process of work, shall give notice to the concerned authorities viz. the Corporation/ Panchayats / Municipalities, State Highways Department, National Highways Department, the Railway department, the Electricity Board, Telegraphs department, the Traffic department attached to the police and other departments or companies 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 TNEB for operating the machinery and equipments. The Employer will pay the necessary service connection and S.D. charges. The Contractor should obtain all approvals for the installation and commissioning of machinery and accessories offered by them from the respective inspecting authorities such as CEIG or CIFG etc., Fees if any, to be paid to the inspecting authorities will be reimbursed by the Employer.

14. Barricading

The pit / 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.

15. Length of Trench Open at One Time

The Pipe line shall be excavated in such length as may be ordered by the Engineer depending on the nature of the ground, the depth from the surface and the risk of damage to the adjoining property. The pipes shall not be covered until they may have been tested to the satisfaction of the Engineer. But in bad ground in close proximity to buildings or in other places where the Engineer shall consider necessary he may limit the length of trench so that there shall not be more than three pipes lengths from the refilled trench to the unbroken ground ahead.

16. Watching and Lighting

The Contractor shall at his expense provide at the site of work sufficient lighting and watching and fencing by night and by day and shall in every respect conform to the police regulations in these matters and he shall free and relieve the Employer, Should he neglect to do so, the same shall be provided by the Engineer and the cost thereof will be recovered from the Contractor.

17. 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. Failure to carry out the work within two days will attract a fine of Rs 500/- per day.

18. Power to Vary Work

The description of work required to be executed by the Contractor are set forth in the specification, schedules and in the drawings, but the Engineer reserves the power to vary, extend or diminish the quantities of Work, to alter the line, level, or position of any work to increase, change or decrease the size, quantity, description, character or

kind of any Work, to order the Contractor to execute the Works or any part thereof, by day or night Work, or to add or to take from the Work included in the contract as he may think proper without violating the contract and the Contractor shall not have any claim upon the Employer for any such variation, extension, diminution, alteration, increase, change or decrease other than for the Work actually done, calculated according to the prices tendered and accepted in this contract.

19. Extra or Varied Work

If the Engineer uses the power reserved to him under Clause 18 above an order in writing signed by the Engineer, shall be given to the Contractor to that effect and any Work executed under such order shall be paid for at the rates set forth in the Schedule of Prices prevailing at the time of execution where such rates in the opinion of the Engineer apply. This shall apply to unforeseen items of work which are not found in the Bill of Quantities. If the rates are not available in the Schedule of Prices, a rate or price shall be agreed upon between the Engineer and the Contractor in writing and failing their agreement the Contractor shall forthwith execute such order and the Engineer shall determine the rates or prices at which the work shall be paid of.

20. Free Flow of traffic

While executing the work, as soon as possible, the Contractor should allow as much traffic as possible on the roads/streets, by refilling the trenches cut across.

21. Tools and Plants

All tools and plants required for the work including sheet piles and timber for shoring and strutting pump sets etc. shall be supplied by the Contractor at his own cost. The rate for the relevant items of work are inclusive of all such tools and plants and apparatus required for the execution of the work.

22. Excess Materials

The Contractor shall be responsible for the procurement of required quantity of materials like pipes, specials, machinery, electrical items etc. Any materials procured for the work even though as per Bill of Quantities, if found excess due to any reasons after completion of the works, shall be taken back by the Contractor and the Employer / Engineer shall not be responsible for such excess materials. Amount paid if any for such excess materials shall be deducted from any bills payable to the Contractor.

23. DELETED

24. Commissioning of Works

The Contractor shall be responsible for successful commissioning of the work as stated in the contract data before handing over.

Special Conditions of Contract

Part - 3

RULES FOR THE PROVISION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS EMPLOYED BY THE GOVERNMENT DEPARTMENTS AND OTHER CONTRACTORS

1. The contractor's special attention is invited to relevant clauses of the 'General Conditions of Contract ' in the Tamil Nadu Building Practice and he is requested to provide at his own expense the amenities mentioned herein to the satisfaction of the Engineer.
2. Application
These rules shall apply to all building, pipe laying and construction works.
3. Definition
 - a) "Work Place" means a place at which on an average fifty or more workers are employed in connection with construction work.
 - b) "Large Work Place" means a place at which on an average 500 or more workers are employed in connection with construction work.

Special Conditions of Contract

Part - 4

1. General

Before submitting the bids, the bidder should carefully go through all the bid documents, drawings and also inspect the place of work so as to get full and first hand knowledge of the site conditions based on which he has to quote his rate.

2. 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 stage 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.

3. Flood Damages etc.

The Contractor may take risk insurance at his cost against losses due to unprecedented floods and other acts of God. No claim shall be entertained on this account and paid for.

4. 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, therefore (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.

5. Rates

The Contractor shall particularly note that the accepted rates of the various items shall be inclusive of all incidental charges such as bailing by manual labour, dewatering, shoring etc. if found necessary during the execution and no extra shall be due therefore on any account during the currency of the contract, unless stated other wise.

6. Royalty Charges

The Royalty will be charged for the materials obtained from P.W.Department, or other Government quarries. Assistance as necessary will be given to the Contractor by the Engineer. No plot rent shall be charged for materials stacked on Employer's lands during the course of construction provided all such materials are removed within one month after the work is completed. Royalty or charges due in the case of private quarries and private bodies shall be paid by the Contractor.

7. Payment to Labourer

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

8. Night Works

If night work is required to fulfill the agreed rate of progress and to complete the work within the period stipulated, prior written approval is necessary and all arrangement shall be made by the Contractor including lighting without any claim for extra rate.

9. Errors, Omissions And Discrepancies

In the case of errors, omissions, and/or disagreement between the written and the scaled dimensions on the drawings or between the drawings and the specifications, the following order of precedence shall apply;

- i) In case of discrepancies in dimensions of any item of work as described between the descriptive specifications and detailed working drawings, the dimensions given in the detailed working drawings shall apply.
- ii) In case of discrepancies in description of scope of work between what is indicated in the item of work given in Bill of Quantities and the corresponding detailed technical specifications, the latter shall apply.
- iii) Figured dimensions shall supersede scaled dimensions. The drawings on a large scale shall take precedence over those on a smaller scale.
- iv) Drawing issued as construction drawings from time to time shall supersede the corresponding drawings previously issued.

10. 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 document.

11. Bidder To Satisfy Himself

It will be the Contractor's responsibility to satisfy himself from the inspection of the site that sufficient quantities of construction materials required for the works exist in the designated borrow areas and quarry sites.

Failure by the Contractor to have done all the things, which in accordance with this condition he is deemed to have done shall not relieve him of the responsibility for satisfactorily completing the work as required.

12. Employment Of Scarcity Labour

If Government of Tamil Nadu declares a state of scarcity or famine to exist within 16 kms. of the project site, the Contractor shall be required to employ in his works for which he will need unskilled labour and to the extent his works can accommodate any person or persons certified to him by the Engineer to be in need of relief and the Contractor shall pay to such persons wages not below the minimum wage which the Government may fix in this behalf from time to time.

- 13.** All labourers and other employees of the Contractor should be covered by a suitable accident insurance policy to cover liabilities under the Workman's Compensation Act.

14. Electricity Tariff

The unit rates and prices quoted by the Bidder in the Bill of Quantities shall include the cost of electric energy required for construction at the rates fixed by the Tamil Nadu Electricity Board.

Special conditions Of Contract
Part - 5

SAFETY PROVISION

1. Suitable scaffolds shall be provided for workers for all that 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 no steeper than 1\4 to 1 (1\4 horizontal to 1 vertical). IS code for scaffolding and ladders I.S 3696 Part -I and Part II and its latest revisions is to be followed.
2. Scaffolding or staging more than 3.25 meters 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 and otherwise secured atleast 1 metre high above the floor or platform of such 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.
3. 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 metres above ground level, it shall be closely boarded, having adequate width and be suitably fenced, as described in 2 above. Every opening in 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. Every ladder shall be securely fixed. No portable single ladder shall be over 7 metres in length. Width between side rails in a rung ladder shall in no case be less than 30 cm, for ladders, this width shall be increased by atleast 6mm for each additional 30cm length. Uniform steps spacing shall not exceed 30cm.
4. Adequate precautions shall be taken to prevent danger from electrical equipment. 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 defence of every suit, action or proceedings at law that may be brought by any person for injury sustaining, owing to neglect of 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.
5. 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 asphalt 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) Stonebreakers shall be provided with protective goggles and protective clothing.
 - d) When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that manhole covers are opened and manholes are ventilated atleast for an hour before workers are allowed to get into them. Manholes so opened shall be cordoned-off with suitable railing and warning signals or boards provided to prevent accident to public.
 - 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 paint dry rubbed and scraped.
 - iii) Overalls shall be supplied by the Contractor to workmen and adequate facilities shall be provided to enable working painters to wash during and on cessation of works.
6. 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 shall be taken for prompt rescue of any person in danger and adequate provisions shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.
7. 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 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 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 of testing.
 - d) In case of departmental machine, safe working load shall be notified by the Engineer. 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 he shall get it verified by the Engineer.
8. Motors, gearing, transmission, electrical wiring and other dangerous parts or hoisting appliance shall be provided with such means so as to reduce to minimum risk and accidental descending of load; adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. 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.
 9. 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. Adequate washing facilities shall be provided at or near place of work.
 10. 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.
 11. 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.
 12. 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".
 13. The Contractor shall at his own cost provide and maintain at the sites of works, standard first aid box as directed and approved by the Engineer, for the use of his own as well as the Employer's staff on site.
 14. Notwithstanding the above provision 1 to 15 Contractor is not exempted from the operation of any other Act or rules in force relating to safety provisions.

15 Environmental Protection Work

15.1 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.

15.2 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.

15.3 Earth Work 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 completed.

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.

15.4 Replantation

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 will be got approved before replanting any trees.

15.5 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 form 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.

15.6 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.

15.7 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.

The Contractor shall preferably use local labour / Skilled persons during construction.

15.8 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 minimise spills.

The Contractor shall have a preventive maintenance program for construction equipment and vehicles to meet emission standards.

15.9 Noise Pollution

The Contractor shall normally undertake construction work during daytime only (between 7.30 to 18.00 hrs) and when authorised 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.

15.10 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

The Contractor shall provide garbage cans at suitable fixed place and have the garbage disposed off regularly.

15.11 Aesthetic Improvement

The Contractor shall through proper house keeping 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 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 pre construction condition.

15.12 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 borrows site. In case excavation in arable land is unavoidable, topsoil layer (30 cms. depth) shall be saved and returned after construction work is completed so as to minimise impacts on ecosystem, agriculture and animal husbandry.

The Contractor shall educate construction workers to protect natural resources, wild plants and animals.

15.13 Risk Of Accidents

The Contractor shall provide efficient lighting equipment and safety signs on temporary roads during construction and shall adopt and implement adequate traffic regulation.

The Contractor shall take effective safety and warning measures to reduce accidents.

The Contractor shall provide suitable temporary crossings to facilitate normal life and business.

15.14 Responsibility For Accidents, Damages Etc.

The care of the whole of the permanent work until their completion as defined in Clause 49 and for the period prescribed in Clause 58 and of the whole of the temporary work until their removal shall remain with the Contractor who shall be responsible for all accidents or damages from whatever cause arising and chargeable for anything that may be stolen, removed, destroyed or damaged to whomsoever belonging and also for making good all defects and damages to the said Works or to any property adjoining or any cause whatever, whether such damage or defects were occasioned by the negligence of the Contractor or not or may be or might have been discovered during the progress of the works or in consequence thereof, or shall appear to be known after the completion whereof or whether payment may wholly or partially have been made or the Works approved as supposed to have been properly done, and no certificate or approval of any works by any officers or members of the Employer shall effect

15.15 Noise Monitoring

I. Monitoring Frequency:

a) During construction period: 12 times a year each time including day and night.

b) During Commissioning period: 4 times ad hoc monitoring will be taken.

II. Monitoring points:

During construction period: Near construction sites, factory sites and sensitive areas.

5. CONTRACT DATA

CONTRACT DATA

Items marked "N/A" do not apply in this Contract.

The following documents are also part of the Contract:	Clause Reference
"As Built" drawings and/ or O&M Manuals (Within 28 days from the date of completion)	[58]
· The Schedule of Other Contractors	[8]
· The Schedule of Key Personnel for construction activities	[9]
1. Project Manager	B.E. (Civil) with min. of 5 years experience in at least one Project/Work of similar nature.
2. Key Personnel	
i. Civil / Mechanical Engineer	B.E. (Civil) with minimum of 3 years experience of which a min. of 1 year in similar nature of water supply or sewer works.

Penalty for not employing Project Manager and other Key Personnel till the date of employment of the personnel [9.3]

Project Manager	Rs.50,000/month
Other Key Personnel	Rs.25,000/month / each

The Employer is

Name : Chennai Metropolitan Water Supply & Sewerage Board. (1.1)

Address: No.1, Pumping Station Road, Chintadripet, Chennai-600 002

The Engineer is : The Chief Engineer (C) Water (1.1)

Name of Authorized Representative: Superintending Engineer/Executive Engineer

The Adjudicator appointed jointly by the Employer and Contractor is:

Name : Thiru. **V. RAJAGOPAL** (1.1)

Address : Old No. 7/3 New No.13/3 Shyam's Nest,
2nd Main Road,
Raja Annamalaipuram,
Chennai 600 028.
Phone No. : 044-24620177

The name and identification number of the Contract is: **SHIFTING OF EXISTING 800MM DIA M.S. WITH 800MM DIA D.I., 450MM DIA D.I. AND 100MM DIA D.I. WATER MAINS FOR THE PROPOSED CONSTRUCTION OF GRADE SEPARATOR IN G.N.T. ROAD (MOOLAKADAI JUNCTION), DEPOT – 2, AREA – I, CONTRACT NO: CNT / WSS / MWB / DEP / 2000 / 2010-11.**

1. The start shall be within 7 days from the date of issue of Notice to proceed with the work.

(1.1)

2. The Intended Completion Date for the whole of the laying of pipeline works is 180 days from the start date.

(17, 28)

3. Description of Milestones (physical implementation of Construction contract)

SHIFTING OF EXISTING 800MM DIA M.S. WITH 800MM DIA D.I., 450MM DIA D.I. AND 100MM DIA D.I. WATER MAINS

Milestones

S. No.	Name of work	Total %	Milestones		
			(% of Completion of work)		
			1	2	3
			60 days (%)	120 days (%)	180 days (%)
1	Supplying of 800mm internal dia DI, pipes & specials	100	40	100	--
2	Supplying of 450 mm internal dia DI pipes & specials	100	40	100	--
3	Supplying of 100mm internal dia DI pipes & specials	100	40	100	--
4	Laying, jointing, testing and commissioning of DI pipes of 800mm Dia ID including fabrication of specials etc.	100	10	70	100
5	Laying, jointing, testing and commissioning of DI pipes of 450mm Dia ID including fabrication of specials etc.	100	10	70	100
6	Laying, jointing, testing and commissioning of DI pipes of 100mm Dia ID including fabrication of specials etc.	100	10	70	100
7	Supplying of sluice valve and construction of valve chambers	100	0	0	100

4. The Contractor shall submit a revised program for the works within 7 days of delivery of Letter of Acceptance. [27]

5. The Site possession date shall be within 7 days from the issue of notice to proceed with the works [21]

6. The Site is as defined in the Index Plan (Volume- II) [1]

7 The Defects Liability Period is

- | | |
|--|-------------|
| (a) For Pipe line Works | Five Years |
| (b) Civil Works | Five Years |
| (c) Electrical, Mechanical and Instrumentation works | Three years |

8. The minimum insurance cover for loss of or damage to the works, plants, materials, equipments, physical property in connection with contract, personal injury or death is Rs.30 lakhs for occurrence with the no. of occurrences limited to four. After each occurrence, contractor will pay additional premium necessary to make insurance valid for four occurrences always [13]
9. The following events shall also be Compensation Events: [44]
- Nil -
10. The period between Program updates shall be 30 days [27]
11. The amount to be withheld for late submission of an updated Program shall be Rs. 10,000/- [27]
12. The language of the Contract documents is English [3]
13. The law, which applies to the Contract, is the law of Union of India, applicable to Tamilnadu and the law of Tamil Nadu. [3]
14. The currency of the Contract is Indian Rupees [46]
15. Institution whose arbitration procedures shall be used INDIAN ARBITRATION AND CONCILIATION ACT 1996 [25]
16. Fees and types of reimbursable expenses to be paid to the Adjudicator is Rs.2000/- per day plus boarding, lodging , traveling and other charges as per actuals [25]
17. Price adjustments – **Deleted**
18. The proportion of payments retained (retention money) shall be 5% from each bill subject to a maximum of 5% of contract value and 2.5% of retention amount will be returned along with the final Bill. The balance amount of 2.50 % of the total value of the Works will be retained for a period of 2 years reckoned from the date of completion without interest and this amount will be paid to the Contractor after obtaining an irrevocable Bank Guarantee for the further period up to the completion of defect liability period. [48]
19. The liquidated damage for the whole work, works out per day and that for the milestone are as under: [49]
- | | | |
|-----------------|-----------|---------|
| For milestone 1 | Rs. 2,750 | per day |
| For milestone 2 | Rs. 4,900 | per day |
| For milestone 3 | Rs. 550 | per day |

The maximum amount of liquidated damages for the whole of the Works is 10% (ten percent) of final contract price. [49]

20. The amounts of the advance payment are: [51]

Nature of Advance	Amount (Rs.)	Conditions to be fulfilled
Mobilisation	up to a maximum 10% of the Contract value.	On submission of irrevocable Bank Guarantee (to be drawn within 20% of the contract period from the start date.

21. Repayment of advance payment for mobilization and equipment: [51]

The mobilization advance shall be repaid with an interest of 13.5% per annum with percentage deductions from the interim payments certified by the Engineer under the Contract. Deductions shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached not less than 15 percent of the Contract Price or 1 month from the date of payment of first installment of advance, whichever period concludes earlier, and shall be made at the rate of 25 percent of the amounts of all Interim Payment Certificates until such time as the loan has been repaid, always provided that the loan shall be completely repaid prior to the expiry of the original time for completion pursuant to Clauses 17 and 28.

The Securities shall be for the following minimum amount equivalent as a percentage of the Contract Price [52]

Performance Security to be calculated as per Clause 34.5 of ITB plus an additional security in terms of ITB Clause 29.5.

The standard form of Performance Security acceptable to the Employer shall be as presented in clause 34.1 Instructions to Bidders.

The date by which “As-Built” drawings (in appropriate scale) in 5 sets in digitized form are required is within 28 days of issue of certificate of completion of whole or section of the work, as the case may be. [58]

The amount to be withheld for failing to supply “As Built” drawings and O&M Manuals by the date required is Rs.5,00,000 [58]

The following events shall also be fundamental breach of contract [59.2]

1. The Contractor has contravened Sub-clause 7.1 and Clause 9.0 of GCC

The percentage to apply to the value of the work not completed representing the Employer's additional cost for completing the Works shall be 20 percent or as per actual whichever is higher. [60]

22 The payment terms: All payments will be subjected to deduction of retention money as stated in clause 48 of GCC.

22.1 PAYMENT TOWARDS CIVIL WORKS

Payments will be made for civil works to the extent of 95% of the value of the finished work done by the Contractor. 5% will be released after satisfactory commissioning.

22.2 PAYMENT TOWARDS ELECTRICAL/MECHANICAL WORKS -- Deleted

22.3 PAYMENT TOWARDS SUPPLY OF DI PIPES & SPECIALS

1. For supply of pipes

70 % of the quoted rates will be released after supply of above at site on production of Bank Guarantee equivalent to the amount to be paid.

2. For laying , jointing , testing of pipe line at site

20% payment from the quoted rates will be released after laying, jointing, testing of pipe line at site. The Bank guarantee obtained towards the advance paid for the pipes already laid , jointed and tested can be released proportionately .

3. For commissioning of the pipe line

Remaining 10 % payment from the quoted rates will be released after commissioning of the pipe line

Note: The amount due under Sl.No.1 of 22.3 on DI pipes and specials will be paid as follows:

1. For the first and second consignment of pipes and specials, payment shall be made only when the pipes and specials are accepted at site by the Engineer.
2. For the subsequent consignments, payment shall be made only when the pipes and specials are accepted at site by the Engineer and atleast 50% of the pipes and specials supplied at site in the consignment immediately preceding the present consignment and 100% of all other earlier consignments are laid, jointed and tested to the satisfaction of the Engineer.

22.4 PAYMENT FOR OTHER ITEM:

Payment for all other items will be made as defined in the bill of quantities as per the actual at the quoted rates.

6. FORMS OF SECURITIES

Forms of Securities

Acceptable forms of securities are annexed. Bidders should not complete the Performance and Advance Payment Security forms at this time. Only the successful Bidder will be required to provide Performance and Advance Payment Securities in accordance with one of the forms or in a similar form acceptable to the Employer.

Annex A:	Deleted
Annex B:	Performance Bank Guarantee
Annex C:	DELETED
Annex D:	Bank Guarantee for Advance Payment

Annex B

PERFORMANCE BANK GUARANTEE

To: _____ *[name of Employer]*
_____ *[address of Employer]*

WHEREAS _____ *[name and address of Contractor]*
(hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____
dated _____ to execute _____ *[name of Contract*
and brief description of Works] (hereinafter 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 recognized 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]*¹ _____ *[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]*¹ as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor 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 thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way 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 7 Calendar months from the date of issue of certificate of completion.

Signature and seal of the guarantor _____
Name of Bank _____
Address _____
Date _____

¹ An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract including additional security for unbalanced Bids, if any and denominated in Indian Rupees.

Annex D

BANK GUARANTEE FOR ADVANCE PAYMENT

To: _____ *[name of Employer]*
_____ *[address of Employer]*
_____ *[name of Contract]*

Gentlemen:

In accordance with the provisions of the Conditions of Contract, sub clause 51.1 ("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 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]*¹ _____ *[in words]*.

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 Contract documents which may be made between _____ *[name of Employer]* and the Contractor, shall in any way 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.

7. SPECIFICATIONS

(Refer volume-II)

8.BILL OF QUANTITIES

(Refer volume- III)

9.DRAWINGS

(Refer volume-II)

DECLARATION

- i) I s/o
..... Proprietor / Partner / Director of
..... Do hereby declare and undertake as under :
- ii) That in the capacity of Contractor by M/s.
..... I will comply with the provisions of Contract Labour (Regulations & Abolition) Act, 1970 by obtaining a valid license under the Act and the Rules thereto and similarly under Factories Act wherever applicable.
- iii) I will pay the wages in accordance with the Minimum Wages Act to all my employees.
- iv) That I abide to recover the Employees Provident Fund and the Employees' Insurance contributions (both Employees and employers contribution) from the payment of bills every month.
- v) My Code Nos. for E.S.I. and E.P.F. are & and both the Employees, Employers contributions will be remitted by me in my code numbers and copy of the remittance challans will be produced. In case, if I am failing to remit, I will inform wage rates of employees to the Principal employer so that they can remit Employees' State Insurance Contribution & Employees Provident Fund contribution (both for employer and employee) and authorize them to make deductions from the payment of bills.
- vi) I authorize to recover the contributions towards Tamil Nadu Manual Workers (Regulations of Employment and Conditions of work) Act, 1982 fund at the percentage prescribed by the Government from time to time.
- vii) I further declare and undertake that in case of any liability pertaining to my employees is to be discharged by the Principal Employer for my lapse, I undertake to reimburse the same or the Principal Employer is authorised to deduct the same from my dues as payable.
- viii) I will maintain the Registers and records about the Contract Labour employed under Section 29 of Labour (Regulation & Abolition) Act wherever applicable.
- ix) I will take insurance policy under Workmen Compensation Act to meet out any untoward incident until the contract labourers are issued with ESI card.
- x) I will not employ any child labour in a house / worksite / Establishment / other places as per the Section 2 (ii) of the Child Labour (Prohibition and Regulation) Act 1976 (Child means, a person who has not completed his fourteenth years of age).

SIGNATURE OF CONTRACTORS



**CHENNAI METROPOLITAN WATER SUPPLY AND SEWERAGE BOARD
CHENNAI- 600 002**

NATIONAL COMPETITIVE BIDDING

BID DOCUMENT

FOR

**SHIFTING OF EXISTING 800MM DIA M.S. WITH 800MM DIA D.I.,
450MM DIA D.I. AND 100MM DIA D.I. WATER MAINS FOR THE
PROPOSED CONSTRUCTION OF GRADE SEPARATOR IN G.N.T. ROAD
(MOOLAKADAI JUNCTION), DEPOT – 2, AREA – I**

CONTRACT NO: CNT / WSS / MWB / DEP / 2000 / 2010-11

BID DOCUMENT

VOLUME - II

TECHNICAL SPECIFICATIONS & DRAWINGS

**SUPERINTENDING ENGINEER (CONTRACTS & MONITORING)
CHENNAI METROPOLITAN WATER SUPPLY & SEWERAGE BOARD**

No.1, Pumping Station Road, Chintadripet, Chennai 600 002.

Telephone: 044 – 28451300 Fax : 044 – 28458181

E-mail : cmwssb@md2.vsnl.net.in

TECHNICAL SPECIFICATION

This project contemplates **Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I**

The work involves:

- 1) Supplying, Conveying, Delivery, Laying and Jointing of
 - (i) 800mm Dia D.I. pipes, 450mm Dia D.I. pipes & 100mm Dia D.I. pipes & Specials
 - (ii) MS specials such as 45 deg. Bend 22 1/2 deg. Bend and 11 ¼ Bend
 - (iii) Sluice valves
 - (iv) Construction of Valve Chambers

Testing and commissioning of the works of Shifting of existing 800mm dia M.S. with 800mm dia D.I., 450mm dia D.I. and 100mm dia D.I. Water Mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot – 2, Area – I

SPECIFICATIONS

INTERPRETATION

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

- a. "The Board" means the Chennai Metropolitan Water supply and Sewerage Board, a Statutory Body constituted under Madras Metropolitan Water Supply and Sewerage Act 1978 having its Office at No. 1, pumping Station Road, Chintadripet Chennai - 2 and any officer duly authorised by this Board to act on its behalf.
- b. `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 :
- c. `Engineer' means Chief 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 authorised assistants and duly authorised representatives.
- d. `Works' means works to be constructed, completed and maintained in accordance with contract.
- e. TNBP - Tamil Nadu Building Practice.
- f. IS - Indian Standards
- g. ISS - Indian Standard Specifications

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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.
- a. 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.
- b. 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.
- c. 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.
- d. 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) 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 prestressed 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
viii)	H.D.P.E.Pipes -- Deleted	
ix)	Ductile Iron Pipes	
	IS: 8329 – 2000	Centrifugally cast (spun) Ductile 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: 9523 – 2000	Ductile Iron fittings for pressure pipes for Water, Gas & Sewage - Specifications
	IS: 12288 – 1987	Code of practice for use and laying of Ductile Iron Pipes.
	IS: 2062 – 1999	Steel for General Structural purposes – Specification.

IS: 2720 Methods of test for soils (Parts I & XLI) (latest revisions)

IS: 3025 – (1964 to 2006) Method for sampling and test (physical and chemical) for water and waste water (Part 1 to 59)

x) M.S. Pipes

IS: 7322 – 1996 Specials for steel cylinder reinforced concrete pipes

IS: 102 – 1962 Ready mixed paint, brushing, red lead, nonsetting, and priming

IS: 2074 – 1992 Ready mixed paint, Red oxide Zinc Chrome and priming

IS: 823 – 1964 Code of procedure for manual metal arc welding for mild steel

IS: 817 – 1966 Code of practice for training and testing of metal arc welders

IS: 1182 – 1983 Recommended practice for radiographic examination of fusion – welded butt joints in steel plates.

IS: 2595 – 1978 Code of practice for radiographic testing

IS: 3658 – 1999 Code of practice for liquid penetrant flaw detection of welding

IS: 5334 – 2003 Magnetic particle flaw detection of welding – code of practice

ASTM E94 Recommended practice for radiographic testing

ASTM E109 Dry powder magnetic particle inspection

ASTM E138 Wet magnetic particle inspection

ASTM E165 Liquid penetrant inspection

IS: 3600 – 1985 Code of procedure for testing of fusion welded joints and weld metal in steel

IS: 4853 – 1982 Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.

IS: 3589 – 1991 Specification for electrically welded steel pipes for water, gas and sewage (150 to 2000mm nominal diameter)

IS: 7343 – 1986 Code of practice for ultrasonic testing for Ferrous welded pipes and tubular products

IS: 2598 – 1966 Safety code for Industrial radiographic practice

IS: 5822 – 1994 Code of practice for laying of welded steel pipes for water supply

IS: 6631 – 1972 Steel pipes for Hydraulic purposes

IS: 5504 – 1969 Spirally welded pipes

IS: 814 – 1991 Welding of M.S. pipes

MS specials

IS: 7323

MS specials

xi)

Manuals

Tamil Nadu Building 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 authorised 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 of 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 for the execution of the work has to be obtained by the Contractor from the Tamil Nadu Electricity Board.
2. The Contractor is forewarned that there can be interruptions in power supply for reasons beyond the control of the Tamil Nadu Electricity Board 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 UNDERTAKING:

Before commencing operations the contractor has to obtain permission from local bodies / Highways Department 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 to the Corporation of Chennai / State Highways and National Highways. Any delay in getting the permission from the Corporation / Panchayats / Municipalities, 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. the Corporation / Panchayats / Municipalities, State Highways Department, National Highways Department, Railway Department, Electricity Board, Telegraphs Department, Traffic Department attached to the police and other departments or companies 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 TNEB for operating the machinery and equipments. 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 CEFEG 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 road or track he shall submit details to the Engineer for approval, a minimum of seven days before such work commences.

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 Municipal Road Department or the Highways Department, as the case may be, notwithstanding the general procedures included in Chapter 5, Earthwork. Where all permissions are correctly obtained the cost of such reinstatement will be paid directly by the employer.

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 of 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 labourers 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 labourer 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 conforming to the latest Indian / International standards shall be used. Providing materials of approved quality and conforming 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 $\frac{1}{4}$ to 1 ($\frac{1}{4}$ 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 atleast 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 energised, 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 of 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 atleast 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 scarped.
 - 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 authorised 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 to 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 authorised 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 house keeping 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 kms.

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 CMWSSB 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 with out 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:

5.1.1. 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 stratas.

5.1.2. 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

Diameter (mm)	Trench width (m)
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. Barrication 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 with excavated earth 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, excavated earth 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 CMWSS Board will pay the cost.

b. Municipal Roads:

The reinstatement of the Municipal roads, i.e. Asphalt and WBM roads and side walk surface will be carried out by the Municipal Roads Department of the Chennai Municipal Corporation or by the Highways Department and CMWSSB Board will 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 atleast 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 storey 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, atleast 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	85 100	100	--	--	--	95 100	--	--	--
20 mm	0 20	85 100	100	--	--	30 70	95 100	100	--
16 mm	--	--	85 100	100	--	--	--	90 100	--
12.5 mm	--	--	--	85 100	100	--	--	--	90 100
10 mm	0 5	0 20	0 30	0 45	85 100	10 35	25 35	30 70	40 85

- 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, alkalies, 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 find 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 CI 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 uncompacted concrete vertically and at regular intervals. Where the uncompacted 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.

1. 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.
2. 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.

3. 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 structurals 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 sticking 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 or 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:

Steel reinforcement, such as M.S. bars, High yield strength deformed bars etc., required for the works shall be procured by the Contractor. 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:

9.12.1 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 levelled 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 atleast 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 indicated 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.

CHAPTER 11 – MILD STEEL PIPES

11.1 COMPLIANCE WITH STANDARDS

Subject to the further requirement of this specification, the pipes and Specials under this contract shall be of approved manufacture and shall comply with the requirements of BS 3801 – 1990 or IS 3589-2001

11.2 CERTIFICATE OF QUALITY OF PIPES AND SPECIALS

With every consignment of pipes and specials delivered under this contract the contractor shall furnish a certificate worded as follows

"This is to certify that the quality of the pipes and specials delivered in this consignment is not inferior to the quality laid down in the specification."

No payment shall be made in respect of any consignment of pipes and specials which is not accompanied by such certificate.

The contractor shall operate a Quality Assurance System, including Records of

Tests performed by suppliers on materials brought in

Testing of materials (or this contract at various stages manufacture of the result of such testing)

Preservation of the results of such testing; sequence numbering of pipes and fittings.

The Quality Assurance System records shall be open to inspection by the Engineer and shall be maintained in such a way that any pipe or fitting is identified by a unique sequential production number and can be uniquely related to each stage of its manufacture including material origin and quality, date and time of each operation, operator(s) involved and result of relevant quantity control tests.

On completion of the contract, the contractor shall pass a complete set of the Quality Assurance records to the Engineer.

11.3 CONVERSION

Manufacture of pipes and fittings shall be handled only at times when the Engineer is satisfied that the contractor has sufficient skilled supervisory staff in attendance on the shop floor

11.4 ALL PIPES AND SPECIALS SUPPLIED SHALL BEAR THE FOLLOWING MARKINGS IN TRIPLICATE ON THE OUTSIDE OF THE PIPE OR SPECIAL.

The three sets of markings shall be pointed on the item at 120 degrees to each other, such that at least one set can always be seen.

Manufacturers distinguishing mark

Outside Diameter (in mm)

The Letters CMWSSB – AVADI WSS

Length of the pipe/angle of the bend (mm degrees)

Approximate weight of the pipe or a special (Tons) Sequential manufacturing number

Pipe thickness (mm)

The letters CMWSSB – AVADI WSS shall be painted on only after the pipes or specials have been found to satisfy the tests and all other requirements of the specification. The sequential manufacturing number shall not only be painted on the pipe, but shall also be stamped indelibly onto the inside of the socket.

Approved duly identifiable colored bands shall be used to differentiate between sized and unsized pipes. The pipes and specials shall be made by submerged arc welding from carbon steel with an ultimate tensile stress of not less than 430N/sq.mm and a lower yield stress of not less than 275 N/sq.mm

11.5 GRADE OF STEEL

The M.S Spirally Welded pipes shall be made by manufacture

Rolling hot-rolled coils so that a spiral seam is formed around the circumference of the pipe. The spiral seam shall be butt welded internally and externally by an automatic submerged arc welding process

The weld metal shall have a smooth finish with no abrupt edges and shall not stand more than 1.5 mm proud of the pipe shell internally or externally.

Mismatches of adjacent surfaces at sectional welds shall not exceed 2mm, and shall be faired out on the outside of the pipe or fitting only.

Welding procedures, welder specification, weld testing and other manufacturing requirements shall be as required for Class II welding of BS 2971.

11.6 THICKNESS AND DIAMETER

The thickness of the hot rolled coils and diameter of the pipes shall be as shown below, except as otherwise specified.

Sl.No.	Nominal diameter In mm	Nominal Thickness of Steel Plate in mm	Thickness Of Cement Mortar Lining in mm	Factory Test Pressure in Kg/cm ²
3	800	10	12.5	14.0

11.7 EFFECTIVE LENGTH

The Effective Length (the actual length that a pipe contributes when assembled in a run of piping) of each pipe shall be as the Contractor chooses provided that the Effective Length is not less than 8 meters or greater than 13.5 meters and that all full-length pipes are of the same Effective Length. Certain details of the Drawings are based on an assumed Effective Length for the purposes of illustrating the Work, and the Contractor shall be responsible for designing and constructing at his own cost and to the Engineer's approval any additional or revised supports, restraints or other details necessitated by the Contractor's choice of Effective Length. The variation of pipe length from the agreed or specified length shall be kept to the minimum possible and shall in any case not exceed 50mm.

Welding procedures, welder qualification, weld testing and other manufacturing requirements shall be as required for Class II welding by B.S. 2971.

11.8 SPECIALS

Specials shall conform to the appropriate dimensions given in BS 534 - 1990 / on drawing/ IS 7322-1985. Puddle flanges shall be fixed to fittings by smooth, continuous welds on both sides of the flange, and the complete. Puddle flange shall be capable of withstanding the stated axial force. The expansion joint shall be as per the drawings & capable of allowing the required expansion.

11.9 SIZED PIPES

Where stated in the Bills of Quantities sized pipes shall be supplied truly circular throughout their length for cutting to provide closing lengths. The tolerances on the outside diameters of such pipes shall be as set out in table 3 of BS-534.

11.10 PIPE ENDS

At the ends of all 'spigot and socket' ended pipes the weld metal shall be machined externally on the spigot end and internally on the socket of the pipe.

The Cement mortar lining and the external coating of pipes and specials to be joined by welding shall be omitted for a sufficient distance (at least 250 mm) from the ends to prevent damage to the protection during site welding. The external coating of pipes and specials to be joined by mechanical couplings or flange adapters shall be omitted for such additional distance from the ends as is necessary to permit assembly of the joints. The internal surfaces from which the concrete lining is omitted shall be protected with a suitable approved rust inhibitor during manufacture so that extensive cleaning of the surface is not required after jointing on site.

Care shall be taken to ensure that butterfly valve discs will not foul cement mortar linings of adjacent pipe work.

11.11 SLEEVE JOINTS

Sleeve Joints shall comply with following:- BS 534 - 1990.

Type I Joints: The pipes shall be supplied with spigot end parallel and sleeve end with diameter tapered to approx. 0.8 mm per 25 mm length of sleeve. The minimum length of sleeve shall be 75 mm.

The sleeve shall be sized to ensure that the spigot will enter the sleeve freely and be engaged by the socket when fully home.

11.12 SLIP JOINTS

The slip joints shall be designed to allow the pipes to be laid with an angular deflection of not less than two degrees between adjacent pipes. The minimum lap shall be 75 mm, The Contractor shall supply with his Tender a drawing showing the details of the type of joint included in his Tender.

The ends of pipes shall be machined so that fillet welds can be used for jointing. The spigot shall fit accurately into the socket so that the amount of metal required to form the weld is reduced to a minimum.

The sleeve end of the pipes shall have a suitable tapped hole provided with matching plug to permit an air pressure test of the joint to be carried out on completion of welding.

11.13 FLEXIBLE COUPLINGS AND FLANGE ADAPTERS

Flexible couplings and flange adapters shall be of mild steel and shall be Viking-Johnson couplings as manufactured by the Victualic Co. Ltd. or Dresser Couplings as manufactured by the Dresser Manufacturing Division in the U.S.A. or other similar approved type suitable for making a watertight flexible connection between plain ended pipes, or between a plain ended pipe and a flanged fitting.

Flexible mechanical coupling shall be without the center register. Unless otherwise specified, the external surfaces of couplings and adapters shall be cleaned down to metallic finish and primed and painted with two coats of red lead oxide paint. The internal surfaces shall be similarly treated and protected with two coats of non-toxic approved epoxy bituminous paint.

All mechanical couplings shall be of appropriate internal diameter and shall be capable of withstanding the maximum works test pressure specified for the pipes they are to connect, at a joint deflection of up to 3 degrees in any direction.

All mechanical couplings and flange adapters shall be supplied complete with all necessary coupling rings, nuts, bolts, washers and rubber rings. Wedge joint rings shall comply with B.S. 2494, and shall be made of ethylene propylene rubber (EPDM) or Styrene Butadiene Rubber (SBR).

Bolts and nuts shall be hexagonal with dimensions in accordance with B.S.4190.

11.14 FLANGED JOINTS

All flanges shall be of steel, welded to the pipe by the electric arc process or other approved method. Flanges shall be square to the longitudinal axis of the pipe and truly faced over their whole width. The bolt holes, which shall be drilled off centre, shall be truly in line end-to-end with the longitudinal axis of the pipe.

Flanges shall be in accordance with B.S.4504 NP16.

Each set of flange jointing materials shall be complete with nuts, bolts, washers and joint rings. Joint ring; shall be EPDM or SBR reinforced with two-ply flex fabric and complying with B.S.5392, and shall extend to the inner edge of the bolt holes with dimensions and in compliance with B.S. 865 Part-.I. Bolts and nuts shall be hexagonal and shall be in accordance with B.S.4190.

11.15 SPECIAL JOINTS

Where a joint occurs between a steel pipe (or special) and a valve the internal diameter of the steel pipe or special shall be finished to match the bore of the valve by gradually decreasing or increasing the thickness of the concrete lining in the steel pipe or special. However the lining shall be nowhere less than 6 mm thick. Any increase or decrease in the thickness of the concrete lining along the length of such a pipe or special shall be gradual and smooth and the Contract Rates shall be deemed to Include for all costs incurred in providing such a lining.

11.16 CONTROL TESTS

Control tests as defined in B.S.3601 clause 13 shall be carried out as follows before pipes are lined or coated: -

Test

Tensile Test (I 3.1) - once every 50 pipes

Submerged-arc weld test (13.2) - every 50 pipes

Hydraulic Test - Every pipe (fee Clause 11.7 for test pressure to be applied)

Radiography of Welds - 3% of welds in every pipe & 100% for specials.

All pipes, which pass the hydraulic test, shall be stamped with the Contractor's test stamp.

The minimum length of weld to be radiographed at any location shall be 300 mm each end. The execution and interpretation of weld radiography shall be to AFII Standard.

11.17 DEFECTS AND METHOD OF REJECTION

Materials which show injurious defects at the place of manufacture or at Site, or which prove to be defective when properly applied in service shall be completely repaired or shall otherwise be replaced at no cost to the Employer.

Injurious defects shall include cracks, leaks, laminations, lack of complete penetration, lack of complete fusion, dents exceeding one eighth of the specified wall thickness and under cutting or reduction in the pipe wall thickness adjacent to a weld exceeding 0.8 mm in depth. Slag inclusions and gas pockets or voids shall be considered to be minor imperfections and may be accepted if the maximum size and distribution does not exceed the limits shown in Table 9.3 and 9.4 and figures 9.2 and 9.3 of A.P.I. Standard 5L - 1991.

Every pipe or special, which fails to pass the Hydraulic Pressure Test, shall be rejected.

Any pipe or special, which has been rejected, shall be marked in a distinctive manner, which will preclude any possibility of its use for purposes of this contract. Such pipes and specials

may be submitted for re-test following the correction of any defects, where such correction is permitted.

11.18 CLEANING

After hydraulic testing of each pipes has been completed satisfactorily, pipes and specials shall be thoroughly descaled by acid prickling or grit blasting in order to remove all mill scale, rust, paint, grease and loose dirt. After cleaning, the pipes and specials shall be protected from and maintained free of all oil, grease and dirt from whatever source until they have received their external coatings and concrete linings.

11.19 INTERNAL LINING

All steel pipes and specials shall be lined internally to the thickness of 12.5 mm. of Cement Mortar, made from Ordinary Portland Cement and fine aggregate. The materials used for lining, the method of lining and curing of the finished lining and the manufacture and testing of test cubes shall comply with B.S.534: 1990 and shall be carried out to the approval of the Engineer.

11.20 CENTRIFUGALLY APPLIED CEMENT MORTAR LINING

The pipes shall be lined at plant with Centrifugally applied cement mortar made from Ordinary Portland Cement and specially graded washed silica sand. The cement mortar shall have a minimum cement content of 1000 kg/m³ and water cement ratio of between 0.3 to 0.45.

11.21 METHODS

11.21.1 The cement mortar lining shall be applied by centrifugal spinning process for pipes and by manual application for fittings.

11.21.2 The mortar shall be applied by high speed spinning centrifugal process. The consistency of the mortar mix and the speed and duration of the spinning shall be such that the segregation of the aggregates from the cement is minimized. After the mortar has been evenly distributed, the pipe shall be spun at high speed to produce a dense lining with smooth surface and a minimum of shrinkage. Water centrifuged from the mortar shall be removed.

11.21.3 After being lined, the pipes shall be marked with the date of lining and stored undisturbed for 7 days for maturing when water curing is used. Means shall be employed to prevent the lining from drying too rapidly, particularly during the 48-hour period after lining operation. The lining shall be kept damp by spraying with water or by other means. Method and period of curing other than water shall be accepted if approved by the Engineer.

11.21.4 The surface of the lining shall be smooth and free from irregularities.

11.21.5 Fine surface crazing, hair cracks or cracks up to 0.25 mm wide in saturated linings and not over 300 mm in length shall not be a cause for rejection.

11.21.6 Cracks over 0.25 mm in width and over 300 mm in length in saturated linings, shall be made good using compatible material.

11.21.7 Lining thickness shall not be less than 12.5 mm with tolerance of + 3 mm. and - 0mm.

11.21.8 Hand finishing of the end of the bore of the pipe for not more than 100 mm shall be permitted to rectify the thinning of linings. Fittings and specials shall be lined by centrifugal process and the same requirements as straight pipes, or if their shape precludes this, they shall be hand finished and cured so as to achieve comparable results.

11.22.1 The lining materials thickness end tests shall comply with the requirements for continuously applied cement mortar linings

11.22.2 The pipe shall be charged in a single operation and spun at a suitable speed to achieve a minimum rate of radial acceleration of 250 m/s^2 until uniform layer of lining has been attained over the whole of the inner surface with the exception of stop backs for jointing

11.22.3 The spinning of the pipe shall continue until the surplus water has been dispersed and the greatest possible density of lining is obtained. Any damage caused to the lining by removal of the end rings shall immediately be made good by hand before the lining is set. No more than one hour shall elapse between the removal of lined pipe from the lining machine and commencement of the approved curing procedure.

11.23 TESTS ON CEMENT MORTAR LINING

11.23.1 Test blocks of the same material as used for pipe lining shall be made in 100 mm. moulds and subjected to cube crushing tests. Each block shall be removed from -its mould as soon as practicable and cured under conditions of temperature and humidity identical with those in which lining of the pipe is cured.

11.23.2 The cube strength of the test cube shall not be less than 31 N/mm^2 after 28 days of curing or 17 N/mm^2 after 7 days of curing. The density of the test cube shall not be less than 2100 kg/m^3 .

11.23.3 After the laying is completed test shall be conducted to ascertain the value of 'C' In Hazen William Formula. The value should not be less than 130.0

11.24 STOP BACKS OF PROTECTION AT ENDS

11.24.1 Pipes and specials supplied with cement mortar linings which are to be joined together by internal welding shall have the lining stopped back at the ends a distance of 250 mm. to permit welding of the joints without damage to the lining.

11.25 PROTECTION OF LINED PIPES AGAINST DAMAGE IN STORAGE TRANSPORT & HANDLING

The ends of all lined pipes and specials shall be sealed to exclude foreign matter during transit and storage. This protection may be in the form of plugs, discs or plastic sheeting.

11.26 FIELD JOINT

After the welding is completed the gap between C.M. lining of two pipes shall be made up manually using C.M. 1:2 and cured by curing compound.

11.27 EXTERNAL COATING FOR UNDERGROUND PIPES

This specification covers the cleaning, priming, coating and wrapping of steel line pipe for external protection.

Contractor shall furnish all materials equipment, labour, supervision at job site necessary to coat and wrap pipe as described in these specifications.

All work to be done under these specifications by Contractor shall be conducted diligently, continuously and in good faith in a thorough careful, skillful and workman like manner in full accordance with accepted pipeline coating practices and as approved by the Engineer. Contractor shall perform the work in accordance with NAPCA Pipe Coating Specification Bulletin No.3-67 unless specified otherwise in these specifications. The Engineer will inspect the result of the work and determine acceptability. Contractor shall provide to the Engineer access to all phases of the work.

11.27.1 MATERIAL AND EQUIPMENT:

Primer shall be Type B, synthetic primer conforming to BS: 4146 - section 2.2

Coal tar enamel shall be Type - IV Grade 120 / 5 in accordance with BS-4164 and shall be suitable for a design temperature of 2000F (930C).

Primer and enamel shall be obtained from the same manufacturer in accordance with AWWA C 203-91 section 2.4.4.

Glass fibre reinforcement material shall be reinforced in the longitudinal direction, shall have a minimum thickness of 0.5 mm (0.020 inches) and shall conform to AWWA C 203-91 Section 10.3

The outer wrap material shall be a coal tar impregnated (15 lb) perforated fibre glass with coal tar enamel in accordance with Section 2.4 of AWWA C203-91 and shall conform to the requirements of AWWA C 203-91 Section 7.11 and 7.12

The Contractor shall demonstrate that the coal tar enamel proposed to be used will form a firm bond to the primer proposed to be used and shall receive approval from the Engineer prior to the start of priming operations.

The Contractor shall submit samples of proposed glass fibre reinforcement and fibreglass with coal tar enamel outer wrap to the Engineer and receive approval prior to the start of coating operations.

All equipment, tools and supplies furnished by Contractor must be of good quality, adequate design, must be maintained in good condition during use and shall be subject to the approval of the Engineer.

Coating materials shall be properly handled and stored by Contractor to prevent deterioration. Any coating or wrapping materials, which are damaged or condemned by the Engineer because of Contractor's negligence, shall be replaced at Contractor's expense.

All cleaning and priming machines, coating machines and combination cleaning and coating machines shall be equipped with rubber or hard fibre crawler wheels. Knurled steel or other type crawler wheels, capable of marking or indenting the pipe shall be prohibited. Contractor shall employ only competent, skilled and careful workmen experienced in the operation of cleaning, priming, coating and wrapping machines.

If requested by the Engineer, Contractor shall secure at no expense to the Owner, the services of manufacturer's service representative for any machine not functioning properly.

Contractor shall furnish suitable kettles for heating the enamel. Kettles shall be equipped with the following:

- i) Continuous mechanical agitation devices.

- ii) Dial type indicating thermometers of a suitable range (60 degree to 200 degree C) and mounted with the bulb 100 mm from the bottom of the kettle and the dial plainly visible.
- iii) 1.6 mm (1 / 16 - inch) mesh strainer boxes that can be easily cleaned.

All kettles shall be clean and may not contain any coating residues, dirt water or other foreign matter before starting work. Kettles shall be cleaned periodically during the work at the Engineer's request. If kettles or other equipment have previously been used with a coating material that is not compatible with the material to be used in these specifications, the Engineer may require the Contractor to burn out the kettles and other equipment or remove all traces of the old material.

11.28 COATING APPLICATION

11.28.1 SURFACE PREPARATION

The outside surface of the pipe shall be thoroughly cleaned to the satisfaction of the Engineer with approved sand or steel shot blast cleaning. The pipe shall be cleaned to Swedish Standard SIS 2-1/2 as shown in Swedish Standards and the procedure to be used shall be approved by the Engineer prior to being used.

Before cleaning, oil and grease shall be removed from Surface by wiping with clean rags saturated in a suitable solvent approved by Engineer.

The compressed air for blasting shall be free of water and oil. Adequate separators and traps shall be provided.

Blast cleaning operations shall not be conducted on surfaces that will be subject to becoming wet after blasting and before coating; when the pipe surfaces are less than 2.50 C. above dew point; or when the relative humidity of the air is greater than 85 per cent, unless preheating of the pipe is employed. Blast cleaning under these conditions can be conducted provided the pipe can be warmed to a temperature sufficient to perform the blasting operations without visual appearance of moisture on the pipe surface. Preheat pipe temperature shall not exceed 650 C.

After cleaning, the pipe surfaces shall be bare metal free of all mill scale, lacquer, old coatings, oil, grease, moisture, rust, mud, dust, welding residue other foreign or deleterious matter.

11.28.2 PRIMING

The primer shall be a material that is recommended by the enamel manufacturer as compatible for use with the enamel coating. Primer shall be kept at a warehouse and only the daily requirements shall be brought to the job site. Primer shall be thoroughly agitated in its container before use. Only the amount of primer required for immediate use shall be emptied from the drums into open container. After obtaining the quantity required, bungs shall be immediately replaced to prevent the loss of solvents by evaporation. Primer, which has become contaminated with foreign matter or has thickened because of evaporation of solvents shall not be used. The primer shall be cold applied to a clean, dry surface, immediately after the cleaning operation.

The primer shall be applied as received from the manufacturer unless, in the opinion of the Engineer, a thinner should be used to speed up the drying time. The thinner when used shall be mixed with the primer in the manner and proportions recommended by the manufacturer of the primer.

Primer shall be machine applied at a rate recommended by the manufacturer on new pipe in a uniformly thin film which shall be free from runs, bubbles, sags, dust, grass or foreign matter. Primer shall completely cover the circumference of the pipe and all surfaces, which are to be enamel coated. All missed spots or areas covered with insufficient primer shall be touched up immediately by hand brushing. Primer which has been applied too heavily, such as at the base of welds, shall be brushed out before the primer sets. Any runs or sags, which have dried, shall be scrapped off and reprimed. Hand brushing of primer where required shall be done in a neat and workman like manner using only good quality paint -brushes. Care shall be taken to prevent damage to the primer film prior to enamel application.

The pipe shall be reprimed at Contractor's expenses, If in the opinion of the Engineer deterioration of the primer has occurred before the application of the enamel. Only two applications of primer are permitted. If the enamel is not applied before the second coat or primer has lost its effectiveness, the pipe shall be cleaned to bare metal by a cleaning machine or solvents and re-primed.

Primer once used shall not be reused either by recycling or otherwise. Removal of primer from the primed pipe due to abrasion from any metallic contact will be re-primed properly and allowed adequate curing time before flood coating.

The primer coat shall be exposed for curing before flood coating, only within the time limits recommended by the manufacturer. It shall be shielded from dust impingement' while curing. Dust and other contamination shall be removed from the primed surface before flood coating. Enamel shall not be applied until primer has cured. Contractor shall test the dryness of the primer at the bottom of the pipe.

11.28.3 COATING AND WRAPPING

11.28.3.1 Fibre reinforced coal tar enamel coating

After the primer has been properly applied and adequately cured the pipe shall be coated by successive layers of coal tar enamel glass fibre reinforcement coal tar enamel, glass fibre reinforcement and impregnated fibreglass with coal tar enamel outer wrap.

The coating and wrapping shall terminate 250 mm from the ends of each length of pipe. The finished thickness of the coating and wrapping shall be a minimum of 4.75 mm throughout.

The surface preparation, priming, coating and wrapping shall meet the requirements of the following sections of AWWA Standard C-203-91.

2.13.1 PREPARATION OF SURFACES

2.13.2 PRIMING

2.13.3 PRE-HEATING OF PRIMED PIPE

2.13.8 COAL-TAR ENAMEL APPLICATION

2.13.12 ELECTRICAL INSPECTION

2.14.1 TRANSPORTING AND HANDLING (EXCEPT THAT A.R.A. LOADING RULES WILL NOT APPLY).

2.9 FIELD BOND TEST PROCEDURE FOR PRIMER AND ENAMEL.

The enamel shall be furnished in expendable sheet metal or paper drums. The enamel will be chopped or cut on a suitable platform to prevent the enamel from coming into contact with dirt, weeds, cinders, grass and other contaminants. The chopped or cut pieces of enamel may not weigh more than 10 Kg. The pieces of enamel shall be covered when they are in danger of contamination because of atmospheric conditions.

Care shall be taken to prevent contaminants from mixing with the enamel at any time. The enamel shall be slowly heated to the temperature recommended by the manufacturer in a clean kettle.

When the enamel has reached the recommended temperature, the flame under the kettle shall be reduced to prevent overheating. Only batch heating of the enamel will be permitted. The kettle shall be emptied of one charge of enamel and cleaned, if necessary, before the next charge of enamel is added. All enamel taken from the kettles shall be strained.

During the time that the enamel is in a molten condition, it shall be continuously agitated. Small kettles or batch pots not equipped with mechanical agitators shall be stirred with steel paddles every fifteen (15) minutes. Kettle lids shall be kept tightly closed at all times except for small kettles when the lid may be opened for stirring. Wooden sticks or paddles may not be used for stirring the enamel. Enamel heated in excess of the maximum temperature specified by the manufacturer shall be condemned and dumped. The temperature of enamel required to produce the thickness of coating specified shall be maintained at all times during application.

In case of an interruption or short shutdown due to weather conditions or other unavoidable circumstances, the temperature of the enamel charge shall be reduced approximately to 55o C lower than the application temperature until coating operations resume.

The enamel shall be applied with an approved combination coating and wrapping machine. The enamel shall be applied in such a manner that it will adhere tightly to the primed pipe in a continuous unbroken film of the specified thickness. Machine operators shall be required to make all necessary adjustments to assure a continuous film of enamel without undue loss of temperature at point of application. Defects such as bubbling or foaming, shall be cause for shutting down operations until air pockets if any have been removed from pumps and supply lines, and required coating shoe adjustments have been completed. The pipe ambient temperature during application of the enamel shall be within the limits specified by the manufacturer.

Coating shoes shall be kept evenly centered on the pipe and shall not be allowed to drag or thin the enamel below specified thickness at any point due to improper bridling. Shoes, which are not round or are damaged, shall be immediately replaced. One or more auxiliary spray rings shall be used if necessary, Thickness of the coating applied shall be frequently tested with an approved pit gauge. The coating punctured by the pit gauge shall be repaired.

A reasonable even coating of hot tar enamel shall be applied over the entire surface of the pipe. The minimum thickness of the enamel at this stage shall be 2.4 mm.

Immediately following application of the hot tar enamel to the pipe and before the enamel has cooled appreciably the glass fibre reinforcement material shall be applied over the enamel in a uniform spiral wrap, in such manner that the wrapper is drawn into the hot enamel causing enough

of it to penetrate through the glass to furnish a proper bond with the next layer of enamel. A second application of hot coal tar enamel shall then be applied of such thickness that the composite thickness of two layers of enamel and reinforcement shall be minimum of 4.75 mm.

A second layer of glass fibre reinforcement material shall then be applied immediately behind the second coat of enamel in uniform spiral wrap and pulled into the enamel. The fibre-glass with coal tar enamel outer wrap shall then be applied immediately behind the glass fibre reinforcement in a tight uniform spiral. The overlap at the edges of all wrapping shall be not less than 12 mm nor more than 25 mm. The tension of the wrapper should be so adjusted that it does not pull through the hot enamel and come in contact with the metal surface. This may be checked by cutting out a section of the coating at the lap in the wrapper and making a physical examination. The size of the bead formed at the lap indicates whether the tension is correct or not. If the bead is 15 percent higher than the felt, it indicates that the felt has been pulled in too tightly, thus squeezing the enamel out of the lap.

No wrinkling in the wrapping will be allowed and the outer wrapping shall be completely bonded to the enamel.

The coating shall be continuous for the full length of the pipe, except that a length of at least 250 mm but not more than 300 mm on each end of the pipe shall not be coated. This uncoated position near the pipe ends shall be applied with temporary coating as specified elsewhere after concrete coating if any, and before stock piling the line pipes.

All foreign substance, dirt, steel shrapnel and other debris shall be removed from inside of pipe before stockpiling or shipping. All primer and enamel inside the pipe shall be removed with solvents and wiped clean. The coated pipe shall be placed in such a manner that the enamel can set cool and harden without damage.

11.28.3.2 External coating of pipeline using polyolefin cold applied tapes shall be done as per Annexure.

11.29 INSPECTION, TESTING AND REPAIRS

All records of inspection and testing of material received by Contractor and all manufacturer material certificates shall be submitted to the Engineer.

All materials shall be certified by means of the manufacturer's certificate of analysis for each batch of material supplied. Representative samples of material may be tested by the Engineer. The cost of testing shall be borne by the Contractor.

Pipe identification shall be preserved by Contractor by maintaining identity of each joint of pipe.

All stages of the work shall be subject to full time inspection by the Engineer. Such inspection shall not relieve the Contractor of his responsibility to provide materials and workmanship to this specification.

For Field Bond Test Procedure, Section 2. 9 of AWWA C 203-91 shall be applied to each pipe in the initial production, until such time as the Engineer is satisfied that the bond is satisfactory, when he may relax the test to one pipe in ten, chosen at random.

The Engineer shall be permitted to test the coating and any repairs subsequently made to it, in compliance with this specification. He will from time to time cutout 25 square cm samples from the coating for determination of thickness. Contractor shall repair such cut outs and other defects in the coating at no extra compensation

Contractor shall furnish high voltage electronic holiday detectors of a type acceptable to the Engineer and shall test all coating applications immediately after coating and wrapping. The holiday detector shall be a low impedance high voltage holiday detector such as Spy model S-120 or equivalent. Testing for coating flaws shall be in accordance with NACE Standard RP-02-74, "Recommended Practice High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation", latest edition. The minimum detector voltage required may be determined by the following formula.

$1250(t)0.5$ Voltage setting, where "t" is the specified minimum coating thickness expressed in m.

While deciding upon the test voltage due consideration has to be given to perforated fibre glass with coal enamel wrap application and thickness.

Calculated test voltage shall be checked against the test voltage arrived at by following the procedure prescribed in Section 6.2 of AWWA Standard C-203-91 and use higher of the two voltages for regular inspection work.

The crest voltage of the holiday detector shall be set as high as practicable and operating voltage set as specified earlier. Contractor shall provide necessary devices for calibrating the holiday detector.

All coated pipe under test shall be positively grounded by a means satisfactory to the Engineer. The detector electrode shall be periodically cleaned to continuously provide full contact with the surface of the coating. The approved electronic holiday detector shall be passed over the coated and wrapped pipe as coating progresses. The detector shall be passed at a sufficient distance behind the coating and wrapping machine to permit the enamel to set. The initial inspection is made to provide prompt warning of coating machine maladjustments or other conditions preventing a proper coating application as specified, in order that immediate corrective adjustments may be made.

Any defective part of the coating shall be clearly marked by Contractor immediately after it is detected.

All pin holes, voids, air bubbles, cracks, and other breaks shall be carefully marked. Repairs may be made immediately following the coating and wrapping operation or may be deferred, but in any case shall be repaired and reinspected prior to storing or shipping. Repairs to enamel coating shall be made by removing the wrap over the damaged coating in a manner that will not disband the adjacent coating. The repair area shall be primed and hot enamel shall then be poured or 'ragged' over the area, with the felt wrap embedded and bonded to the enamel. All coating repairs shall be made with the wrap smoothly applied and without wrinkles or buckles. Repair shall be at least equal in effectiveness to the coating applied to the principal part of the line. All repairs must successfully pass a test by the electronic holiday detector.

Any pipe joints shall be rejected if three (3) or more holidays are detected in its length. Similarly, a pipe joint shall be rejected and no repair allowed to it if any one holiday is bigger than 0.1 square meter in size.

Contractor shall repair all coating damage and defects at no additional cost to Owner. All coating operations shall be subject to physical examination and samples shall be cut from the coating as required by the Engineer. Pipes shall be handled in such a manner as to prevent damage to enamel and wrapper.

If the coated pipe is to be stored, it shall be coated with a spiral wrap of Kraft paper or a water resistant white wash as per AWWA C 203-91 Section 2.6.

Prior to final stacking of pipe, the unprimed ends shall be cleaned by wire brushing and coated with as per recommendation of the manufacturer of coating. Such temporary protective

coating should not require removal while making field-joints and applying corrosive protective coating later while laying the line. The type and film thickness is to be agreed by the Engineer.

11.30 HANDLING COATED PIPE

Contractor shall develop the method of stock piling on trucks and barges and shall furnish special loading spacers, bolsters and the like, approved by the Company's engineer, to protect the pipe during transport.

Coated pipe shall be handled at all times with wide non-abrasive or leather belts or other equipment designed to prevent damage to the coating. All such equipment shall be kept in repair so as to prevent injury to the coating. The use of tongs, bare pinch bars, chain slings, protruding rivets, pipe hooks without proper padding, or any other handling equipment that may be injurious to the coating shall not be permitted. The coated pipes will be padded while being transported. It should be noted that the road's condition may not be very conducive for such transport.

Yard coated pipe shall be raised or lowered to or from stock pile, ground, barge, rail car, or truck by means of brass lined or padded pipe end hooks engaging the ends of the pipe and carried by wire rope on chain slings with 'Spreader bar' between lifting lines. The bolster of the rail car, trailer, or barge shall have a bearing surface not less than 30 mm to give necessary support to the padding which protects the coating. Sacks partly filled with sand or sawdust should be placed on the bolster and between the outside bottom pipes and the bolster stakes. All chains, cables, or other equipment used for fastening the load must be carefully padded.

The maximum piling heights for various types of coated pipe shall be limited to such heights as will prevent damage to pipe and coating.

All pipes shall be tight nested (laid parallel with full length contact). No concrete coated pipe shall be loaded, piled or nested with regular coated pipe.

11.31 REPAIR OF PIPE

Any flaws discovered in the pipe during the cleaning or coating operations but not caused by Contractor will be repaired as approved except the cost will not be to the account of contractor.

11.32 FIELD JOINTS

After the welding is completed, tested and approved, the procedure as described for parent pipe will be strictly adhered to. If the pipe trench is flooded with water, the same will be pumped /

bailed out. The field joint will be allowed to dry before cleaning operation commences. The backfilling will be applied in sufficient quantity so that coating and subsequent wrapping do not leave any void. The filler will be to match the coating specification.

CHAPTER 12 - INSTALLATION OF PIPELINES

12.1 CONTRACTOR TO SUPPLY PIPE MATERIALS

Unless otherwise indicated on the Drawings or stated in the Specification or Bill of Quantities, all pipes, joints, valves, specials and jointing materials required for the works shall be supplied by the Contractor at his own cost.

12.2 HANDLING OF PIPES AND SPECIALS GENERAL

Pipe specials shall be received, transported, stored installed and handled in accordance with the manufacturer's recommendations subject to this Specification and the approval of the Engineer. Handling operations shall be carried out with care.

Pipes and specials shall be lifted and moved only by wide non-abrasive slings or by other means acceptable to the Engineer. Wire ropes, chains and hooks shall not be permitted to come in contact with external sheathing or external surfaces of unsheathed pipes.

12.3 TRANSPORT OF PIPES AND SPECIALS

During transport, loading and unloading, pipes and specials shall not be allowed to come into contact with any sharp projections, which may cause damage. During transit, pipes and specials shall be well secured, supported and protected.

Pipes shall be provided with 4-6 legged spider stiffeners so designed as not to damage the lining. The stiffeners shall not be removed until a joint is about to be made.

The ends of all pipes and specials shall be suitably covered, and protected against damage during transit with straw contained in Hessian secured to the pipe ends. All flanges shall have wooden discs temporarily bolted on. Pipes and specials shall be wrapped or cushioned so that no load is taken directly on the external sheathing.

12.4 PREPARATION OF STOCKPILE AREAS

Pipes and specials shall be delivered to and stacked singly at stockpile areas arranged by the Contractor and approved by the Engineer. Prior to the arrival of any pipes or fittings, the Contractor shall prepare each of these areas by:

(i) Setting out firm, well-drained and level areas for pipe stacking, and for vehicle, and for vehicle access and turning;

(ii) posting supervisory staff to register the arrival of deliveries, supervise off-loading and guard the Stockpile Areas and contents;

(iii) erecting covered storage (Part 1) for joint rings and other materials susceptible to damage by weather;

(iv) Installing approved bearers for pipes and specials, which shall keep pipes and specials at least 150 mm, clear of the ground and support them securely without damage to the external sheathing.

12.5 HANDLING OF VALVES AND ACCESSORIES

Valves and pipe laying accessories such as joint gaskets shall be delivered securely packed in crates except that the Engineer may approve delivery in sacks or cartons and storage on shelves of, small items such as bolts, nuts, washers and small-diameter gaskets.

All materials other than pipes and specials shall be stored inside the Temporary Storage Buildings described in Section. Except for purposes of inspection, materials shall remain inside their crates, cartons or sacks until required for installation. The full permanent protective coating system shall be applied as soon after installation as possible.

12.6 DAMAGED PIPES, SPECIALS, VALVES, ETC.

All pipes, specials, valves, etc. shall be carefully examined for damage prior to fixing or laying and prior concreting or backfilling.

If any pipe, special, valve, etc., is found to be damaged in any way, the Contractor shall notify the Engineer. The damaged item shall be clearly marked and set aside for repair, cutting to a shorter length or removal from site as the Engineer may direct. All expenses involved in repairing, cuffing and or replacement of defective or damaged pipes, specials, valves, etc. shall be borne by the contractor. The contractor shall be responsible for any delays caused thereby only pipes which on inspection are found to be sound in every respect shall be fixed or laid.

Before steel pipes and specials are laid, all damaged covering and lining shall be cut out and replaced with new materials compatible with the sheathing material as directed by the Engineer. Cracks up to 0.8 mm wide may be caulked with an approved material, provided the cracks are not fully circumferential and that no detached areas on lining can be detected in the internal mortar lining of steel pipes and specials.

All pipes, valves and specials shall be examined for rust and loss of paint prior to installing in position. The exposed surfaces of valves affected by rust shall be wire brushed and painted with repair coats of approved material compatible with the manufacture. The ends of pipes and specials shall be wire brushed (if necessary) and cleaned, primed and painted with two coats of solution compatible with the factory applied material.

12.7 SIGHT RAILS

Where pipelines are to be constructed in trench the Contractor shall provide, fix and maintain at such points as may be directed by the Engineer property painted sight rails and boning rods or predetermined measurement for the boning in of individual pipes to correct alignment. The sight rails shall be situated vertically above the line of pipes or immediately adjacent thereto and there shall at no time be less than three sight rails in position on each length of pipeline under construction to any one gradient. Consideration will be given by the Engineer to alternative methods for controlling alignment such as laser beam instruments.

12.8 PIPE TRENCH CONSTRUCTION

No more than 100 metres run of pipe trench shall be opened up ahead of pipe laying operation, unless otherwise approved by the Engineer.

The trench shall be excavated to the minimum width necessary to ensure an adequate working space subject to the requirements of chapter 5 of the Specification. The Engineer will not certify excavation or over break outside the trench widths and depths shown on the Drawings except where the Contract so permits. Where pipes are to be laid on a concrete bed the width of the excavation at the bottom of the trench shall be the width of the underside of the concrete bed. Where bends are made by deflecting pipes at joints the trench shall be locally widened to permit this operation. The sides of the trench shall be cut vertical, and where necessary shall be protected against caving in by timbering to the approval of the Engineer.

The Contractor shall form pipe trenches as far as practicable with vertical sides and plane inverts to the widths, depths and gradients specified or instructed by the Engineer. Where necessary

to maintain the stability of the upper part of the trench, sides may be lightly battered at the Contractor's expense but vertical sides shall be maintained below the pipe waist level. If the Engineer considers that the batter needed to maintain slope stability and safe working is excessive, he will instruct the Contractor to install trench support at no extra cost. The results of a site investigation are available at the offices of and the Engineer to guide the Contractor in planning the Works.

12.9 LAYING PIPES IN TRENCH

The formation of trenches of pipelines shall be even and free from stones and other protrusions. Pipes shall be laid in a dry trench. If the formation of the trench lies below the water table the Contractor shall install a dewatering system to the approval of the Engineer. Dewatering shall Continue until all Works below the water table are completed or as otherwise directed by the Engineer.

Before any pipe, special or valve is laid in position ready for jointing, its internal surfaces shall be thoroughly wiped, clean and free of dirt, stones, etc. to ensure that no debris, sticks, stones, rages or other foreign matter is left in the pipeline. The pipes shall be laid true to alignment and gradient as shown in the Drawing or as indicated by the Engineer, each pipe being boned between sight rails so that except where otherwise specified or ordered by the Engineer the finished pipeline shall be in a straight line both in horizontal and vertical planes. In no case shall the pipeline be laid to a gradient flatter than 1 in 500. Care shall be exercised to ensure that the barrel of every pipe is evenly bedded throughout the whole length. The pipes shall be gently lowered into the trench by means of a crane, or suitable shear legs and chain blocks, with rope or canvas slings. Hooks shall not be used. No pipe shall be rolled and dropped into the trench, or allowed to assume an inclination of more than 5 degrees to the horizontal while on the slings.

To prevent the entry of foul water, earth and other foreign matter into the pipelines the Contractor shall provide and fix suitable stops for efficiently closing all open ends of the pipelines in the trench at all times when work is not actually being carried out at such open ends.

In certain instances, subject to the agreement of the Engineer, air valve tees and washout tees may be installed at the pipe joints nearest to the specified position provided that the approach gradients are amended to ensure that the air valve tees and washout tees are installed at the highest and lowest points respectively of the sections of the pipelines concerned.

The pipeline route and/or alignment shown on the Drawings is only tentative. The exact location of the pipeline, valves, bends, etc. shall be decided by the Engineer on the Site. Bends are

shown on the Drawings at sharp changes of direction in both the vertical and horizontal planes. These bends are the standard bends. At places where there is a change of direction but no bend is shown, the intention is that the change of direction shall if possible be achieved by deflection of the joints.

The contractor shall be available at each current pipe laying location the equipment necessary for obtaining bedding and backfill samples and performing in-situ tests. He shall use this equipment to the extent necessary to control the trench bedding and backfill to the Specification or as may be required by the Engineer, and shall also test the samples in a laboratory as required.

Except where otherwise shown on the Drawings or directed by the Engineer the cover to pipes shall not be less than 1.2 meter.

12.10 BEDDING AND BACKFILL MATERIALS FOR STEEL PIPE LINES

As per clauses 5.12 and 5.20 of chapter 5.

12.11 LAYING AND AND BACKFILLING PIPES

The pipe trench shall be completed in accordance with Clause 12.9 and the bedding material placed and compacted in accordance with the approved Procedure following on the Trial, in layers not exceeding 150 mm thick. Bedding material shall be laid to a depth such that, with at least 300 mm of bedding below the pipe barrel, the base of the pipe is embraced over an arc as specified on the Drawings.

After the above depth of bedding has been completed, a dished recess to conform to the shape of the pipe shall be excavated in the bedding so that when the pipe is positioned to correct line and level it is substantially uniformly supported by the bedding. Part of the bedding shall be omitted at each joint protection.

The Contractor shall provide and use effectively the equipment needed to compact properly the bedding and backfill below the lower Parts of the pipe.

The pipe shall then be placed on the bedding and its vertical and horizontal diameters measured at the ends and mid-point. Every effort shall be made to avoid damaging the pipe sheathing.

The pipe shall then be finally aligned, the joint made, air tested and protected. Backfill shall be placed in layers with a thickness not exceeding 150 mm.

Once the backfill has reached 300 mm above the crown of the pipe, the pipe internal vertical deflection at the welded joint and mid-point shall be checked by an approved means to ensure that it is not excessive. If deflection at this stage is such that subsequent backfilling is unlikely to restore the specified deflection, the backfill shall be carefully excavated and recompacted, or replaced if needed by better material.

Above 300 mm from the crown of the pipe, the remainder of the trench up to the underside of the reinstatement shall be filled compacted in horizontal layers not exceeding 300 mm thickness.

As the backfill is raised, the Contractor shall gradually withdraw the trench sheets, in order to ensure that backfill is compacted firmly against the virgin soil in the sides of the trench.

When backfilling is completed, the vertical and horizontal diameters at each joint and mid-point shall be measured again. The measured deflection shall show the vertical diameter to be the longer with less than 2% deflection.

Reinstatement shall be as specified elsewhere, but no reinstatement shall be carried out until the Engineer has approved the backfill.

The Contractor shall record details of the successive procedures of trench excavation, placing bedding, pipe laying, jointing, air-testing, protection, backfilling hydraulic testing and reinstatement on a record proforma the layout of which shall be agreed with the Engineer at the commencement of the Contract. One copy of the pro-forma shall record all the activities related to each pipe length, and shall identify the pipe by both its manufacturing number and its position in the line. Cut pipes shall be identified by the original manufacturing number of the whole pipe.

On the pro-forma, the hydraulic testing shall be recorded only as to its successful achievement and the test pressure applied: Full details of the hydraulic testing shall be recorded elsewhere in the format of Appendix A.

12.12 TRIAL EXCAVATION AND BACKFILING

Prior to proceeding with laying pipelines the Contractor shall undertake a Trial Excavation and Backfilling. The purpose will be to test the Contractor's proposed method of working and to provide a basis for systematic control of bedding and backfill throughout Contract. Three days

before undertaking the Trial, the Contractor shall submit to the Engineer a Method Statement for approval. The Trial shall not commence Until the Engineer has approved the statement and the Contractor has provided in the Site Laboratory all staff and equipment necessary for the Trial.

The Trial Excavation and Backfilling shall conform to the approved Method Statement and shall take place at a point on the designated rising main route so that if it is successful the work undertaken during the Trial can form part of the Permanent Works.

In the Trial, the Contractor shall excavate the trench, prepare the pipe bedding, lay and join the pipes, air-test the joints, apply protection and place and compact the backfill up to 300 mm above the crown of the pipe over a total pipeline length of 30 metres. All these procedures shall be carried out in conformity with the Specification using methods, plant and personnel which the Contractor proposes to use on the remainder of the Contract.

All laboratory tests related to the Trial and to subsequent control of pipe laying shall be carried out in the Contractor's Site Laboratory. In-situ density shall be measured by sand replacement.

12.13 ADEQUATE SEPARATION FROM OTHER PIPELINES

In city area the Present Pipeline will run parallel to undeterminant/unknown Pipes-and rabies. The distnc, of separation should be $2(D+d)$. where D is the diameter of the large pipeline and 'd' is the diameter of the small pipeline.

If the Pipelines are crossing at the right angles, minimum distance suggested is approximately should be recorded as they have to be checked during commissioning of cathodic protection system. If sufficient distance is not feasible, both the pipelines at the crossing should be rigidly tested for Holiday Detection and Pearson Detection so that there is no pinholes left.

If distance of minimum 500 mm cannot be maintained when the pipelines are crossing at right angles, insulating materials such as polyetheiene sheets. etc. shall be provided. About metres on either side of the crossing on foreign facilities is suggested.

The pipelines shall be permanently insulated, from other underground utilities like cast iron pipelines. water mains, cables of all types etc.

If at times H.T. cables are to. be crossed. they shall be shielded by PVC pipe around them.

12.14 OPEN CUT ROAD CROSSINGS

Maximum precaution shall be taken so that there is no damage to the pipeline at these crossings. These crossings shall be provided with one additional coat of coal tar enamel and tested for peel test and Holiday Detection. All precautions will be taken so that the coating in this length is not damaged while backfilling.

12.15 PIPE CUTTING AND CLOSURE UNITS

The use of closure units shall be avoided as far as possible by laying each pipeline in a continuous length. However, where this proves impossible at any point, the Contractor shall form the closure units by cutting sized pipes to the exact lengths required, allowing a tolerance for insertion. No pipe shall be cut for any closure without the prior consent of the Engineer.

Where it is necessary to cut pipes to provide closing lengths or for laying pipe specials or in the repair of damaged or chipped pipes, the cutting shall be neatly and accurately performed so as to have the end of the pipe truly normal to the axis of the pipe.

Where it is necessary to cut steel pipes to provide closing lengths the damaged concrete lining near the cut shall be repaired and shaped for jointing and the external coal tar enamel shall be stripped over a sufficient distance from the end to accommodate the collar joint or flexible mechanical coupling.

12.16 ASSEMBLING FLANGED JOINTS

Flanged joints shall be properly laid true to line and level before bolting and on no account shall drifts or podgers be used in the bolt holes. Flanged bolts shall be carefully and evenly tightened in such sequence that diametrically opposite nuts are tightened together to ensure even pressure on the joint ring.

For tightening of all bolts in pipe joints, the Contractor shall provide and use torque spanners of the "break back" type set to give the tightening torque recommended by the manufacturer.

After flange bolts have been fully tightened, the final coating shall be applied.

Washers shall be included below all bolt heads and nuts.

Joint rings and gaskets shall be stored, until needed, in a cool place free from direct sunlight.

12.17 CONCRETE BED AND SURROUND

Where concrete protection to pipelines is to be provided a blinding layer of concrete shall be laid over the full width of the bottom of the trench so as to satisfy the following requirements:

Details of Concrete Blinding	
Minimum thickness of blinding (mm)	300
Minimum extent of surround each side of pipe barrel (mm)	500
Minimum clearance between blinding and pipe barrel (mm)	150

The concrete blinding shall be allowed to set and be thoroughly cleaned before pipe laying commences.

The length of pipeline laid in any one operation before concreting the pipeline shall be as directed by the Engineer so as to permit accurate laying of the pipeline and proper compaction of the fill.

Pipes shall be firmly supported on precast concrete blocks and separated from them by a 25 millimeters thick saturated softwood packing.

After the pipeline has been tested by the Contractor and proved by the Engineer the concrete shall be thoroughly washed and additional concrete Class '25/20' shall be carefully placed and compacted thereon to avoid disturbing the pipes or joints until the appropriate profile for the type of protection required has been reached.

Concrete protection to the pipelines shall be either bed or surround as shown on the Drawings or ordered by the Engineer in writing.

The Concrete protection shall be placed the full width of the trench and never less than 150 millimeters on each side than the barrel of the pipe. When support of excavation is provided building paper shall be placed against that support before concreting to facilitate careful withdrawal of the support.

12.18 THRUST AND ANCHOR BLOCKS

The Contractor shall build thrust and anchor blocks to the details shown on the Drawings or details to be issued by the Concrete Engineer. *Class "M -15" concrete with nominal reinforcement shall be used.

The bearing faces of sit thrust and anchor blocks shall be cast against the vertical bearing sides of the excavation defined in the Drawings or by the Engineer.

The tops of buried blocks shall in general be 250 mm below finished ground level.

12.19 BUILDING PIPE THROUGH MASONRY & BRICKWORK

Where it is necessary for any pipe to pass through non-water-retaining masonry or brickwork, the masonry or Masonry brickwork shall be arched over the pipe. The diameter of the Masonry & Brickwork hole thus formed shall be 25 mm larger than the external diameter of the pipe and the space between the masonry or brickwork and the pipe at the hole shall then be filled with bituminous felt to provide a cushion to the perimeter of the pipe.

12.20 INSTALLATION OF PIPES ON SADDLE SUPPORTS, INSIDE BOX CULVERTS

Saddle supports shall be built of concrete Class "M 25" as directed. Pipe shall be held onto saddle by the of pipe Straps which shall be accurately formed so that when securely bolted down they conform closely to the pipe circumference. Straps on saddles where the pipe is to have free axial movement shall be so arranged that bolts are full tightened; there is no restraint of axial movement of the pipe, The pipe strap shall be clear of the pipe by not more the 3 mm around the arc of upper semi circumference.

Where axial restraint is required, the saddle shall embrace the pipe totally as directed.

Freedom of axial movement shall be provided at all saddles unless directed by the Engineer.

Pipes laid on saddle shall be straight pipes only and shall be laid true to line and level so that the entire length on any one set of saddles is on a straight alignment and constant slope. Change of slope shall be permitted only at fittings.

Pipe straps and the pipe inside box culvert shall be fully protected with primer and Aluminium paint before they are fixed in place.

The Pipe Straps shall be placed correctly about the pipe and the rag-bolts and nuts of pipe Straps shall be set hand tight in the lugs of the Pipe Straps with the nut at about mid hread before the final lift of concrete is poured. When the concrete has set, the nuts shall be removed and the Pipe straps reset with sufficient spacing washers to obtain the correct positioning of the pipe straps

when the nuts are fully tightened. After tightening, the nuts shall be secured by the locking-tab washers, and the whole assembly of nuts, bolt and washers given a liberal coating of zinc paint in dry conditions.

*Class 25/20 indicates M-25 concrete with maximum size of aggregate 20mm.

12.21 PIPE STRAPS

Pipe straps shall be fabricated of mild steel to B.S. 1712 and shall be a close nut, but non bending fit on the pipes & should not restrain the pipeline. The nuts of the ragbolts shall be galvanised. The ragbolts shall be encased atleast 100 mm. The nuts on these ragbolts shall be galvanised hexagonal nuts equipped with galvanised locking tap washers. Galvanised plain circular washers shall be provided.

12.22 BUILDING PIPES THROUGH STRUCTURES

The plain end of a pipe built through a wall or structure shall protrude from the concrete by a maximum of 300 mm or that distance required to properly make the joint to the next pipe.

Any over excavation adjacent to a structure and beneath the formation level of a pipe trench to be excavated by the Contractor shall be backfilled to the formation level of the pipe trench with concrete Class 15/20. This concrete shall extend to the limit of the over-excavation along the line of the pipe trench and across the full width of the pipe trench or to the limit of the excavation whichever is the lesser.

Where the pipeline beyond the structure is above ground and is to be coated in an Aluminium Paint System (Clause 12.29), a rectangular chase 25 mm deep and 25 mm wide shall be formed in the concrete as it is cast. The chase shall extend around the full perimeter of the pipe. After removing the former and allowed the concrete to cure, the Contractor shall clean and fill the chase completely with an approved thixotropic sealant to prevent ingress of moisture between the pipe and the concrete. The sealant shall be compatible with the aluminium Paint primer and system and shall achieve its final set within 24 hours. The Aluminium Paint then be applied across the face of the sealant up to the concrete.

12.23 WELDING

All electric arc welding equipment shall be to the approval of the Engineer and shall comply with BS-638. The Contractor shall submit for the Engineers approval details of the welding procedure which he proposes to adopt.

Care shall be taken to avoid starting fire.

The Contractor shall make test specimens on bare steel shells or pipes of the same size and thickness as the pipelines to be welded. The joints shall be tested in the presence of the Engineer for each procedure in accordance with requirements of A. P. I. Standard 1104.

The contractor shall obtain radiography of the welds as required by the Engineer and shall radiograph not less than 2% of the welding carried out on pipelines.

Only procedures approved in writing by the Engineer shall be adopted for welding on the pipelines, and change from one procedure to another will not normally be permitted without submitting the new procedure for retesting.

12.24 WELDING PERSONNEL

Only the most highly skilled welders shall be employed on the works, and every welder before commencing any joint welding shall prepare specimens for testing in accordance with A.P.I. Standard 1104 for each welding procedure proposed by the Contractor.

The Engineer will advise the Contractor in writing which welders pass the performance qualification test. Only these welders will be allowed to joint pipes in position and the Engineer will be entitled to withdraw his approval of any welder responsible for making-joints which fail to meet the required standard.

12.25 MAKING WELDED JOINTS

Steel pipes to be jointed by welding shall be jointed by means of an internal and an external circumferential electric arc weld at each joint.

Before placing the pipes together the portion of the sockets and spigots to be welded shall be cleaned to a bright metallic finish. The spigot end shall then be placed in the socket and forced inside so that the spherical surfaces are in contact and the gap between the pipes at the end of the spigot is nowhere greater than 1.5 mm.

Where pipes are to be jointed by a steel split collar, the pipes ends and the collar shall be cleaned to a bright metallic finish. The collar shall then be placed on the ends of the pipes so that the space between the pipe ends shall be about 25 mm and shall be aligned symmetrically below the centre line of the collar. The collar shall be clamped tightly onto the pipes using the lugs provided and welded longitudinally. After completion of the internal and external circumferential welds, the lugs shall be removed and the longitudinal weld completed internally and externally.

The weld shall be of the convex full fillet type for lap welded joints made manually by the metal arc process using approved types of electrodes, Each time the arc is started it shall be manipulated to obtain complete fusion of the weld metal with the pipe metal and any previously deposited weld metal. Before welding is over, any previously deposited weld metal all slag shall be completely removed and the adjacent pipe metal shall be cleaned by wire brushing.

All welds shall be subject to inspection by the Engineer and shall comply with the requirements of, BS 5136 for freedom from undercutting. fusion penetration and soundness.

12.26 AIR TESTING OF WELDED JOINTS

After each joint has been welded, steel pipe shall be air tested in the following manner in the presence of the Engineer.

The annular space between the two welds shall be air tested to a pressure of 2 Mpa., While this pressure is maintained for a minimum period of ten minutes, the welds shall be examined carefully for leakage. Any defective welding shall be treated as directed by the Engineer. The screwed plug shall be replaced and welded after each joint has been satisfactorily tested. The Contractor shall provide, all necessary gauges, equipment, labour and materials for air testing welded joints.

12.27 COMPLETION OF COATING & WRAPPING AT JOINTS

After the Engineer has advised the Contractor in writing that a joint to be buried has complied with the Specification, the external coating & wrapping shall be completed to ensure continuity of protection along the pipeline.

The bare metal shall be thoroughly cleaned to a bright finish and it shall be immediately coated with a primer solution. The primer shall be applied cold by brush.

The Contractor shall ensure that personnel are not endangered by toxic fumes arising from the process and materials for completion of coating & wrapping at joints.

12.27.1 COALTAR ENAMEL COATING FOR FIELD JOINTS

After the joint is cleared after pressure testing, the uncoated surface shall be machine cleaned for any dirt, grease. The brushes and scrapers used for cleaning will be in good condition. The cleaned pipe shall be immediately primed as per the specifications and manufactures'

instructions. Once the pipe is cleaned and till the coating on the field joint is completed, the complete joint shall be free from any moisture, dust and water.

After the primer is cured, hot coal tar enamel will be poured and spread by suitable sling made of cloth or by brushes etc. all over the bare areas near the field joint and immediately fibre glass cloth will be wound before hot enamel is set so that the fibre glass get adequate impregnation. Second coat of enamel will be applied; outer wrap will be wrapped around the surface. The overlap over the parent coating and the field joint will be minimum 50 mm.

Men making the field coating will be experienced. It is in this area that subsequent Pearsons Detection can reveal defects. Extreme care shall be taken to achieve good bond and field coating is as strong as yard coating electrically and mechanically.

Holiday Detection will be immediately carried out to the satisfaction of the Engineer.

12.28 COMPLETION OF INTERNAL LINING AT WELDED JOINTS

On completion of the external sheathing the steel exposed at gaps in the internal lining together with the adjacent lining shall be thoroughly cleaned and wire brushed and all dust removed. The adjacent lining shall be wetted with thick cement slurry but no accumulations of water in the gap shall be allowed. The internal lining shall then be completed by filling the gap with cement mortar which shall be made from one volume of cement to two volumes of fine aggregate to ensure a smooth continuous lining throughout the pipeline.

The Contractor shall ensure adequate ventilation where the personnel are working within the pipeline.

12.29 Making Joints with Mechanical Flexible Coupling and Flange Adaptors (if required by the Engineer)

Joints made with mechanical flexible couplings and flange adaptors shall be made in strict accordance with the instructions given by the manufacturer, between pipe spigots which are of the correct external diameter.

Mechanical Joints shall not be included on lengths of pipe in concrete surround.

The pipe ends at a flexible coupling shall be separate by an amount sufficient to accommodate expansion of the pipes due to a rise in temperature from ambient to 40 degrees C. Before jointing, the ends of each pipe shall be wire brushed to remove any protective material

adhering to the coating, together with any protuberances which may have been caused by rubbing of the packing material and to remove all rust at exposed surfaces due to the stripping of the bituminous coating. The pipe ends on the inside surface of the sleeve of the coupling or adaptor shall then be painted with two coats of approved bituminous paint.

The coupling or adaptor shall be slipped loosely over the fixed pipe, if possible, or otherwise over the loose pipe to be attached. The loose pipe shall then be supported in the 'correct position, axially aligned with the fixed pipe (or flange) and at the recommended distance from it. If at this stage it is apparent that one or both pipes, if this is practical, or to substitute a new pipe or pipes with squared end. The Contractor shall himself bear the cost of re-trimming or replacing pipes when he is responsible for or a skew end.

The coupling shall then be aligned centrally over the gap between pipes and the bolts tightened systematically so that the sealing rings are uniformly and steadily compressed. If the coupling is not square to the pipe on completion the bolts shall be slackened for and then retightened when the coupling has been correctly positioned.

On completion of the joint, the Contractor shall sheath the joint by one of the Methods specified for sheathing joints,

12.30 PAINTING OF EXPOSED STEEL PIPELINES

Exposed portions of steel pipelines shall be protected by a paint system of which the primer coat shall have been applied in the manufacturer's works

Damaged primed surfaces shall be repaired in the field by cleaning and further priming with the same primer to at least the thickness of the works-applied primer coat.

After the completion of pipe assembly in the field, damaged areas of the primed surface shall be fully repaired and the whole surface shall be cleaned of foreign matter. The finishing paint coat shall then be applied.

The finishing coat shall be aluminium heat-resisting finish applied in sufficient layers (at least 2) to give a minimum dry film thickness of 50 micron.

The primer and finishing coats shall be mutually compatible and shall be from the same approved manufacturer.

The approval of the Engineer shall be obtained to all details of paint system application, including surface preparation, works environment, application techniques, intermediate drying times and repair of coatings.

Paint shall not be applied to wet surfaces or during rain. The Contractor shall be deemed to have made full allowance in his Tender for the effects of weather.

12.31 RECORD OF MATERIALS AND ARTICLES BURIED BY BACKFILLING

Before any excavation is backfilled, the Contractor or Articles and his representative and the Engineer or his representative shall make a joint inspection and compile a record of the number of buried pipes, specials, fittings, valves, joints, etc. All such records shall be signed by both parties and shall be binding.

12.32 VALVE CHAMBERS

Pipeline valve chambers to be provided under the Contract shall be constructed in accordance with the details shown in the Drawings.

The pipes, specials and valves in the chamber shall be set on Class 15/20 concrete blocks to exact line and level prior to the construction of the chamber walls and all parts of the steel pipes and specials which are to be encased in Concrete shall be brushed clean to bare metal.

12.33 SAMPLING POINTS

As directed by the Engineer, the Contractor shall fix 2-inch BSP tappings and blanking plugs into pipework in chambers for the purpose of sampling and metering.

12.34 INDICATOR POSTS

The Contractor shall provide and fix precast concrete indicator Posts posts, close to the centre line of the pipes, at valves, washouts and other points as directed by the Engineer.

The posts shall firmly be planted into the ground to the depth as per standard and the backfilling well rammed.

12.35 TESTING PIPELINES

Pipelines shall be tested -in the presence of the Engineer in lengths between valve chambers or in such shorter 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 test pressure specified.

Permanent valves may be included in the tested length but shall be opened during the tests and shall not be used to isolate the test section,

The arrangements for testing a pipeline shall include provision for the purging of air from the pipeline prior to a water test.

The Contractor shall keep a record of all tests on pro-forma as in Appendix A which shall be available for inspection and handed over to the Engineer on demand.

Each pipeline shall be tested after completion with the exception of any backfilling not necessary for the stability and safety of the work.

Prior to the testing of a pipeline, permanent valves included shall be checked and sealed in their fully-open positions. The pipeline shall then be filled with potable water and the air released. After having been filled the pipeline shall be left under operating pressure for at least 24 hours so as to achieve conditions as stable as possible for testing.

The pressure in the pipeline shall then be raised steadily until the specified test pressure is reached and the same shall be maintained at this level by pumping if necessary for a period of one hour. The pump shall then be disconnected and no further water shall be allowed to enter to pipeline for a period of one hour. At the end of this period the original test pressure shall be restored by pumping and the loss measured by drawing off water from the pipeline until the pressure as at the end of the one-hour test period is again reached.

The permissible loss from pipelines under test shall not exceed 0.02 litres per day per millimeter of nominal bore per kilometer of pipeline per bar of pressure (calculated as the average pressure applied to the length of pipeline being tested).

Gauges used for testing pressure pipelines shall have a dial diameter of not less than 100 mm and a full-scale reading not greater than twice the specified test pressure. Before any gauge is used the Contractor shall arrange for it to be checked independently and a dated certificate of its accuracy shall be provided for the Engineer. The Engineer shall be permitted to order his own independent test of the contractor's gauges. The test pressure shall be as indicated on the Drawings.

The Contractor shall at his own expense provide all water required for filling, testing and retesting pipelines (if necessary), and any pumps, pipe work fittings, pressure gauges and personnel required for the purpose.

12.36 DISINFECTING AND FLUSHING OF PIPELINE

After all the pipelines have been tested to the satisfaction of the Engineer, and final connection made, they shall be thoroughly disinfected and flushed in sections by the Contractor. Water for this purpose will be supplied. However, the Contractor is to submit one week in advance for the Engineer's approval a works schedule to allow the Engineer to make available the quantity of water required for the Contractor for the purpose of disinfecting and flushing the main. Where there is shortage of water due to whatever reasons, the Engineer reserves the right to alter the Contractor's tentative schedule and if the Engineer deems necessary, may permit the Contractor to draw water for this purpose only during periods of low demand. No claims for extra whatsoever shall be allowed in this respect and no claim for standing time shall be entertained.

The operation of all valves including scour and air valves shall be checked by the Contractor and any necessary adjustments made to ensure correct operation.

The method used for chlorine injection shall be the following subject to any changes ordered or approved by the Engineer.

The section of the pipeline to be disinfected shall first be emptied and then filled with a solution of chloride of lime (or other approved chemical) containing at least 20 mg/l of chlorine.

The length of pipeline which is being sterilized shall be completely isolated from existing supply mains. The chlorine solution shall remain in the pipeline for at least 27 hours during which period all valves in the treated pipeline shall be operated so as to be thoroughly disinfected. After the required sterilisation period the chlorine solution shall be drained from the pipeline which shall then be thoroughly flushed out with potable water before being put into service.

On completion of chlorination and flushing the pipeline shall not be put into service until the Contractor has demonstrated by means of approved bacteriological tests that the water delivered at the outlet end of the pipe length under test is to a satisfactory potable standard. The water shall be considered bacteriologically acceptable when it is shown to contain no detectable coliform organisms.

The commissioning of the pipeline including completion of all connections to existing apparatus shall be fully studied by the Contractor who shall submit for the Engineer's prior approval a programme for the commissioning operations. The Contractor shall amend the programme as necessary to take account of all comments and requirements of the Engineer and shall then undertake all commissioning works in accordance with the approved programme.

12.37 COMMISSIONING OF TRANSMISSION MAIN

The contractors for transmission main shall co-ordinate their commissioning activities mutually and with other co-related contractors for pumping station and treatment plant to ensure timely completion of the Project. The commissioning programme shall be submitted to the Engineer one month in advance of the date of commencement of commissioning and written approval obtained.

The transmission mains shall be commissioned reach by reach at convenient lengths along with all accessories and ancillaries by the respective contractor. During the commissioning period, the contractor shall operate the scour valves of the transmission mains to remove all accumulated silt, dirt and debris to the satisfaction of the Engineer and disinfect the mains (as specified in para 12.36) which are to carry the treated water. They shall check for leaks, if any, and rectify them and shall ensure that each and every piece of equipment / valves in the main are working satisfactorily under the design pressure ensuring correct operations.

The contractor shall demonstrate the operation of control valves at Porur, Vanagaram and all insertion points covered in volume-3 and satisfy the engineer that mains behave safely when static pressure is fully developed in the mains. During the commissioning period it is imperative to check closely the behavior of thrust blocks / anchor blocks, valve chambers, pipe supports in box culverts, etc.

At the time of handing over the work to the employer the contractor shall furnish a detailed O & M manual describing operation and maintenance of sluice valves, air valves, etc. He shall train the employer's staff in operation and maintenance during the commissioning period.

12.38 HANDING OVER

The contractor shall operate the entire system as a whole for a period of 4 running weeks to demonstrate to the satisfaction of the engineer that entire works are performing satisfactorily without any deterioration in quality and diminution in quantity due to leakages, etc. The entire works shall be handed over thereafter to the Employer in a fully operating condition.

12.39 SITE TRAFFIC CROSSING PIPELINE

The Contractor's Site Traffic shall not cross the backfilling pipeline without auxiliary support except where the backfilling and reinstatement have been carried out to the point at which public traffic is permitted to cross the line. At other crossing points for Site Traffic, the Contractor shall install a temporary bridge of adequate strength spanning from undisturbed ground on one side of the pipe trench to undisturbed ground on the other.

In no circumstances shall the Contractor's Site Traffic cross above an elevated section of pipeline.

12.40 SPIKED GUARDS

Spiked guards as indicated by the Engineer shall be fixed to exposed pipelines as directed on Site.

CHAPTER 13 – M.S SPECIALS

13.1 GENERAL:

Specials such as Y-pieces, Bends (single or composite), Tees, Tapers, etc. shall be in accordance with IS: 7322 – 1985. Smaller branches, angle piece bends etc. may be fabricated at site, care being taken to ensure that the fabricated fittings have at least the same strength as the pipeline to which they are jointed. If any extra single bends have to be modified by cutting their ends to suit the variation in deflection, the same shall be done by the Contractors as may be directed by the Engineer. For such cutting of pipes and specials, the Contractors shall not be paid for separately.

13.2 FLANGES:

Blank flanges shall be provided at the end of pipes or specials where sluice valves ,blank flanges,tapers etc. have to be introduced. The contractors shall assemble the flanges in exact position of the sluice valve,if necessary,so as to get the desired position of the sluice valve etc.either vertical or horizontal and shall then fully weld the flanges from both sides in such a way that no part of welding protrudes beyond the face of the flanges.In case welding protrudes beyond the

flanges and if the Engineer orders that such protrusions be removed the contractors shall either file or chip them off. If required and when ordered by the Engineer, the contractor shall provide gusset stiffeners welded as directed on site

13.3 BLANK FLANGES:

Blank flanges shall be provided at all ends left unattended for the temporary closure of work, and also for commissioning a section of the pipeline or for testing the pipeline laid. For temporary closures, non-pressure blank flanges consisting of mild steel plates, tack welded at the pipe ends may be used. For pipes subjected to pressures, the blank flanges or Domes suitably designed as per Engineer's requirements shall be provided. All the above arrangements shall be done at Contractor's expense.

13.4 STIFFENER RINGS:

The stiffener rings shall have to be provided wherever directed. The Contractor shall weld the same to the pipes with one circumferential run on each side. The pieces of the rings shall also be welded to each other as directed.

If the stiffener rings are fixed in position after the pipes are lowered into the trench, the welding and guniting shall be carried out in the same welding pit excavated for the field joints and, therefore, no extra payment will be made for the excavation of the pit for welding and guniting.

13.5 STRAPS:

Wherever pipe laying work is done from two faces and / or has to be done in broken stretches due to any difficulty met with at site, the final connection has to be made by introducing straps to cover gaps upto 30cms. length. Straps shall also be provided as per the procedure of fixing Expansion joint. Such straps shall be fabricated in the field by cutting pipes, slitting them longitudinally and slipping them over the ends to be connected in the form of a collar. The collar shall be in two halves and shall have its inside diameter equal to the outside diameter of the pipe to be connected. A minimum lap of 8cm on either ends of the pipe shall be kept and fillet welds shall be run both internally and externally for circumferential joint. The longitudinal joints of the collar shall be butt-welded. All fillet welds shall have a throat thickness of not less than 0.7 times the width of welding.

13.6 MANUFACTURE OF M.S. SPECIALS AND FITTINGS:

General:

The specification covers the manufacture, supply, testing and delivery of mild steel electrically welded pipe fittings with plain ends, and flanged ends. The Tenderer shall supply specials required for curves, tees, branches, manholes, air valves, scour and sluice valves. Specials

shall suit the diameter of M.S. pipes, air valves, scour valves and sluice valves and conform to the details furnished and elsewhere in the tender documents. The dimensions of the fittings shall conform to IS: 7322 – 1985.

Steel Short Pipes:

- a) M.S. Specials and fittings shall be manufactured with steel plates of appropriate thickness as given in schedules and directed by Engineer in charge. The steel plates shall conform to IS: 2062 – 1999.
- b) The manufacture of M.S. Specials and fittings shall be done in conformity with IS: 7322 – 1985.
- c) The ends of M.S. Pipes, short pipes and specials shall have bevelled ends for welding.
- d) Ovality of the specials and fittings shall be removed before inlining / outer coating is done.

13.7 FABRICATION OF FITTINGS:

The fittings shall be fabricated from tested pipes or plates or sheets conforming to specifications IS: 2062 – 1999 (Grade 410). The minimum thickness of the plate shall be 10mm. Special attention is directed to these specifications which cover physical, chemical, manufacturing and mechanical equipments. Test certificates for plates and other materials shall be submitted by the Contractor to the Engineer for approval before fabrication of the fitting is commenced. No material shall be used in the fabrication of any Specials and fittings, which has not been properly inspected by the Engineer.

Manufacturer's equipment for all specials, such as welding, flame cutting and other operations shall be of a standard and quality necessary to produce specials meeting the specification. Equipment, in general, shall be in good condition and shall be modern as judged by the standards of the industry.

The longitudinal seams of fabricated specials shall be butt welded: shop girth seams shall be butt welded. All welding shall be three run.

All edges cut to size shall be uniform and smooth. Those edges to be welded that are prepared by flame cutting shall be free from scale and slag accumulations.

Edges of plates to be jointed by an automatic welding machine shall be formed to the shape required for the particular welding process and automatic welding machine shall be employed in carrying out the agreed procedure. Edges of plates to be jointed by manual welding shall be formed to the shape required by the Engineer in accordance with the drawings. The resulting edges for welding shall be uniform throughout the entire length of the plate.

Minor defects in the welds of electric – welded pipe and specials such as sweats or leaks, shall be repaired. Repairs of this nature shall be made by completely removing the defect, cleaning the cavity and then welding. The workmanship involved in the repair is subject to approval of the Engineer.

Special sections having a butting plates of different thickness shall have the heavier plate sufficiently bevelled so that the apex of the weld groove shall correspond with that of the lighter plate.

All lap breaking, rolling, cleaning of plate surfaces to be welded and fitting-up operations, as well as the qualification of the welding operators, welding procedure, automatic welding, manual welding and correction of welds in pipes and specials shall be in accordance with the relevant standards and codes.

Reshaping pipes and special, after they are manufactured shall be done by re-rolling or by pressure. Reshaping of pipe by excessive hammering or dropping will not be permitted.

Diameter of all bolts circle of the flanges shall comply with the relevant IS: 1538 – 1993 for flanged pipes and specials. Bolts, nuts and washers shall be in accordance with IS: 1367 – 8.8 Grade.

Flanged pipes:

Flanged pipes and specials of varying length and diameter shall be externally and internally lined with mortar. Dimension of the flanges, welding details and welding procedure shall be in accordance with the IS: 7322 – 1985. Flanges shall be welded to a section of the pipe before machining. Faces of flanges shall be machined. The pitch circle shall be as per IS: 1538 – 1993. The minimum thickness of flange shall be 40mm after machining.

Flanged branches

- a) Flanged branches shall be fabricated in accordance with the general specification and to the Engineer's requirement. Wall opening shall be formed by welding fabricated structural steel of approved design to the steel cylinder and shall be lined internally and coated externally
- b) Flanged branches for air and scour valves shall be welded into pipe in the required position. The branch for an air valve shall be vertical and at right angle ,to the longitudinal axis of pipe. The invert of the branch for a scour

valve shall be horizontal and at right angles to the axis of pipe and shall align with the invert of the barrel of the main pipe .

- c) All flanges shall be machined to standard thickness ,square to the axis of the pipe and the bolt hole shall be drilled evenly off center and true to the pitch as per IS: 1538-1976.
- d) Dimensions of the flanges, welding details and welding procedure shall be in accordance with the IS : 7322-1974. The minimum thickness of flange shall be as mentioned in the Bill of quantities .

Bends:

Bends to provide change of alignment in main line shall be manufactured to suit the site conditions from completed and tested pipes by angle cutting the barrel or by such other standard procedure and rewelding. Bends shall be with machined lined internally and coated externally as given in the schedule. The bends should be fabricated based on a drawing submitted by the contractor and approved by the Engineer in charge.

- a) Bends shall be fabricated taking into account the vertical and horizontal angles for each case.
- b) The bends shall have welded joints and the upstream and downstream ends of each bend shall have a straight piece of variable lengths as required.
- c) Bends shall be designed with deflection angle of maximum 10 deg. between segments.
- d) When the point of intersection of a horizontal angle coincides with that of a vertical angle, or when these points can be made to coincide, a single combined or compound bend shall be used, designed to accommodate both the angles. The combined bend should have a pipe angle equal to the developed angle, arrived at from appropriate formula.
- e) All joints in bends shall be thermally stress relieved as specified.
- f) Details of thrust collars anchor bolts, holding down straps, saddle plates should be furnished together with full specifications in contractor's fabrication drawings.

Tapers:

Tapers shall be manufactured out of steel plates and hand lined internally and coated externally. The tapers shall be suitable for connections to the sluice valves / or flanged tailpiece on one side and to M.S. Pipe on the other side. Stiffener rings shall be provided to afford rigidity to the taper. They shall be manufactured generally in accordance with IS: 7322 – 1985.

Notwithstanding anything said, elsewhere, the Contractor shall furnish the thickness of the steel plate used and other relevant details and shall get the approval for these details from the Engineer, before fabrication.

Manholes :

- a) Manholes shall be placed at locations as shown in drawing and as directed by the Engineer. Manholes in the pipeline shall be placed in suitable position in the in the top quadrant.
- b) The contractor shall fabricate different parts of manhole in conformity with relevant IS specification, well established practices and as directed by the Engineer.

Closing or make up sections:

Closing or make up sections shall be furnished appropriate locations on the line to permit field adjustments in pipe line length to compensate for shrinkage in field welded joints, differences between actual and theoretical lengths and discrepancies in measurements.

Test Heads:

Test heads may be ellipsoidal, standard dished as per ASME code or hemispherical heads. They shall be welded in the shop and removed after the test. Allowance should be made in the length of the pipe section receiving the test head for the welding and removal of the head and preparation of the plate edges for the final weld after testing.

No separate payment will be made for such test heads. The rate quoted for the supply and laying of pipes shall be deemed to cover the cost of such installations.

13.8 PROCESS OF MANUFACTURE FOR WELDING:

Any of the following process whichever is appropriate shall be employed for butt welding depending on the options of the pipe quoted in the BOQ.

- a) Automatic submerged arc welding;
- b) Automatic metal arc welding with covered electrodes;
- c) Automatic metal arc welding with bare electrodes;
- d) Manual metal arc welding as per IS: 9595 – 1996.
- e) Electric resistance welding

All electrodes shall conform to IS: 814 – 2004.

13.9 THICKNESS OF M.S. PLATE:

Minimum thickness of M.S. Plate shall be 10mm.

13.10 GENERAL:

All works and material under specification will be rigidly inspected during all phases of manufacture and testing and such inspection shall not relieve the Contractor of his responsibility to furnish material and perform work in accordance with this specification. The Contractor shall notify the Executive Engineer, in advance of the production of materials and fabrication thereof in order that the Engineer may arrange for mill and shop inspection.

The Engineer may reject any or all pipe fittings that are not of the material specified, that are not fabricated in accordance with the outlined procedure, and that do not obtain the prescribed test results, condition of fittings and tolerance set forth in the relevant IS drawings and the specification.

The Engineer shall have free access to those parts of all plants that are concerned with the furnishing of materials of the performance of work under this specification.

The Contractor shall furnish the Engineer reasonable facilities and space without charge for inspection, testing and obtaining of any information he desires in respect of the character of material used and the progress and manner of the work.

The Contractor shall provide 2 (two) sets of accurate 'go' and 'no go' ring gauges to measure the diameter of fittings for the use of the Engineer at no extra cost.

13.11 TOLERANCE:

Tolerance for straight pipe and fittings shall as follows:

(a) Straightness:

Finished pipe sections shall be truly straight with walls parallel to the axis of the pipe and be not out of the alignment by more than 0.2 percent of the total length.

(b) Length:

Straight pipe shall not vary from the specified overall length by plus 10mm or minus 0 mm for length upto and including 6 m. For specials and fittings, it shall be as per IS: 7322 – 1985.

(c) Circumference:

The outside circumference of pipe shall not vary by more than 0.5 percent.

(d) Outside diameter at ends:

Tolerance (+) 2.4mm or (-) 0.8mm.

(e) **Angular direction:**

For specials and fittings, it shall be as per IS: 7322 – 1985.

Notwithstanding these tolerances and the surface irregularities permitted, any dimensional variation of surface irregularity which prevents proper entry of the spigot in to the socket or which permits leakage past the rubber jointing ring shall be the cause for rejection.

13.12 TESTS:

Each special or fitting should be subjected to tests as per clause of 8 of IS: 7322 – 1985 before inlining and outcoating.

CHAPTER 14 - DUCTILE IRON PIPES

14.1 MATERIALS:

Ductile Iron:

Ductile iron is an iron / carbon / silicon alloy, in which the carbon exists in a pure form as spherical graphite due to addition of small amount of magnesium to molten cast iron. The spherical shape of its graphite increases the mechanical properties such as tensile strength, toughness and ductility. The pipes manufactured by ductile iron shall conform to IS: 8329 – 2000.

Cement:

The cement used for internal cement mortar lining shall be ordinary Portland cement and shall conform to IS: 12269 - 1987 with its latest amendments.

Aggregate:

The aggregate shall conform to IS: 383 with its latest amendments.

Water:

The water used in the preparation of cement mortar mix shall conform to the requirements of mixing water given in IS: 456.

Rubber Gaskets:

The Rubber Gaskets used for push-on joints shall conform to IS: 12820 – 2004. The quality of rubber required shall be as per IS: 5382. Rubber ring bundles from every lot shall carry with them manufactures test certificate for the following mechanical properties.

- a) Hardness
- b) Tensile strength
- c) Compression strength
- d) Oil immersion test
- e) Water absorption test
- f) Stretch test and visual examination

The test procedures, the scale of sampling and the criteria for acceptance shall be as per IS: 5382 and IS: 3400.

The Engineer or his representative shall at all reasonable times have free access to the place of manufacture for inspection and examining the test conducted by manufacturer.

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint, the size of the pipe with which they are to be used, the manufacture's name and trademark, the month and year of manufacture.

Rubber gaskets should be stored in a cool, dark place protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The rubber gasket should, whenever possible, be stored in a relaxed form free from tension, compression or any other deformation.

14.2 CLASSIFICATION:

Pipes have been classified as K7, K8, K9, K10, K12, K14 depending on service conditions and manufacturing process. In the Bid document, the class of socket spigot pipe is considered as K9.

14.3 INSPECTION:

All works and materials under specification will be inspected during all phases of manufacture and testing and such inspection shall not relieve the Contractor of his responsibility to furnish materials and performed work in accordance with this specification.

The Contractor shall notify the Engineer, in advance of the production of materials and fabrication thereof, in order that the employer may arrange for mill and shop inspection.

The Engineer may reject any or all materials or work that do not meet with any of the requirements of these specifications. The Contractor shall rectify or replace such rejected material / performed work at his own cost to the satisfaction of the Engineer.

The Engineer shall have free access to those parts of all plants or any other premises and sites that are concerned with the furnishing of materials or the performance of work under this specification.

The Contractor shall furnish to the Engineer or his representative responsible facilities and space without charge for inspection, testing and obtaining of any information he desires in respect of the character of material used and the progress and manner of the work.

The Contractor shall furnish all the test results from an approved laboratory at any time during the progress of work to the satisfaction of the Engineer. The laboratory shall be approved by the Board.

14.4 MANUFACTURE OF D.I. PIPES:

The metal used for the manufacture of pipes shall be such that the pipes are of ductile iron complying with the metallurgical properties specified in IS: 8329. Therefore the manufacturer shall arrange good quality control system for selection of raw material. It shall be manufactured by any method at the discretion of the manufacturer, provided that the requirements defined in IS: 8329 are complied with. It is also essential that either the Contractor / supplier or the manufacturer should ensure that the manufacture of D.I. pipes and Specials should be fully covered by ISO 9000 certification.

The pipes shall be stripped with all precautions necessary to avoid warping or shrinkage defects. the pipes shall be free from surface or other defects. Pipes showing small imperfections which result from the method of manufacture and which do not affect their serviceability, shall not

be rejected on that account alone. Minor defects arising out of manufacturing process may be rectified with the consent of the Engineer in charge.

Pipes centrifugally cast shall be heat treated in order to achieve the necessary mechanical properties and to relieve casting stresses in accordance with IS: 13655-1993.

If the specified mechanical properties and Brinell hardness are not as per the standard, the pipe may be subject to reheat treatment.

In case of push-on flexible joints, the spigot ends shall be suitably chamfered for smooth entry of pipe in the socket fitted with the rubber gasket.

In case of flanged pipes, the flanges shall be at right angle to the axis of the pipe and machined on the face. The boltholes shall be drilled.

The bolthole circle shall be concentric with the bore and the two flanges of the pipe shall be correctly aligned.

14.5 SAMPLING:

Sampling criteria for various tests, unless specified in the standard, shall be as laid down in IS: 11606 - 1986.

The material acceptance tests shall be carried out on ductile pipes grouped in batches as follows. Each batch shall be made up of pipes cast successively as under:

DN	80 to 250	200 pipes
DN	300 to 600	100 pipes
DN	700 to 1000	60 pipes

14.6 MECHANICAL TESTS:

Mechanical tests shall be carried out during manufacture. Test shall be conducted for every four hours of production. The results obtained shall be taken to represent all the pipes of all sizes made during that period.

14.7 DUCTILE IRON FITTINGS:

The fittings shall conform to IS: 9523 – 2000. The manufacture of fittings is similar to the Ductile Iron pipes and the mechanical properties of these fittings also similar to pipes.

14.8. TENSILE TEST:

Two test pieces obtained by cutting bars from spigot end of two pipes selected for testing when tested in accordance with the methods specified in IS: 9523 – 2000 shall satisfy the following requirements:

Grade	Nominal Diameter (Dn) mm	0.2% Proof Stress Min, MPa	Tensile Strength Min, MPa	Percentage Elongation after fracture, Min on Gauge Length = 5.65 S ₀
1	80-1000	300	420	10
2	1100-2000	300	420	5

NOTE: The proof stress shall only be measured when specially agreed between the manufacturer and the purchaser.

14.9 BRINELL HARDNESS TEST:

For checking the Brinell hardness, the test shall be carried out on test bars cut from the fitting used for test conforming to IS: 1500 – 2005. The Brinell hardness shall not exceed 230 HB on the external unmachined surface.

14.10 HYDROSTATIC TESTS:

For hydrostatic tests, all fittings shall be kept under pressure for 15 seconds; they may be struck moderately with a 700-g hammer. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. As far as possible, hydrostatic test shall be conducted before coating the fittings.

14.11 WORKS AND INSTALLATION TEST REQUIREMENTS:

All fittings shall withstand hydrostatic test pressure at works as specified in the following Table:

Nominal Diameter (Dn) (1)	Hydrostatic Test Pressure For Fittings Mpa (as per IS 9523)
Upto 300	6.0
350 to 600	5.0
700 to 1000	4.0
1100 to 2000	2.5

14.12 CEMENT MORTAR LINING:

The process of lining for D.I. pipes is done at the factory itself and it shall conform to IS 11906 - 1986 and its latest amendments.

14.13 MORTAR:

The mortar of the lining shall be composed of cement, sand and water.

Additives may be used, provided that they do not prejudice the quality of the coating and that of the transported water and that the lining remains in accordance with all the requirements of International Standard.

The mortar shall be thoroughly mixed and shall have consistency, which results in a dense and homogeneous lining.

The mortar shall contain by mass at least one part of cement to 3.5 parts of sand.

14.14 CONDITION OF THE INTERIOR SURFACE OF THE PIPE BEFORE APPLICATION OF THE LINING:

All foreign bodies, loose scale or any other material, which could be detrimental to good contact between the metal and the lining, shall be removed from the surface to which the lining is to be applied. The inner surface of the pipe shall also be free of any metal projections likely to protrude beyond 50% the thickness of the lining.

14.15 APPLICATION OF THE LINING:

The mortar of the lining is case centrifugally inside the pipe. Apart from the inner surface of the joint, the parts of the pipe coming into contact with the transported water shall be entirely covered with mortar.

The mortar shall be free of any cavities or visible air bubbles and care shall be taken to ensure maximum density at all points. The consistency of the mortar, the time required and the speed of centrifuging the pipe shall be controlled so that segregation of the sand in the lining is reduced to a minimum.

Once centrifuging is finished, the lining shall be cured at temperatures greater than 0°C. Any loss of water from the mortar by evaporation shall be sufficiently slow that hardening is not impeded.

Repairs to damaged or defective areas are allowable. The damage mortar shall first be removed from these areas. Then the defective part shall be repaired by using a trowel with fresh mortar so that a continuous lining having a constant thickness is again obtained.

For the repair operation, the mortar shall have a suitable consistency; if necessary, additives may be included to obtain good adhesion against the side of the existing undamaged mortar.

14.16 THICKNESS OF THE LINING:

The normal thickness of cement mortar lining shall not be less than for various size of pipes as shown below:

Diameter DN (mm)	Lining Thickness (mm)
80 – 250	3
300 – 900	5
over 900	6

Thickness of lining shall be checked frequently as the Engineer may direct in order to maintain proper control on the lining operations. Graduated needle or other approved appliance shall be used for measuring the thickness. The tolerance in the lining thickness shall be +3mm and no minus tolerance is allowed.

14.17 SURFACE CONDITION OF THE HARDENED LINING:

The surface of the cement mortar lining shall be uniformly smooth. Only isolated grains of sand are allowed to appear on the surface of the lining.

The lining shall be free from corrugations or ridges that could reduce the thickness of the lining to less than the minimum value at one point, as specified in the above table.

On contraction of the lining, the formation of cracks cannot be avoided. These cracks, together with other isolated cracks, which may result from manufacture or may develop during transportation, are acceptable up to a width of 0.8mm.

The structure of the lining is related to the centrifuging process.

On the inner surface of the lining, a thin layer of the sand and cement is formed which may extend up to approximately one quarter of the total thickness of the mortar.

The manufacturer shall take maximum care in keeping the internal surface of pipe even and uniformly smooth. The check of unevenness of pipe shall be done as per IS 11906 - 1986

CHAPTER – 15 – SUPPLYING AND LAYING OF DUCTILE IRON PIPES AND FITTINGS

15.1 Laying of Pipes

(A) Ductile Iron Pipes & Fittings

The Ductile iron (DI) Class “K7” and/or “K9” pipes and their Specials shall be manufactured, laid and tested as per relevant IS 8329:2000. The net length of the sewer pipes as laid shall be measured along the centerline of pipe, in running meters to the nearest centimeter

Ductile Iron pipes shall generally conform to Class K7 and K9 with socket & spigot ends and flanged ends shall conform to IS 8329:2000. DI pipes used for sewer mains shall be lined with Sulphate Resistant Cement mortar and coated with bitumen and in areas where the soil is corrosive or in coastal areas, appropriate coating shall be provided using zinc coating. The pipes shall be of uniform bore and straight in axis.

Standard length DN 100 to 300 pipes shall be 5.50 meter and DN 350 to 600 pipes shall be of 6.00 meters. Pipes shall be provided in standard lengths and balance 10% in short lengths as outlined in the applicable IS specification.

All pipe work, pipe fittings, jointing materials etc., shall be of the best quality, free from defects and obtained from a supplier approved by the Engineer. The installation of the pipe work shall be carried out using skilled personnel and pipe work shall be installed according to the drawings provided by or approved by the Engineer. Where valves are incorporated in pipe work, the valves shall be provided with their own supports, such that no excess loading is exerted on pipe work. All pipe work materials shall be off-loaded, stored on site and handled thereafter in such a manner that they are adequately protected from damage or deterioration.

Unless otherwise stated all underground pipes shall be buried in trenches, which have been excavated in accordance with the relevant section of the Specification.

Before being used, each pipe casting or fitting shall be properly examined and should it appear defective in any way, it shall be set apart and not used until it has been examined and passed by the Engineer. All metal pipes, which shall be buried in the ground, shall, prior to their installation, be slung and sounded in an approved manner. Any pipe found to be faulty by this method, shall be set aside for examination by the Engineer.

All pipework shall be cut with proper pipe cutting tools. The use of hammer and chisel for this purpose shall not be permitted. Great care shall be exercised when cutting concrete/bitumen lined spun iron and ductile iron pipes, to ensure that there is no damage to the lining. Should any damage to the lining take place, which is to an extent, which the Engineer deems to be undesirable, then the pipe shall be rejected. The Contractor shall then prepare another pipe for incorporation into the works. All pipes, which have been cut, shall have the edges dressed and de burred.

15.2 Jointing D.I. 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.

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 bevelled 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.

15.3 Concreting Pipelines

The use of different sizes of stoneware pipes at various depth with conditions for concrete encasing is shown in following table.

Size range mm ϕ	Depth Range (m)	Material	Concrete Encasing
200 - 350	0 to 1.0	SW	Full
200 - 350	1.0 to 2.5	SW	Nil
200 - 350	2.5 to 3.0	SW	2/3 Bottom
200 - 350	3.0 to 3.5	SW	Full

The bedding for different sizes of SW pipes shall be with M-15 Concrete as per IS code.

The minimum earth cover for all the pipes to be laid shall be not less than one meter.

15.4 Superior Road Surface

Some of the roads along the alignment of the pipe line have superior road surface such as cement concrete and asphaltic concrete. Cutting these road surface will be paid for separately at the rates quoted in the bill of quantities.

15.5 Length of Trench Open at one Time

The pipe line shall be excavated in such length as may be ordered by the Engineer depending on the nature of the ground, the depth from the surface and the risk of damage to the adjoining property. The pipes shall not be covered until they have been tested to the satisfaction of the Engineer. But in bad ground, in close proximity to buildings or in other places where the Engineer shall consider necessary he may limit the length of trench so that there shall not be more than three pipes length from the refilled trench to the unbroken ground ahead.

15.6 Demolishing existing Sewers/Sewer Lines

Where existing sewers or manholes whether shown on the drawings or not, are intended to be taken out or demolished or where the Engineer directs that this be done the Contractor shall do so at his cost provided that the sewer or manhole to be demolished lie within the limits of the new excavation. The space previously occupied by the old sewers or manholes shall be completely filled up with suitable earth and rammed.

15.7 Sub-Drain

Should sewage or water be met with in such quantities as to tender it advisable in the opinion of the Engineer to use a sub-drain this shall consist of 150 mm stoneware pipes laid open jointed in a gird or channel excavated in the bottom of the trench and surrounded and covered with 75 mm of fine, clean broken stone or brick (unless concrete be ordered by the Engineer). The Contractor shall keep the sub-drain free from sand or other deposit by means of chains or other methods. At intervals not exceeding 30 meters, a 100 mm off 150 mm square function shall be inserted at the sub-soil water level to form a "grouping up" pipe. On completion of the length of sewer the entire length of sub-drain shall be solidly filled in the presence of the Engineer with liquid grout consisting of ten parts of sand to one of cement. The Contractor's price for sub-drains shall include the necessary excavation, broken stone or brick providing and laying of pipes junctions etc, and temporarily connecting up branch drains and grouping up the pipes, on completion. With the exception of the sub-drains the whole cost of keeping the works clear of water shall be borne by the Contractor.

15.8 Slip and Fall

Every precaution must be taken against slips and falls of earth, clay, rock and sand etc. in the excavations but in the event of any occurring, the Contractor shall remove the surplus arising from the slip or fall

with out payment from the Corporation and he shall make good the space caused by such slips and falls, which may be outside of the dimensions of the work ordered, at his cost.

The Engineer will determine in each case whether such space is to be filled up in whole or part with concrete, brick or masonry of the quality and kind used in the adjoining work, and if part only is to be so filled that materials are to be used for the remaining part. If excavation is taken out by Contractor to too great a depth for any reason whatsoever he shall fill it up to the proper level with brick work or concrete as in the case of slips and falls. If in the opinion of the Engineer there is possibility for the newly constructed work having been damaged or disturbed by slips and falls, the Work shall be laid bare and examined and any damage made good at the expense of the Contractor.

15.9 Timbering Ordered to be left in Trenches

The Engineer may order the timbering of trenches to be left in at any part of the Work where in his opinion damages might be done to adjoining property or streets if the timbering were withdrawn; he may also order timbering to be left in as bearers under concrete or other foundations. The top of all timbering so ordered to be left in shall be 300 mm clear beneath the surface of the ground. For timbering ordered by the Engineer to left in the Contractor will be paid at the schedule rates. No payment will be made for timber left in without a written order from the Engineer. The Contractor shall at his expense, shore, sling, protect, support, alter, restore and make good all houses, bridges, barns, buildings, drains, culverts, water mains, sewers, electric posts, fences or any other properties or things which may be disturbed or damaged during the execution of the Works. Should he fail to do so, the same shall be carried out by the Engineer and the cost thereof recovered from the Contractor. Care shall be taken not to move without the consent of the proper authorities, any pipe, culvert cable, pole, wire, building or other structures. If instructed by the Engineer in writing permanent supporting works shall be constructed by the Contractor, or the position of any existing work shall be changed. Such permanent work that may be ordered in writing by the Engineer, if specified by him to be an extra work, will be paid for on the valuation fixed by the Engineer.

15.10 Old Materials

Any old sewer, iron work pipes, bricks or other materials met with on the Works and which require to be removed for the construction of the Works shall be held as belonging to the Corporation and if required shall be removed from out of trenches by the Contractor without any extra cost.

15.11 Treasure Trove

Any coins, curiosities or antiquities or treasure trove found during the construction of the Work shall be immediately delivered to the Corporation.

15.12 Offensive Matter

The Contractor at his expense shall disinfect with chloride of lime or other strong disinfectant all offensive matter immediately it is taken out of the trenches and shall cart away or cover up such matter as soon as possible.

15.13 SUPPLYING AND LAYING OF PIPES (WATER)

15.13. DUCTILE IRON PIPE

15.13.1 Materials

Ductile iron is an iron/carbon/silicon alloy in which the carbon exists in a pure form as spheroidal graphite due to addition of small amount to magnesium to molten cast iron. The spheroidal shape of its graphite increases the mechanical properties such as tensile strength, toughness and ductility. The pipes manufactured by ductile iron shall conform to IS 8329-2000. DI pipes shall be lined with cement mortar using ordinary Portland cement (inner) and coated with bitumen and in areas where the soil is corrosive or in coastal area appropriate coating shall be provided with zinc coating.

Cement

The cement used for internal cement mortar lining shall be ordinary Portland cement and shall conform to IS-269 with its latest amendments.

Aggregate

The aggregates shall conform to IS-383 with its latest amendments.

Water

The water used in the preparation of cement mortar mix shall conform to the requirements of mixing water given in IS.456.

Rubber Gaskets

The Rubber gaskets used for push-on joints shall conform to IS 12820-1989. The quality of rubber required shall be as per IS.5382. Rubber ring bundles from every lot shall carry with the manufactures test certificate for the following mechanical properties.

Hardness

Tensile strength

Compression strength

Oil immersion test

Water absorption

Sketch test and visual examination

The test procedure for the scale of sampling and the criteria for acceptance shall be as per IS.5382, IS 3400 and IS 784.

The Engineer or his representative shall at all reasonable times have free access to the place of manufacture for inspection and examining the test conducted by manufacturer.

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint the size of the pipe with which they are to be used, the manufacture's name and trade mark the month and year of manufacture.

Rubber gaskets should be stored in a cool, dark place protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The rubber gasket should, whenever possible be stored in a relaxed form free from tension, compression or any other deformation.

15.13.2 Classification

Pipes have been classified as K7, K8, K9, K10, K12, K14 depending on service conditions and manufacturing process. In the Bid document, the class of socket spigot & flanged pipe is considered as K7 & K9.

The contractor shall furnish all the test results from an approved laboratory at any time during the progress of work to the satisfaction of the Engineer.

15.13.3 Manufacture of D.I. Pipes

The metal used for the manufacture of pipes shall be such that the pipes are of ductile iron complying with the mechanical properties specified in IS:8329. Therefore the manufacturer shall arrange good quality control system for selection of raw material. It shall be manufactured by any method at the discretion of the manufacturer, provided that the requirements defined in IS:8329 are complied with.

The pipes shall be stripped with all precautions necessary to avoid warping or shrinkage defects. The pipes shall be free from surface or other defects. Pipes showing small imperfections which result from the method of manufacture, and which do not affect their serviceability, shall not be rejected on that account alone. Minor defects arising out of manufacturing process may be rectified with the consent of the Engineer-in-charge.

Pipes centrifugally cast shall be heat treated in order to achieve the necessary mechanical properties and to relieve casting stresses in accordance with IS:13655-1993.

If the specified mechanical properties and Brinell hardness are not as per the standard, the pipe may be subject to reheat treatment.

In case of push-on flexible joints, the spigot ends shall be suitably chamfered for smooth entry of pipe in the socket fitted with the rubber gasket.

In case of flanged pipes, the flanges shall be at right angle to the axis of the pipe and machined on the face. The bolt holes shall be drilled.

The bolt hole circle shall be concentric with the bore and the two flanges of the pipe shall be correctly aligned.

15.13.4 Sampling

Sampling criteria for various tests, unless specified in the standard, shall be as laid down in IS 11606 1986.

The materials acceptance tests shall be carried out on ductile pipes grouped in batches as follows. Each batch shall be made up of pipes cast successively as under

DN	80 to 250	200 pipes
DN	300 to 600	100 pipes
DN	700 to 1000	60 pipes

15.13.5 Mechanical Tests

Mechanical tests shall be carried out during manufacture. Test shall be conducted for every four hours of production. The results obtained shall be taken to represent all the pipes of all sizes made during that period.

15.14 DUCTILE IRON FITTINGS

The fittings shall conform to IS 9523-1980. The manufacture of fittings is similar to the Ductile iron pipes and the mechanical properties of these fittings also similar to pipes.

15.14.1 Hydrostatic Tests

For hydrostatic tests, all fittings shall be kept under pressure for 15 seconds; they may be struck moderately with a 700-g hammer. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. As far as possible, hydrostatic test shall be conducted before coating the fittings.

15.14.2 CEMENT MORTAR LINING

The process of lining for D.I. pipes is done at the factory itself and it shall conform to ISO 4179 and its latest amendments.

15.14.3 Mortar

The mortar of the lining shall be composed of cement, sand and water.

Additives, may be used, provided that they do not prejudice the quality of the coating and that of the transported water and that the lining remains in accordance with all the requirements of International Standard.

The mortar shall be thoroughly mixed and shall have consistency which results in a dense and homogeneous lining.

The mortar shall contain by mass at least one part of cement to 3.5 parts of sand.

15.14.4 Condition Of The Interior Surface Of The Pipe Before Application Of The Lining

All foreign bodies, loose scale or any other material which could be detrimental to good contact between the metal and the lining shall be removed from the surface to which the lining is to be applied. The inner surface of the pipe shall also be free of any metal projections likely to protrude beyond 50% the thickness of the lining.

15.14.5 Application of the Lining

The mortar of the lining is cast centrifugally inside the pipe

Apart from the inner surface of the joint, the parts of the pipe coming into contact with the transported water shall be entirely covered with mortar.

The mortar shall be free of any cavities or visible air bubbles and care shall be taken to ensure maximum density at all points. The consistency of the mortar, the time required and the speed of centrifuging the pipe shall be controlled so that segregation of the sand in the lining is reduced to a minimum.

Once centrifuging is finished, the lining shall be cured at temperatures greater 0°C. Any loss of water from the mortar by evaporation shall be sufficiently slow that hardening is not impeded.

Repairs to damaged or defective areas are allowable. The damaged mortar shall first be removed from these areas. Then the defective part shall be repaired by using a trowel with fresh mortar so that a continuous lining having a constant thickness is again obtained.

For the repair operation, the mortar shall have a suitable consistency; if necessary, additives may be included to obtain good adhesion against the side of the existing undamaged mortar.

15.14.6 Thickness of the Lining

The normal thickness of Cement mortar lining shall not be less than for various size of pipes as shown below.

Diameter, DN (mm)	Lining Thickness (mm)
80-250	3
300-900	5
over 900	6

Thickness of lining shall be checked frequently as the Engineer may direct in order to maintain proper control on the lining operations. Graduated needle or other approved appliance shall be used for

measuring the thickness. The tolerance in the lining thickness shall be +3mm, there being no minus tolerance.

15.15 LAYING AND JOINTING OF D.I. PIPES

15.15.1 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 which 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.

15.15.2 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 be 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 batons and secured with wooden wedges. The pipes shall be stacked with each tier at right angles to the preceding tier.

15.15.3 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 in to the trench. Pipes over 300 mm 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.

15.15.4 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.

15.16 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 for 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 got approved from the Engineer-in- change. 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.

15.17 JOINTING WITH PUSH ON JOINTS

The rubber gasket shall be inserted in to the groove in the socket. The spigot end shall be lubricated with good quality vegetable oil. Petroleum based oil or grease should never be used. Then the spigot shall be slipped into the socket by means of jack on the other end. 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 1/4 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.

Whenever new pipes laid are to be joined 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.

15.18 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 fibre 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 hole 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.

15.19 Flat Curves

Any deviation either in plan or elevation of less than $1\frac{1}{4}$ degrees shall be effected by laying the straight pipes round a flat curve of such radius that the minimum thickness of lead at the face of the socket shall not be reduced below 6 mm or the opening between the spigot and socket increased beyond 11mm at any joint. A deviation of about 1 or 2 degrees each joint can be effected in this way. If the joints used are spigot and socket joints, using lead or cement the spigot shall be carefully centered in the socket by one or more laps of white hemp spun yarn, sufficient yarn only being forced into the socket to leave a depth of lead or cement as directed by the Engineer.

15.20 Pipes not Truly laid

Any pipe or pipes laid, which on inspection are found to diverge from the true lines and levels shall be removed and relaid to the true lines and levels by the Contractor at his expense, the old jointing being properly cleared of the pipes and fresh joints made. Any pipes damaged in removal shall be replaced at the Contractor's cost.

15.21 Cutting of D.I. 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.

15.22 Covering up Open Ends

The contractor shall take particular care to ensure that the apertures and open ends of pipes are carefully covered whenever the workmen are not actually employed therein.

15.23 Works to be Left Water - tight

The Contractor shall construct the pipes chambers and all other Works so that they shall be watertight. Should any leakage appear they 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.

15.24 Cleaning of Mains

During the whole 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.

15.25 Third Party Inspection:

15.25.1 The pipes shall be accepted successfully after the third party inspection by the agency authorized by CMWSS Board.

CHAPTER 16 - LAYING AND JOINTING OF D.I. PIPES

16.1 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.

16.2 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.

16.3 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.

16.4 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.

16.5 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.

16.6 SUPPORT OF PIPE FOR NALLAH / RIVER CROSSING: -- Deleted

16.7 TESTING:

After laying and jointing, the pipeline 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 equipments and shall arrange for all tests to be witnessed by the Engineer or his representative. The Contractor shall provide all things necessary for carrying out testing and cleaning including water pumps, gauges, piped connections, stop ends, and all other temporary works.

Pipelines 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 pipelines 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 pipeline but this shall not relieve the Contractor of his obligations to achieve successful tests 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 pipeline 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 pipeline 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 backfilled over the centre of each pipe to prevent movement under the test pressure.

The Contractor shall make his own arrangements to procure necessary equipments, 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. If the testing apparatus and equipments are available with the Board, they can be hired by the Contractor at usual conditions and charges.

The length to be tested shall be provided with two blank flanges fastened on the usual manner by collar bands and bolts to the end pipes or if the length to be tested shall have a sluice valve at each end, such blank flanges may be dispensed with.

The length of pipes to be tested shall first be filled in with water from a higher section of pipes already laid or with clean water obtained from a service connection, as the Contractor may arrange with the approval of 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 other means as the Engineer may direct.

The test pressure shall not be less than 10 kg/cm^2 .

Each pipeline or section thereof, shall be filled with water and all air removed. The pressure in the pipelines shall be raised steadily until the site test pressure is reached in the lowest part of the section. This pressure should be maintained, by pumping if necessary, for a period of not less than 1 hour. The pump should then be disconnected and no further water permitted to enter the pipeline for a period of 1 hour. At the end of this period, the reduced pressure in the pipeline should be measured, the original test pressure restored by pumping and the loss measured by drawing off water from the pipeline until the pressure has fallen to match the reduced pressure previously noted. The loss shall not exceed 0.02 litre per mm diameter per Kilometer per 24 hours for each bar of head applied. If the pipeline fails to pass the test, the faults shall be located and repaired and the pipeline retested until it passes the pressure test. All exposed pipe, fittings, valves and joints shall be visually inspected during the tests.

If the length of pipeline under test is found to be satisfactory and no leaks or sweating are found at the pipe joints or at the joints of specials and connections, then this length of pipeline will be passed by the Engineer.

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.

Maximum field test pressure for pipes with flexible joints:

Table – 1 on page 11 of IS:12288 is not applicable in this case as our test pressures are well below the maximum field hydraulic test pressures given in the table.

Allowance of test pressure for lower elevations:

As regards allowance for lower points, there is marginal level difference in levels, between 2 points in the section to be chosen for testing and hence the difference in pressure developed will be insignificant.

Saturation of pipe material:

As regards saturation of material, it is significant in case of RCC, PSC pipes for DI pipes it is insignificant. We are not clear whether the remark is aimed at saturation of inner CM lining. The adequate curing of the lining will take care of this. Also the duration of the test is long enough to discount such possibility.

16.8 INTERCONNECTION WORK:

The interconnection work between the existing main and the 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, 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 / MS 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.

16.9 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 fibre 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 boltholes 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.

16.10 DISINFECTION OF MAINS:

Upon completion of a newly laid main or when repairs to existing pipes are made, the main shall be disinfected as directed by the Engineer.

The main shall be flushed prior to disinfection except when the tablet method is used. After initial flushing, the hypochlorite solution shall be applied to the water main with mechanically or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solution may be fed with a hand pump.

In the case of mains of large diameter, water from the existing distribution system or other approved source shall be made to flow at a constant measured rate into the newly laid pipeline. The water shall receive a dose of chlorine also fed at a constant measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at not less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column of 'Slug' of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/l. for atleast 3 hours. As the chlorinated water flows through tees and crosses, related valves and hydrants shall be operated so as to disinfect the appurtenances.

In the case of newly laid mains in which scrupulous cleanliness has been exercised, the tablet method can be adopted and in this method, the initial flushing is dispensed with. The calcium hypo chlorate tablets, are placed in each section of pipe and also in hydrants, hydrants branches and other appurtenances. The tablets shall be attached by an adhesive and must be at the top of the main. The main shall then be filled with water and the water shall remain in the pipe for atleast 24 hours.

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the mains is no higher than that generally prevailing in the system or less than 1 mg/l.

After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriological quality and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. When the samples are satisfactory, the main may be placed in service.

The Contractor is expected to carry out the disinfection work as a part of laying the pipes and his rates for laying the pipes should include the disinfection and other connected works till the main is placed in service unless otherwise specified in the schedule.

CHAPTER 17 - APPURTENANCES

A. SLUICE VALVES

17.1 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.

17.2 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.

17.3 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.

17.4 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)

17.5 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.

17.6 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.

17.7 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.

17.8 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.

17.9 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.

B. FIRE HYDRANTS

17.10 GENERAL:

The type of fire hydrant is underground sluice valve type and conforming to IS: 909 – 1992.

- a) Body
- b) Bonnet
- c) Spindle
- d) Gland
- e) Spindle cap
- f) Spindle nut

- g) Valve
- h) Screwed outlet
- i) Outlet cap and chain

17.11 MATERIALS:

- 1) Body, bonnet, gland, outlet cap and spindle cap shall be made of case iron grade FG 200 of IS: 210 – 1993.
 - b) Die castings – LCB 2 of IS: 292 – 1983
 - c) Hot forging – Grade 1 of IS: 291 – 1989
- 2) Spindle shall be made of brass conforming to IS: 320 – 1980 or IS: 319 – 1989 or stainless steel Gr 04 Cr 18 Ni 10 conforming to IS: 6603 – 2001.
- 3) Gaskets shall be made of rubber conforming to IS: 937 – 1981 or IS: 638 – 1979 or leather conforming to IS: 581 – 1976 or compressed asbestos fiber conforming to IS: 2712 – 1998.
- 4) Gland packing shall be of asbestos thread conforming to IS: 4687 – 1995.
- 5) Bolts and nuts shall be made of carbon steel conforming to IS: 1367 (Part 14) -1984.

17.12 FINISH:

All parts shall be of good finish, clear of all burns and sharp edges. All castings shall be clean and sound excluding of plugging, welding or repairs of any defects.

17.13 COATING OF PARTS OTHER THAN SLUICE-VALVE:

- 1) Immediately after casting and before machining, all cast iron parts shall be thoroughly cleaned, and before rusting commences, shall be coated by dipping in a bath containing a composition having a bituminous base and maintained at a temperature between 143° and 166° C. The proportions of the ingredients of the composition shall be so regulated as to produce a coating having the properties specified below:
- 2) The casting shall be re-heated before dipping, either by immersion in hot water or by heating in an oven, or shall be held in the dipping bath sufficiently long to reach an equivalent temperature, the method used being at the maker's option. Care shall be taken to see that the castings are perfectly dry immediately before dipping. On removal from the bath, the castings shall be sufficiently drained and ensure that no portion is left uncoated.
- 3) The coating shall be such that it shall not impart any taste or smell to water. The coating shall be smooth, glossy and tenacious, sufficiently hard so as not to flow when exposed to

a temperature of 77° C and not so brittle at a temperature of 0° C as to chip off when scribed lightly with the point of a penknife.

17.14 PAINTING:

Complete hydrant shall be painted externally with two coats of fire red paint conforming to shade No.536 of IS: 5 – 2004.

17.15 PERFORMANCE REQUIREMENTS:

1. Hydrostatic Pressure Test:

Each assembled unit shall be subjected to a hydrostatic pressure of 2.1 MN/m² with the valve open and outlet closed for a period of 2.5 minutes for the purpose of locating porosity in the casting. When so tested, it shall not fail or show any sign of leakage either through the valve body or through the gland of the spindle.

2. Valve Seat Tightness Test:

The stop valve shall be fully closed by screwing down the spindle. A hydrostatic pressure of 1.4MN/m² shall then be applied to each valve on its inlet side. There shall be no leakage through the valve and its seat.

17.16 CRITERIA FOR ACCEPTANCE:

Each hydrant shall be tested for the requirements prescribed in this standard.

17.17 MARKING:

- 1 Each hydrant shall be clearly and permanently marked with the following information:
 - a) Manufacturer's name or trade-mark, and
 - b) Year of manufacture
- 2 The hydrant may also be marked with the Standard Mark.

C. AIR VALVES

17.18 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.

CHAPTER 18 - FIXING OF VALVES**18.1 FIXING OF SLUICE VALVES:****18.1.1 General:**

The specification lays down the requirement for lowering, laying and jointing Sluice valves.

18.1.2 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.

18.1.3 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.

18.1.4 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 fibres 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.

18.1.5 Testing:

After installation of sluice valve the same is tested to 1 ½ times of its test pressure. The joints of sluice valve shall with stand 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.

18.1.6 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.

18.2 FIXING OF AIR VALVES:

18.2.1 General:

The specification placed down requirement for lowering laying and fixing Air Valves.

18.2.2 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.

18.2.3 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.

18.2.4 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.

18.2.5 Testing:

The specification pertaining to sluice valve shall also apply to air valves.

18.2.6 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.

18.3 FIXING OF C.I. M.H. FRAME AND COVER IN RCC SLAB:

18.3.1 General:

The specification includes all requirements of fixing C.I. M.H. frame and cover of specified size and weight in the RCC slab with locking arrangement. For fixing the C.I. 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 C.I. 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.

18.3.2 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

CHAPTER 19 - PRESSURE GAUGES

19.1 Material:

The brief specifications for pressure gauges is as follows:

The pressure gauges shall be of Bourdon type having a range between 0 to 9kg / sq.cm. The diaphragm material should be of 316 SS. Accuracy of the pressure gauge shall be 1% with a dial diameter of 150mm. The case shall be of IP 65, die cast Al. The pressure gauge shall be directly mounted with connection of ½ “ N.P.T.M.

19.2 Erection:

The pressure gauges shall be, mounted as near to the process as possible. Impulse tubing / piping length shall be minimum possible. The pressure gauges shall be mounted in a vibration free location. They shall be readily accessible from grade, platform, fixed walkway or fixed ladder and shall be visible from where related equipment is operated.

The pressure gauges shall have one isolating valve and one drain / vent valves for depressuring. The drain / vent valve shall be plugged. The valves used shall be having ½ “ NPTF connections and the material shall be ASTM A 216 GR. WCB or ASTM A 105 unless otherwise specified. The trim shall be AISI 410 unless otherwise specified. All connection shall be made using thread seals preferably PTFE tape. Right tools shall be used and any limits regarding torque for tightening shall be strictly adhered to. Impulse piping shall be done using ½“ o.d seamless annealed ss tubing to ASTM A 269 GR.TP – 136 L with minimum wall thickness of 1.65mm. Compression fittings shall be used. The impulse piping must be supported by an angle of channel and strapped at every meter length. The angle / channel itself must be supported by welding it to some structure. The pressure gauge shall be covered with box.

CHAPTER-20 -- HOUSE SERVICE CONNECTIONS- MDPE PIPES & FITTINGS

20.1 MDPE Pipes

These specifications are for MDPE Blue PE 80 Pipes for House Service Connections of Dia 20 mm to 32 mm OD.

20.1.1 Raw Material

Raw material used to Manufacture MDPE Blue Pipes shall be Virgin Natural Resin PE 80 containing those anti – oxidants, UV Stabilisers & Pigments necessary for Manufacturing of pipes. The Density of Pipes shall be in the Range 0.926 to 0.940 g/cm³ confirming to ISO 4427 Standard. The PE 80 Resin shall have MRS of 8 Mpa.

20.2 Effects on Water Quality :

The MDPE PE 80 Blue Pipes shall confirm to clause 3.5 of ISO 4427 for conveyance of Water for Human Consumption. Also the pipes intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW/KIWA/SPGN/WRC-NSF and certificate of compliance to be produced for the following parameters

- a. Odour & Flavour of Water
- b. Appearance of Water
- c. Growth of Micro Organism
- d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- e. Extraction of Metals

20.3 Pressure Rating:

The Pressure rating of MDPE Blue PE 80 Pipes shall be confirming to Clause 4.1 of ISO 4427 : 1996.

20.4 Colour of Pipes:

The Colour of MDPE PE 80 Pipes shall be BLUE confirming to Clause 3.2 of ISO 4427 : 1996.

20.5 Dimensions:

The pipe dimensions shall be as per latest revisions of Clause 4.1 of ISO 4427 : 1996 and pipes upto diameters 32 mm shall be supplied in Coils of 300 mtrs. The internal diameter, wall thickness, length and other dimensions of pipes shall be as per relevant tables of ISO 4427:1996. Each pipe shall be of uniform thickness throughout its length.

The wall thickness of the PE 80 Pipes shall be as per the table given below:

Nominal Dia of MDPE Pipe (mm)	PR rating	Wall thickness	
		Minimum	Maximum
20	PN 16	2.3	2.8
25	PN 12.5	2.3	2.8
32	PN 12.5	3.0	3.5

The dimension tolerances shall be as per ISO 4427 clause 4.1.3

20.6 Performance requirements

The Pipe supplied should have passed the acceptance test as per ISO 4427. The manufacturer should provide the test certificates for the following tests.

- a Melt Flow Rate
- b Density,
- c Oxidation and Induction test,
- d Hydrostatic Test ,
- e Pigment dispersion Test,
- f Longitudinal Reversion Test.

These tests should be performed in the in-house laboratory of the pipe manufacturer. The Employer will depute Third Party Inspection Agency to the pipe manufacturing facility of the manufacturer to inspect the pipes as per QAP approved by Engineer In charge.

20.7 COMPRESSION FITTINGS :

Compression fittings used for House service connection comply as per ISO 14236

20.7.1 Material of Construction

Compression fittings material shall confirm to ISO14236.Clause -5.

A .Body-Polypropylene

- b. Nut / Cap –Polypropylene.
- c. Clip Ring-POM (Acetylic resin)
- d. Packing bush- Polypropylene
- e. “O” ring – NBR
- f. Threaded metal inserts –SS 304 with BSP Threads

20.7.2 Pressure testing

The pressure rating of compression fittings as per clause 8 of ISO 14236 which shall be PN16

20.7.3 Dimensions:

The Dimension of compression fittings shall be as per clause 7.1 of ISO 14236

20.7.4 Performance requirements

The compression fittings shall be tested as per ISO 14236. Following Test methods shall be performed.

- Clause 8.2.1 -Leak tightness under internal pressure.
- Clause 8.2.2 -Resistance to Pull out.
- Clause 8.2.3 -Leak tightness under Internal Vaccum.
- Clause 8.2.4 -Long term Pressure Test for Leak tightness for assembled joint
- Clause 8.3.2.1 -MRS Value as per ISO 9080
- Clause 8.3.3.1 -Resistance to Internal pressure.

20.7.5 Effects on Quality of Water

The Compression fittings for intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW / KIWA / SPGN / WRc –NSF and certificate of compliance to be produced for the following parameters :

- a. Odour & Flavour of Water.
- b. Appearance of Water.
- c. Growth of Micro Organism
- d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- e. Extraction of Metals.

For clear identification of the water services, the nuts of the fittings should be coloured blue while the body to be black. All fittings with threaded ends should be with BSP threads.

20.8 PVC BALL VALVES (STOP COCKS)

Ball Valves used for HOUSE Service Connections comply to ISO 4422, Part 4.

20.8.1 Material of Construction:

Ball Valve material shall confirm to as per clause 4 of ISO 4422.

- a. Body and Handle - UPVC

- b .Seals - PTFE
- c .O-rings – NBR/EPDM
- d. Material of Construction for compression end will as per specifications for compression fittings.

20.8.2 Pressure Rating

The Pressure of the Ball Valve shall be as per ISO 4422 shall be PN 16.

20.8.3 Dimensions:

The Dimensions of the Ball Valve shall be as per Table 3 of ISO 4422.

20.8.4 Performance Requirements:

The Ball valves shall be tested as per ISO 4422.Following test methods will be performed.

- Clause 7.1 - Resistance of Valve Bodies to internal pressure
- Clause 7.2 - Crushing Test
- Clause 7.3 - Endurance Test
- Clause 7.4.2 - Seat and Packing Test
- Clause 7.4.1 - Operating torque Test

The Ball Valves intended for conveyance of Potable water for Human consumption to be tested to comply with BS 6920 specifications in any of the laboratories like DVGW / KIWA / SPGN / WRc –NSF and certificate of compliance to be produced for the following parameters :

- a. Odour & Flavour of Water.
- b. Appearance of Water.
- c. Growth of Micro Organism
- d. Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- e. Extraction of Metals.

20.9 ELECTROFUSION TAPPING FERRULE

All the electro fusion fittings included in this document should be designed for use in water distribution systems and be manufactured/supplied by manufacturers having ISO 9001: 2000 certification for their quality systems. The products should comply with the following specific requirements.

- 1.The products shall comply with the requirements of BS EN 12201-3: 2003, BS EN 1555-3 or ISO 8085-3.
- 2.All the fittings shall be of SDR 11 rating.

3.The EF Tapping Ferrules used for drinking water applications should have undergone type test by WRc-NSF, U.K according to BS 6920 in any of their Certified Laboratories like WRc – NSF/DVGW/KIWA/SPGN and certificate of Compliance to be produced for the following parameters::

- a Odour & Flavour of Water
- b Appearance of Water
- c Growth of Micro Organism
- d Extraction of substances that may be of concern to Public Health (Cyto Toxicity)
- e Extraction of Metals

4 .All the EF Tapping Ferrules shall be manufactured by injection moulding using virgin compounded PE 80 (MDPE) polymer having a melt flow rate between 0.5 – 1.1 grams/10 minutes and shall be compatible for fusing on either PE 80 or PE 100 distribution mains manufactured according to the relevant national or international standards. The polymer used should comply with the requirements of BS 3412 and/or BS EN 12201-1.

5 .The Electro fusion Tapping Ferrules intended for water distribution applications shall be coloured blue for the clear identification of the services.

6 .All the electro fusion Tapping ferrules should be individually packed so that they can be used instantaneously at site without additional cleaning process. The protective packing should be transparent to allow easy identification of the fittings without opening the bags..

7 .The electro fusion Tapping ferrule should be with only a single heating coil to fully electrofuse the fitting to the adjoining pipe or pipe component as applicable. The heating coils shall be terminated at terminal pins of 4.0 or 4.7 millimetre diameter, protected with terminal shrouds. Each terminal shroud should be additionally protected with polyethylene shroud caps.

8 .No heating element shall be exposed and all coils are to be integral part of the body of the fitting. The insertion of the heating element in the fitting should be part of the injection moulding process and coils inserted after the injection moulding process or attached to the body of the fitting as a separate embedded pad etc. are strictly not acceptable.

9 .The pipe fixation shall be achieved by external clamping devices and integral fixation devices are not acceptable.

10. The brand name, size, raw material grade, SDR rating and batch identification are to be embedded as part of the injection moulding process. Each fitting should also be supplied with a barcode sticker for fusion parameters attached to the body for setting the fusion parameters on an automatic fusion control box. The barcode sticker should also include the fusion and cooling time applicable for the fitting for the manual setting of a manual fusion control box.

11. The fittings should be V-regulated type designed to fuse at a fusion voltage of 40 volts AC.

12. The heating elements should be designed for fusion at any ambient temperatures between -5 to +40 degree centigrade at a constant fusion time i.e. without any compensation of fusion time for different ambient temperatures.
13. A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the terminals. The fusion indicators should not allow the escape of the molten polymer through them during or after the fusion process.
14. All the sockets in the electrofusion fittings should include a method of tapping controlling the pipe penetration (pipe positioner/stopper).
15. The Electro fusion Tapping ferrule should be the top loading type which are to be clamped on the mains for fusion using the custom made top loading clamps exerting 1500N (150 kilograms approximately) top load. Saddles with wrap around clamps made of polyethylene, nylon or any such other material will not be acceptable.
16. The tapping EF Tapping Ferrule should be supplied with suitable adaptors for proper positioning of the top loading clamp into the saddle.
17. The torque required to operate the cutter after fusion on the PE mains should not exceed 45 N-m.
18. The cutter should be designed in such a way that the cut coupon is not allowed to fall into the pipeline and is retained inside the body of the cutter providing a positive sealing of the hole in the cutter head for pressure testing.
19. The EF tapping Ferrules, will have female threaded outlet to connect Compression Metal insert Male thread adaptor fitting for further extension of connection.
20. The threaded outlet should be from sizes ½” to 2” BSP to suit the required House service connections.
21. The outlets should be reinforced with female threaded metal inserts of SS 304.
22. The tapping on the PE mains shall be achieved by a custom built metal cutter supplied by the manufacturer one each for the standard packing box.

CHAPTER 21 - ABBREVIATIONS AND ACRONYMS

C.I.	Cast Iron
C.M.	Cement Mortar
Cm	Centimetre
CMWSSB	Chennai Metropolitan Water Supply & Sewerage Board
Cum	Cubicmetre
Dia.	Diameter
D.I.	Ductile Iron
Km	Kilometre
M.H.	Manhole
M.S.	Mild steel
H.D.P.E	High Density Poly Ethylene
M.D.P.E	Medium Density Poly Ethylene

m	Metre
mm	Millimetre
R.C.C.	Reinforced Cement Concrete
sq.cm	Squarecentimeter
W.C. (ratio)	Water Cement (ratio)

ANNEXURE

EXTERNAL COATING USING POLYOLEFIN COLD APPLIED TAPES FOR MS PIPE LINE BELOW GROUND:

General:

The MS pipes and MS specials sections, connections and fittings laid below ground shall be coated internally with prefabricated polyolefin tape coating consisting of liquid adhesive and prefabricated tape as per AWWA C 214-00. The contractor shall perform all work in accordance with these specifications and the latest pipeline costing practices and shall complete the work in all respects to the full satisfaction of the Board's Engineer. the entire coating operation starting from cleaning and surface preparation till coating shall be performed under the supervision of skilled personnel who are well conversant with the work. Pipes which have been cleaned and primed, or cleaned, primed and coated, without having been inspected and approved shall be rejected.

This specification is not intended to be all inclusive and the use of guidelines set forth here does not relieve the Contractor of his responsibility for the quality and performance of the applied coating system, and to supply coating material capable of performing its intended service.

The Contractor shall propose the name of he manufacturer of the coating. The manufacturer shall be ISO certified. The Contractor shall produce a certificate from the manufacturer stating at least two projects, with Employer's satisfaction certificate, where the coating has performed satisfactorily for at least 5 years. The recommendations of the manufacturer regarding coating process, repairs, etc. shall be provided by the Contractor. The manufacturer should give guarantee for supply of the required quantity as per the project time schedule and take responsibility for supervising the costing application and repair works. Suitable certificate from manufacturer shall be provided for the same.

Referenced Codes, Standards and Relevant Documents:

The following documents (latest revision) are referenced in this specification and are a part of referenced Standards/Codes and/or specification. The more stringent of these shall apply. In case of conflict between this specification and the referenced documents, this specification shall apply.

- (a) ANSI/AWWA C214- Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines.
- (b) ANSI/ASTM D149- Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid electrical insulating Materials at Commercial Power Frequencies.
- (c) ANSI/ASTM D4218- Standard Test Method for Water absorption of Plastics.

- (d) ANSI/ASTM D4218- Standard Test method for Determination of Carbon Black Content in Polyethylene compounds by the Muffle - Furnace Technique.
- (e) ASTM D 1000 - Standard Test Method for pressure - Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
- (f) ASTM E96- Standard Test Methods for Water Vapor transmission of Materials
- (g) ASTM G14- Standard Test Method to impact Resistance of Pipeline coatings (Falling Weight Test).
- (h) ASTM G17- Standard Test Method for Penetration Resistance of Pipeline Coatings (Blunt Road)
- (i) NACE RP-02-74-High-Voltage Electrical Inspection of Pipeline Coatings prior to installation
- (j) SSPC-PA-2-Measurement of Dry Paint Thickness with Magnetic Gauges.
- (k) SSPC-SP1-Solvent cleaning
- (l) SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning External Coating on Pipeline Cold Applied Tape

Coating System

System Components:

The prefabricated polyolefintape protective coating shall be at least three layers comprising of primer, inner tape wrap and outer wrap and consisting of the following:

- 1) A liquid adhesive layer
- 2) An inner-layer tape for corrosion protection

- 3) An outer-layer tape for mechanical protection.

The inner-layer tape and outer-layer tape shall be made of prefabricated tapes in rolls. The properties of the entire system shall conform to the appropriate values issued in tables below.

Liquid Adhesive

The liquid adhesive shall consist of a mixture of suitable rubber and synthetic compounds and a solvent. The liquid adhesive shall be applied to the properly prepared pipes surface before application of the inner-layer tape. The function of the liquid adhesive is to provide a bonding medium between the pipe surface and the inner-layer tape. The liquid adhesive shall be supplied by the manufacturer that supplies the inner layer tape. The liquid adhesive shall comply with all code and regulatory requirements in effect at the point of application. The liquid adhesive shall not settle in the container forming a cake or sludge that cannot be easily mixed by hand or mechanical agitation and it shall have good machine-application properties.

Physical Properties of the Liquid Adhesive

Color	Base	Property		
			Weight	Flash point
Black	Rubber and Synthetic Resins	Flammable	- 6-8 lb/gal - (0.72-0.965g/l)	- 10° F (-17° C) or greater
		Non flammable	- 10-12 lb/gal (1.20-1.44 kg/l)	None

Inner-Layer Tape

The inner-layer tape shall be a two-layer consisting of a polyolefin (only) backing layer with a laminated butyl-based adhesive layer. The inner tape shall be compatible with the liquid adhesive. The manufacturer shall certify that the backing material shall be polyolefin only, containing not less than 1-0 percent nor more than 3.5 percent, by weight, of nonpolyolefinic material consisting of carbon black and antioxidants. The inner-layer tape shall be applied after the liquid adhesive and before the outer-layer tape. The backing and adhesive shall be made from materials that provide high electrical resistivity, resistance to corrosive environments, low moisture absorption and permeability, and shall provide an effective bond to a properly prepared steel surface. The inner-layer tape shall be of material that will resist excessive mechanical damage during normal application operations and shall be sufficiently pliable for the intended use. The inner-layer tape shall withstand, without tearing, the tensile force necessary to obtain a tightly wrapped inner coating free of voids. The properties of the inner-layer tape shall conform to the values given below:-

Physical Properties of Inner Layer Tape

Property	Requirement		Test Method (Ref AWWA C214-00)
	Minimum	Maximum	
Width Deviation	5% of 1/4 in (6 mm) whichever is smaller	+5%	Sec. 5.3.1
Thickness (20mil (508 um) Normal	19 ml (483 um)		Sec. 5.3.2
Ratio of Adhesive to Total Inner Layer Tape Thickness	40% of total	22 mil (559 um) 60% of total	Sec. 5.3.2
Adhesive to prepared Steel	200 ozf/in width (2.190 N.m width)		Sec. 5.3.3.
Water Absorption (24h)		-0.2% by wt	Sec. 5.3.4
Water-Vapor Transmission Percent by Weight		0.2 perms [(1.15x10 ⁻¹¹ kg (Pa.s.m ³)]	Sec.5.3.5
Dielectric strength	6,000 Visingle thickness 500,000 megohms		Sec.5.3.6
Insulation Resistance			Sec.5.3.7
Tensile Strength	20 ibf/in (3,500 N/m width) 100%		Sec.5.3.8
Elongation	1.0%		Sec.5.3.9
Nonpolyolefinic Material Percent by Weight		3.5%	Sec.5.3.12

Form: The inner-layer tape shall be supplied in roll form wound on hollow cores.

Dimensions: To ensure a proper smooth coating, the inner-layer tape shall be provided in standard widths as per manufacturer recommendations consistent with the pipe diameter.

Outer-layer tape:

The outer-layer tape shall be a two-layer tape consisting of a polyolefin (only) backing layer with a laminated butyl adhesive layer. The manufacturer shall certify that the backing material shall be polyolefin

only, containing not less than 3.0 percent or more than 7.0 percent, by weight, of nonpolyolefinic material consisting of pigments, antioxidants and stabilizers. The outer-layer tape shall be compatible with the inner-layer tape. The primary functions of the outer-layer tape shall be to provide mechanical and outdoor weathering protection to the tape system, and secondarily to contribute to the overall corrosion-protection properties of the system. the outer-layer tape backing shall be compounded so that it will be resistant to outdoor weathering.

The outer-layer should be of suitable quality for the local environment, as follows:-

Storage temperature	:	0 to 50° C
Over-ground Condition	:	0 to 50° C
Under-ground Condition	:	7°C to 35° C
Soil-Nature	:	As provided in Section 9 Drawings
Underground Water Table		Generally dry but gets saturated during monsoon (3 months/year)
Ultraviolet -ray protection	:	Required in outer-layer

Materials used in the outer-layer tape provide some electrical resistivity, low moisture absorption and permeability and resistance to corrosive environments. Materials used shall provide mechanical protection during handling and outdoor storage. The outer-layer tape shall be sufficiently pliable for normal application operations and shall form an effective bond to the inner-layer tope. The properties of the inner-layer tape shall conform to the values given below:-

Physical Property of Outer Layer Tape

Property	Requirement		Test Method (Ref AWWA C214-00)
	Minimum	Maximum	
Width deviation	% or 1/4 in (6 mm) whichever is smaller 19 mil (483 um)	+5%	Sec.5.3.1
Thickness [(20 mil (508 um)] Nominal			Sec. 5.3.2.
Adhesion to inner layer	20 ozf/in width (200 N/m width)		Sec. 5.3.3
Tensile Strength	40 lbf/in (7,000 N/m width)		Sec.5.3.8
Elongation	100%		Sec.5.3.9
Nonpolyolefinic Material Percent by Weight	1.0%	3.5%	Sec. 5.3.12

Test methods are all for tests performed in laboratories. If field test methods for any property are required, consult with the tape manufacturer.

Form: The outer-layer tape shall be supplied in roll form wound on hollow cores.

Dimension: The outer-layer tape shall be provided in standard widths and lengths. The width of the outer-layer tape shall be at least equal to that of the inner-layer tape.

Tests: The tape coatings shall conform to the physical properties stated in Tables provided. The tape manufacturer shall provide the Engineer with certified test reports on each order of tape supplied.

Physical Properties of Total System

Property	Requirement		
	Minimum	Maximum	Test Method (Ref AWWA C214-00)
Thickness 80 ml nominal	73 mil (1.854 um)	88 mil. (2.235 um)	Sec. 5.3.3.
Dielectric Strength	12000 V		Sec.5.3.6
Impact Resistance	25 lbf. in (2.8 N.m)		Sec. 5.3.10
Penetration/Deformation Resistance	25% with no holiday at 72° F (22° C)		Sec.5.3.11

Test methods are all for tests performed in laboratories. If field test methods for any property are required, consult the tape manufacturer:

Coating: system thickness

Depending on operating and installation conditions, more than one application of inner-layer tape and outer-layer tape can be used. The total thickness and combination of the various layers used shall be approved by the Engineer, with proper consideration given to the manufacturer's recommendations. However, in no case shall the thickness be less than those stated in the above tables.

Coating application

General

The coating application shall be a continuous operation starting with properly prepared pipe surface. Three steps, which shall be performed consecutively shall consist of:

- i) liquid adhesive application
- ii) application of the inner-layer tape directly onto the prepared pipe surface and
- iii) application of the outer-layer tape directly on top of the inner-layer tape.

The coating materials shall be stored in a clean, dry area. During steps 2 and 3, one or more layers of inner-layer and outer-layer tape may be applied as specified and approved by the Engineer.

Pipe preparation

Bare pipe shall be free from mud, mill scale, mill lacquer, wax, coal tar, asphalt, oil, grease or any other foreign material. Before blast cleaning, surfaces shall be inspected and precleaned according to SSPC-SP 1 to remove oil, grease and loosely adhering deposits. Visible oil and grease spots shall be removed using a solvent. Only solvents that do not leave a residue shall be used. Preheating to remove oil, grease and mill scale may be used provided that all pipe is preheated in a uniform manner to avoid distortion.

- a) **Clearing:** After drying and removing all loosely adhering foreign materials, the pipe surface shall be cleaned to adhere a surface preparation at least equal to that of ST-3.
- b) **Visual comparative standards:** The Contractor shall prepare a representative area on an actual work surface, as well as visual standards on minimum 6 in. x 6 in. x 1/4 in. (150mm x 150mm x 6mm) panels. When the visual standard meets the requirements of cleaning the panels shall be wrapped in plastic sealed with tape or otherwise protected from surface contamination or corrosion and maintained as a visual reference standard throughout the coating operations. The standard section shall be sealed carefully to prevent rusting. Alternatively, other industry-accepted visual comparative standards agreed on may be used.
- c) **Surface inspection:** The cleaned exterior pipe surface shall be inspected for adequate surface preparation. Surface imperfections, such as silvers, scabs, butts, weld spatter and groups, shall be removed by hand filing or grinding if necessary to prevent holiday.
- d) **Protection from moisture:** Blast cleaned pipe surfaces shall be protected from conditions of high humidity, rainfall, or surface moisture. No pipe surface shall be allowed to flash rust before coating. To ensure a dry pipe surface at the time of liquid adhesive application, the minimum steel substrate temperature shall be 7 deg. C and at least 3 deg. C above the dew point.

Weld Seam Cover:

Longitudinal and coil splice welds. Weld seam cover tape shall be compatible with the liquid adhesive. Before applying the inner-layer tape, the longitudinal and coil splice weld seams shall be ground flush for a distance of 450 mm along the length of the pipe on both ends. These weld seams shall be coated with liquid adhesive and then covered with a strip of tape recommended by the manufacturer. The width of the weld seam tape will be as recommended by the manufacturer and as approved by the Engineer. The weld seam tape shall conform to the provisions of these specifications.

Spiral welds: The spiral weld seam shall be ground flush a full 450mm along the length of the pipe on both ends prior to the coating process. Covering the spiral weld seams with a stripping tape is required only when the profile and position of the weld seam prevents conformability of the tape to the steel surface. This condition is encountered more often on larger diameter (>60 in. (1,500 mm) pipelines, in these cases, the weld treatment shall be specified by the Engineer after consultation with the tape manufacturer.

Coating Application**(i) Liquid Adhesive Application:**

The liquid adhesive shall be applied in a uniform thin film at the coverage rate recommended by the manufacturer. The liquid adhesive shall be thoroughly and continuously mixed and agitated during application to prevent setting. The liquid adhesive may be applied to the exterior surface of the pipe by spray-type or rug-type methods or other suitable means to cover the entire exterior surface of the pipe. The liquid adhesive coat shall be uniform and the liquid adhesive-coated pipe surface shall be free of any foreign substances. Before applying the inner-layer tape, the liquid adhesive layer shall be allowed to dry in accordance with the manufacturer's recommendation.

(ii) Application of Inner-layer Tape

The inner-layer tape shall be applied directly onto the prepared pipe surface using mechanical constant-tension coating equipment. The inner-layer tape shall be spirally applied with overlap width and application tension as recommended by manufacturer. When applied to spirally welded pipe, the direction of the tape spiral shall be generally parallel to the weld spiral. The minimum overlap shall not be less than 25mm. When a new row of tape is started, the ends shall be overlapped at least 150mm measured circumferentially.

(iii) Application of Outer-layer Tape

The outer-layer tape shall be applied over the inner-layer tape using the same type of mechanical equipment used to apply the inner-layer tape. The overlap of the outer-layer tape shall not coincide with the overlap of the inner-layer tape. The minimum overlap of the applied tape and minimum end lap of two rolls shall be the same as that of the applied tape and minimum end lap of two rolls shall be the same as that of inner-layer tape. The outer-layer tape shall be applied at a minimum roll temperature of 21° C. The tape manufacturer shall be consulted for recommended temperatures of roll above 21° C to enhance conformability of the outer-wrap to the pipe surface.

Cutbacks: Cut backs shall be 150mm +/- 25mm. The cutbacks may be straight edge for the total thickness of the coating, or they may be tapered, as approved by the Engineer.

Coating Repair in Field

All holidays visually or electrically discovered either at the coating plant or in the field shall be repaired by peeling back and removing the outer and inner-layers from the damaged area. The exposed areas shall then be coated with liquid adhesive and either (1) a length of inner-layer tapes shall be wrapped around the pipe to cover the defective area; or (2) a patch of inner-layer tape shall be applied directly to the defective area as specified by the Engineer. The minimum lap at the damaged area shall be 100mm all around. The repaired area shall be tested with a holiday detector as per specifications after the repair is completed. If holidays are not found, the repaired area shall be covered with the outer-layer tape with a minimum tape of 100mm beyond the inner-tape patch. Tape conforming to AWWA C214 may be used as replacement for the inner-layer tape when repairs are made.

Field Procedures:

At all times during construction of the pipeline, the Contractor shall use caution to prevent damage to the protective coating on the pipe. No metal tools or heavy objects shall be permitted to unnecessarily contact the finished coating. Workmen shall not be permitted to walk on the coating except when necessary. In these cases, they shall wear shoes with rubber or composition soles and heels or other suitable foot wear that will not damage the coating. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline shall be repaired.

Protection during Welding:

A 450mm wide strip of heat-resistant material shall be draped over the top half of the pipe on each side of the coating holdback during welding to avoid damage to the coating by hot weld spatter. The welder grounding clamp shall not be attached to the coated part of the pipe.

Hoisting

Pipe shall be hoisted using only wide-belt nylon slings or the equivalent. The use of caliper clamps, metal chains, cables, tongs, or other equipment likely to cause damage to the coating shall not be acceptable; nor shall dragging or kidding of the pipe be permitted. The Contractor shall allow inspection of the coating on the underside of the pipe while the pipe is suspended from the slings.

Inspection and Testing:**Material Acceptance:**

Acceptance of the proposed coating materials shall be as specified by the Employer's Engineer from the following options; (1) acceptance of the manufacturer's certified test reports submitted by the contractor with testing conducted by a responsible commercial laboratory designated by the Employer's Engineer; or (3) acceptance of another basis defined and specified by the Employer's Engineer.

Inspection and Testing by the Employer's Engineer

Optional Inspection:

At the option the Employer's Engineer, the entire procedure of applying the protective coating material as described will be inspected from surface preparation to completion of coating. The inspection shall not relieve the Contractor of his responsibility to provide material and perform work in accordance with the specifications.

Coating Application Inspection:

The entire coating operation by the Contractor will be supervised by qualified experts from the manufacturer. The CV of the manufacturer's expert shall be approved by the Employer's Engineer. All coating work will be done in the presence of the Employer's Engineer.

Access of Employer's Engineer:

The Employer's Engineer shall have free access to those parts of all areas that are involved in the providing of materials or the performance of work according to specification.

Facilities for Employer's Engineer:

The Contractor shall provide the Employer's Engineer with reasonable facilities and space without charge to inspect, test, and obtain any information as desired regarding the character of material used, how the materials were applied, the progress and manner of the work, and the result obtained.

Coating-System Tests:**Width Deviation:**

A specimen of inner-layer tape and outer-layer tape at least 0.9 m long shall be removed from each of three randomly selected rolls. The width of the specimen shall be measured at several points along the length of the sample to the nearest 1.6mm using a standard steel scale. The width deviation shall not exceed the limits stated in Tables 4.3.11 and 4.3.12.

Thickness:

The Thickness of the inner-layer tape and outer-layer tape shall be measured at not less than 10 locations on the three rolls of tape coating used. The measurements shall be made with a micrometer calibrated to read in thousandths of an inch and having contact feet of not less than 6 mm in diameter. Thickness measurements outside the limits stated in Tables above shall constitute failure of the tape to meet the thickness requirements.

Adhesion:

The prefabricated inner-layer tape shall be tested for adhesion to a prepared steel surface in accordance with ASTM D 1000 (modified to include a 24-hour dwell time of tape to primed substrate prior to adhesion peel test). The outer-layer tape shall be tested for adhesion to the inner-layer tape in accordance with ASTM D 1000 with above modification. An average value below the limits stated in Tables above shall constitute failure of the tape to meet the adhesion requirement.

Water Absorption:

The prefabricated inner-layer tape coating shall be tested for water absorption in accordance with ASTM D 570. An average value in excess of the limits stated in the properties above shall constitute failure of the tape to meet the water absorption requirement.

Water-vapor Transmission:

The prefabricated inner-layer tape coating shall be tested for water-vapor transmission in accordance with ASTM E 96, method B (at 23° C). An average value in excess of the limits stated in the properties above shall constitute failure of the tape to meet the water-vapor transmission requirements.

Dielectric Strength:

The prefabricated inner layer tape and the outer-layer tape together shall be tested for dielectric strength in accordance with ASTM D149. Any below the limits stated in the properties above for the Outer-layer tape shall constitute failure of the tape to meet the dielectric-strength requirement.

Insulation Resistance:

The prefabricated inner-layer tape and outer-layer tape shall be tested for tensile strength in accordance with ASTM D 1000. An average value below the limits stated in the properties above for the inner-layer tape shall constitute failure of the tape to meet the insulation-resistance requirements.

Tensile Strength:

The prefabricated inner layer tape and outer-layer tape shall be tested for tensile strength in accordance with ASTM D 1000. An average value below the limits stated in the properties above for the inner-layer tape and outer-layer tape shall constitute failure of the tape to meet the tensile strength requirement.

Elongation:

The prefabricated inner-layer tape and outer-layer shall be tested for elongation in accordance with ASTM D 1000. An average value below the limits stated in the properties above for the inner-layer tape and outer-layer tape shall constitute failure of the coating system to meet the elongation requirement.

Impact Resistance:

The total tape system shall be tested for impact resistance in accordance with ASTM G 14. Five samples shall be tested and the results averaged. An average value below the limits stated in Table 4.3 13 shall constitute failure of the coating system to meet the impact-resistance requirement.

Penetration / Deformation Resistance:

The total tape system shall be tested in accordance with ASTM G 17 at 22° C. Five samples shall be tested and the results averaged. An average value above the limits stated in the table for total system shall constitute failure to meet the penetration-deformation resistance requirements with no holiday.

Nonpolyolefinic Material content:

The inner-layer tape and the outer-layer tape shall be tested for nonpolyolefinic content in accordance with ASTM D 4318. Section 9.11, 9.12, and 9.13 of ASTM D 4218 need not be present on the tape method to obtain accurate results. The adhesive layer must not be present on the tape backing when performing the ASTM D 1218 test. Consult the tape manufacturer for the preferred method of adhesive removal. The tests should be performed only on samples taken from tape supplied by the tape manufacturer. Five samples shall be tested and the results averaged. An average value outside the limits given in Tables for the inner-layer tape and outer-layer shall constitute failure to meet this requirement.

Coated-Pipe Tests:**Thickness:**

The thickness of the coating system shall be checked in accordance with SSPC-PA 2. The thickness shall be in accordance with Table for the total system and shall be checked at a frequency specified by the Engineer.

Electrical Inspection for Continuity:

Each coated pipe section shall be electrically tested for flaws in the coating using a suitable holiday detector approved by the Engineer. The detector shall impress a minimum of 6,000V. Reference should be made to NACE RP-02-74. The electrical inspection shall take place on the inner-layer tape before the outer-layer tape is applied. If a holiday is detected, it shall be repaired as per specifications.

Rejection:

Pipe: The Engineer may rejected pipe if the surface condition does not comply with the requirements. Pipe rejected because of inadequate cleaning shall be re-cleaned and re-inspected.

Coating works: When inspection is provided by the Engineer all coating work not done in the presence of the Engineer may be subject to rejection. If at any time the procedure of applying the coating material does not meet the requirements of the specifications all the coating work shall be rejected.

Coating Materials: If any sample of coating material is found not to conform to the specifications, then the coating material represented by that sample shall be rejected. If samples of the Contractors coating

materials that have been previously approved at found not to conform to the specifications, then all the coating material shall be rejected.

Delivery:

Marking:

Containers shall be plainly marked with the name of the manufacturer, type of material, batch or lot number date of manufacture, storage conditions and information as required by federal and state laws.

Packaging and shipping:

Packaging:

All inner-layer tapes, outer-layer tapes and liquid adhesives shall be packaged in suitable containers to ensure acceptance and safe delivery to their destination. Preference of individual or multiple packaging of the tapes and size liquid adhesive container shall be as specified by the Engineer. Rolls of inner-layer pipe and outer-layer tape shall be packaged in quantities not to exceed the weight limitations of the container specifications. Each roll of inner-layer tape and outer-layer tape shall be protected from adhering to other rolls, to the container, or to the packaging material itself using separators. Liquid adhesive shall be packaged in 5 gal (19 l) pails 55 gal (210 l) drums, or other suitable containers.

Shipping, Handling and Storage:

Coated pipe shall be handled, stored and shipped in a manner that will prevent damage to the coating. Pipe also shall be handled and stored in a manner to prevent damaged to pipe walls and ends. Pipe or coating damaged in handling or other operations shall be repaired. Handling during the period of coating also shall be such as to avoid damage to the coating. Thermal expansion is a characteristic of the coating that may cause uneven areas on the coated pipe surface, but does not adversely affect the coating system's performance. These arrears do not require any repair.

Stacking: Sufficient spacers or padding shall be used to prevent damage to the pipe and coating.

Shipping: Pipe shall be transported for the coating yard to the jobsite using sufficient shoring or tonnage, padding and banding to adequately protect the pipe and its coating.

Loading: Pipe shall be loaded for shipping in compliance with existing shipping standards and regulations.

Trench-side Storage: Pipe stored along the trench side shall be suitably supported of the ground to avoid damage to the coating.

Coating for Exterior of Special Sections, Connections and Fittings:

General:

This section provides the requirements for cold applied tapes for the exterior of special sections, connections and fittings, including material application, inspection, testing, marking and packaging requirements.

The protective coating system described in this section consists of a prefabricated cold-applied tape and liquid adhesive applied to the exterior surface of steel water pipe specials connections and fittings.

4.3 1.9.2. Materials and Workmanship:

The materials provided shall meet the provisions of AWWA C 214. Work or material that falls to conform to this standard may be rejected at any time before final acceptance.

4.3. 1.9.2. Material Requirements:

Liquid Adhesive:

Liquid adhesive shall be of a type that can be applied without heat and produced an effective bond between the surface to be protected and the applied tape. Liquid adhesive shall comply with pollution control requirements that are in effect at the location of use. Liquid adhesive that may settle in the container shall not form a cake that cannot be mixed easily by hand stirring or agitation. Liquid adhesive shall have satisfactory properties for spraying, brushing, or other acceptable application methods, and a minimum tendency to produce bubbles during application. Liquid adhesive and prefabricated tape shall be from the same manufacturer.

Prefabricated Tape:

Materials:

Prefabricated cold-applied tape shall be made from materials that provide high electrical resistivity, resistance to corrosive environments and low moisture absorption and permeability and shall conform to the physical property requirements stated in Table below established in accordance with the test procedures. In addition, the tape shall be compatible with and provide an effective bond to the primed steel surface and the previously applied plant or field coatings, and shall seal to itself. The prefabricated, cold-applied tape shall consist of a laminate composed of a plastic film backing and a homogeneous electrometric sealant layer.

The sealant layers, in some instance, are covered with release liners or separators. These liners or separators must be removed prior to performing physical property tests and before application to primed steel surface.

Tapes shall resist excessive mechanical damage during normal application operations and be sufficiently pliable so as to conform to the storage to be coated. The tapes also shall withstand, without tearing, the tensile force necessary to obtain a tightly wrapped coating.

Form: The prefabricated tape shall be supplied in sheets, pads, or rolls wound on hollow cores as directed by the Engineer. Hollow cores shall have a minimum inside diameter or 1¹/₂ 1/2 in (38 mm).

Dimensions

Prefabricated tape shall be provided in standard widths as per manufacturer's recommendations and approved by the Engineer.

Thickness

Prefabricated tape rolls shall be provided in the minimum thickness as approved by the Engineer, but in no case shall be thickness be less than as shown in Table below.

Table Physical Properties of Tape and Coating

Property	Minimum	Test Method (Ref. AWWA C209-00)
Width Deviations :Maximum	+/- 5% of width or 1/4 in (6mm) whichever is smaller	Sec. 5.3.2.1
Thickness: Minimum	30 mil (750 _u m) +/- 5% minimum	Sec. 5.3.2.2
Water-vapor Transmission	0.25 perm (1.44 ng/ (pa.s.m ²) minimum	Sec. 5.3.2.3
Dielectric Breakdown	400 V/mil (15 V/ _u m)	Sec. 5.3.2.4
Insulation Resistance: Minimum	500,000 megohms, minimum	Sec. 5.3.2.5
Adhesion (Bond) to Primed Steel: Minimum	20 ozf/in (220g/cm) width, minimum	Sec. 5.3.2.6

Coating Application

Priming

A uniform, continuous coat of liquid adhesive shall be applied according to the manufacturer's recommendations, as approved by the Engineer. The liquid adhesive coverage and curing or drying time shall be sufficient to ensure an effective bond between the substrate and the coating. Liquid adhesive application shall be limited to the amount of surface area that can be wrapped during the same workday as application of the liquid adhesive; otherwise, the steel must be re-primed. After liquid adhesive application,

and before the tape is applied, care shall be taken to prevent the contamination of the primed surface by any foreign materials such as dirt and moisture.

In case of restriction on use of liquid adhesive because of emission regulation, tape system not requiring the use of liquid adhesives may be used provided that the tape material continues to meet the requirements with prior approval of the Engineer.



**CHENNAI METROPOLITAN WATER SUPPLY AND SEWERAGE BOARD
CHENNAI - 600 002**

NATIONAL COMPETITIVE BIDDING

**BID DOCUMENT
FOR**

**SHIFTING OF EXISTING 800MM DIA M.S. WITH 800MM DIA D.I.,
450MM DIA D.I. AND 100MM DIA D.I. WATER MAINS FOR THE
PROPOSED CONSTRUCTION OF GRADE SEPARATOR IN G.N.T. ROAD
(MOOLAKADAI JUNCTION), DEPOT – 2, AREA – I**

CONTRACT NO: CNT / WSS / MWB / DEP / 2000 / 2010-11

VOLUME – III

BILL OF QUANTITIES

**SUPERINTENDING ENGINEER (CONTRACTS & MONITORING)
CHENNAI METROPOLITAN WATER SUPPLY AND SEWERAGE BOARD
No.1, Pumping Station Road, Chintadripet, Chennai 600 002.
Telephone: 044 – 2845 1300 Fax: 044 – 2845 8181 / 2845 7000
E-mail: cmwssb@md2vsnl.net.in**

PREAMBLE

1. The Bill of Quantities shall be read in conjunction with the instruction to Bidders, General and Special Conditions of Contract, Technical Specifications and Drawings.
2. The quantities given in the Bill of Quantities are estimated and only provisional and are given to provide a common basis for bidding. The basis of payment will be 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 bid in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of contract. Only the pipes, specials and valves that are actually use at the site alone be eligible for payment, extra quantity of specials transported at the site that are not used should be removed from the site and are not eligible for payment.
3. The rates and prices bid in the priced Bill of quantities shall, except insofar as it is otherwise provided under the Contract, include all the Constructional plant, labour, supervision, materials, erection, maintenance, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract.
4. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of Items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
5. The whole cost of complying with the provision of the Contract shall be included in the items provided in the Bill of Quantities, where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of work.
6. General discussion and description of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the contract documentation shall be made before entering prices against each item in the Bill of Quantities.
7. Provisional sums included and so designated in the Bill of Quantities shall be expanded in whole or part at the direction and discretion of the Engineer.
8. The method of measurement of completed work for payment shall be in accordance with standard method of measurements of the institution of Civil Engineers.
9. Errors will be corrected by the Employer for any arithmetic errors in computation or summation as follows stated in clause 27 of ITB Vol. I.

10. Abbreviations used in the Bill of Quantities have the meaning shown below:

mm	: Millimetre
cm	: Centimetre
m	: Metre
Sqm/M ²	: Square metre
Cum / m ³	: Cubic metre
MT	: Metric tonne
No.	: Number
CI	: Cast Iron
D.I.	: Ductile Iron
R.C.C.	: Reinforced Cement Concrete
Wt	: Weight
Kg	: Kilogram
Rmt	: Running Metre

ABSTRACT

Name of work: Shifting of 800mm Dia M.S. with 800mm Dia D.I., 450mm Dia D.I., and 100mm Dia D.I., water mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot - 2, Area - I.

Contract No.: CNT / WSS / MWB / DEP / 2000 / 2010

Sl. No.	Description of work	Amount (in Rs.)
1	Bill No.I -- Supplying and laying 800mm Dia D.I. pipes and specials	
2	Bill No.II -- Supplying and laying 450mm Dia D.I. pipes and specials	
3	Bill No.III -- Supplying and laying 100mm Dia D.I. pipes and specials	
Total		
(Rupees in words)		

Signature of the contractor with seal:

Name and Address:

WORK SCHEDULE

Name of Work: Shifting of 800mm dia M.S., with 800mm dia D.I., 450mm dia D.I., and 100mm dia D.I., water mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot - 2, Area - I.

Bill No.I -- Supplying and laying 800mm dia D.I. pipes and specials (including Labour and Materials)

Contract No.CNT / WSS / MWB / DEP / 2000 / 2010

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
1	Making trial pits for locating the existing alignment including cutting, excavation and refilling etc., complete.	6	Nos.	Each			
2	Cutting asphaltic Road, foundation structure and concrete road by using tractor mounted compressor machine including operators, fuel etc. complete.	324	Hrs.	Hr.			
3	Supplying, Conveying of DI pipes of size 800 mm dia of Class K9 as per IS 8329-2000 or its latest revision, loading, unloading and transporting charges etc. complete including laying, jointing of DI pipes of size 800mm dia from the site of stacking to the site of construction including open cut earth work excavation for trenches in hard stiff clay, stiff black cotton, hard red earth, shales, murams, gravelly soil with and stone mixed with small size boulders and hard gravelly soil, depositing the earth on bank with initial lead of 10 m including pumping sub-soil water, lowering the pipes in to the trenches, aligning and refilling the trenches with excavated earth, watering, ramming to consolidation and disposing the surplus earth etc. complete.						
a)	800 mm dia DI pipe - Average depth of 2.00 m	420	Mtrs.	Mtr.			

Signature of the contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
b)	800 mm dia DI pipe - Average depth of 2.50m (including timbering charges)	310	Mtrs.	Mtr.			
c)	800 mm dia DI pipe - Average depth of 3.00 m (Including timbering charges)	50	Mtrs.	Mtr.			
4	Barrication work along one side of the t+B17renches for laying the pipe line with casurina post at 1.52 m c/c (8 to 10 cm dia and 1.52 m height) verticals, painting the vertical posts in different colours, tying with coir rope, fixing danger flags, danger lights, reflectors including watching during night etc. complete.	780	Mtrs.	Mtr.			
5	Cutting 800mm dia DI pipe	10	Nos.	Each			
6	Supplying Conveying and fixing DI.Specials as per IS 9523-2000 like Tee branches, bends and tapers including earth work excavation and refilling at any depth.						
a)	800 mm dia 45 degree bend with double socket ends	4	Nos.	Each			

Signature of the contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
b)	800 mm dia 22 1/2 degree bend double socket ends	2	Nos.	Each			

Signature of the contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
c)	800 mm dia 11 1/4 degree bend double socket ends	2	Nos.	Each			
d)	800mm dia DI MJ collar	8	Nos.	Each			
7	Supplying and Making Rubber joint - 800mm as per IS 5382-1985	174	Nos.	Each			

Signature of the contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
8	Supplying and conveying to the site, M.S. specials as per IS 7323 fabricated with 10mm thick M.S. plates including cutting the plates, fabrication charges, machining the pipe ends, radiography, bending, drilling the holes, welding, for inside lining of two coats of High build coal tar epoxy finish paint over one coat of inorganic zinc silicate primer / epoxy coating specials and for outside providing cement lining of thick 25mm thick including cost of rubber packing, bolts, nuts and rubber 'O' rings etc. for laying specials above ground level and gunneting the cement mortor 1:3 thick 50mm under a pressure of 2.1 to 2.8 kg / cm2 in layer of 10mm thickness over the reinforcement of welded with 5 mm wire mesh placed in position of size						
	150mm x 150mm including providing form work over the pipe for laying below ground level including all the duty and taxes (central and local) Railway freight, insurance, unloading from railway wagon loading into trucks, transportation to site, unloading, stacking etc. complete as per specification including all the tests required etc. as per the I.S. at the pipe manufacturing yard or factory.						

Signature of the contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
a)	45 degree M.S bend with 10mm thick plate of length 1.5 m (Centre) dia. 850 mm inner & outer 870 mm dia.	1275	Kg.	Kg.			
b)	M.S specials without inside lining out side coating M.S flange with 25 mm thick and 75mm width	700	Kg.	Kg.			
9	Interconnection work to the existing main including cutting the existing main fixing M.S specials, collars, jointing, baling out of water,engaging crane for lifting and aligning, labour for timbering and including earth work excavation and refilling etc. complete.	2	Nos.	Each			
10	Providing thrust blocks with CC 1:3:6 , using 40 mm hard broken stone jelly including earth work excavation, compacting curing etc. complete. 2.0 m depth for 800 mm dia. pipe						
a)	800mm dia DI 45 degree bend	8	Nos.	Each			

Signature of the contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
b)	800mm dia DI 22 1/2 degree bend	2	Nos.	Each			
c)	800mm dia DI 11 1/4 degree bend	2	Nos.	Each			
11	Testing of D.I. pipes with hydraulic testing equipment by filling with water and testing to recommended pressure in convenient stretches and attending the bursts if any occurred during the test ,excluding the cost of pipes including other incidental and operational charges etc., complete for the 800 mm DI.pipes	780	Mtrs.	Mtr.			
12	Supplying Conveying and laying fixing DI.pipe of 900mm dia of class K9 as per IS 8329-2000 Pipe for including earth work excavation and refilling for covering pipe at 3 m depth.	5.5	Mtrs.	Mtr.			
13	Lifting and returning to stores of 800 mm dia. MS Pipe	8	Mtrs.	Mtr.			

Signature of the contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
14	Provision for encasing the M.S specials with CC 1:2:4 using 12 to 20 mm gauge hard broken stone jelly for plain cement concrete works including laying in position, compacting, curing, finishing etc., complete	9.5	Cu.m.	Cu.m.			
Total Rupees in Figures							
Total Rupees in Words							
NOTE: Payment will be made as per the actual quantity used in the site during execution. Any excess materials to be taken by the contractor and no payment will be made for the excess materials not used in the work.							

Signature of the contractor with seal:

WORK SCHEDULE

Name of Work: Shifting of 800mm dia M.S., with 800mm dia D.I., 450mm dia D.I., and 100mm dia D.I., water mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot - 2, Area - I.

Bill No.II -- Supplying and laying 450mm dia D.I. pipes and specials (including Labour and Materials)

Contract No.CNT / WSS / MWB / DEP / 2000 / 2010

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
1	Making trial pits for locating the existing alignment including cutting , excavation and refilling etc., complete.	6	Nos.	Each			
2	Cutting asphaltic Road and concrete road by using tractor mounted compressor machine including operators, fuel etc complete	258	Hrs.	Hr.			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
3	Supplying and conveying to the site of size 450 mm dia DI pipe of Class K-9 conforming to IS 8329-2000 or its latest revision, loading, unloading and transporting charges etc., complete including, Laying, jointing of DI pipes of size 450 mm dia.including earth work excavation of trenches in hard stiff clay, strip black cotton hard red earth, shales, murams, gravel stoney earth and earth mixed with small size boulders and hard gravelly soil, depositing the earth on bank with initial lead of 10 m and pumping of sub-soil water, lowering the pipes into the trenches, aligning and refilling the trenches with excavated earth, watering, ramming to consolidation etc. complete.						
a)	450 mm dia DI pipe - Average depth of 1.50 m	170	Mtrs.	Mtr.			
b)	450 mm dia DI pipe - Average depth of 1.75 m	200	Mtrs.	Mtr.			
c)	450 mm dia DI pipe - Average depth of 2.0 m	60	Mtrs.	Mtr.			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
4	Barricade work along one side of the Trenches for laying the pipe line with casurina post at 1.52 m c/c (8 to 10 cm dia and 1.52 m height) verticals, painting the vertical posts in different colours, tying with coir rope, fixing danger flags, danger lights, reflectors including watching during night etc. complete.	430	Mtrs.	Mtr.			
5	Cutting 450 mm dia DI pipe	10	Nos.	Each			
6	Supplying and conveying to the site of 450 mm diameters of DI specials of such as Tees, Tapers, Bends, Branches, Tailpieces and collars etc., conforming to IS 9523-2000 or its latest revision, loading, unloading and transporting charges etc. complete including fixing D.I. Specials like Tee branches, bends and tapers including earth work excavation and refilling at any depth.						
a)	450 mm dia 45 degree bend with double socket ends	4	Nos.	Each			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
b)	450 mm dia 22 1/2 degree bend double socket ends	2	Nos.	Each			
c)	450 mm dia DI MJ collar	8	Nos.	Each			
7	Supplying and conveying to the site, the following diameters of Rubber gaskets (EPDM) confirming to IS 5382-1985 or its latest revision with ISI mark, loading, unloading and transporting charges etc., complete. For 450 mm dia. including making Rubber joint	110	Nos.	Each			
8	Interconnection work to the existing main including cutting the existing main fixing branches, collars, jointing, baling out of water and including earth work excavation and refilling etc. complete including cutting 450 mm dia DI water main and fixing 450mm dia D.I. main for interconnection.	2	Nos.	Each			
9	Providing thrust blocks using CC 1:3:6, 40 mm hard broken stone jelly for PCC works for 450 mm dia. pipe @ 2.0 m deep including earth work excavation.						
a)	450 mm dia DI 45 degree bend	4	Nos.	Each			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
b)	450 mm dia DI 22 1/2 degree bend	2	Nos.	Each			
10	Testing of DI. pipes with hydraulic testing equipment by filling with water and testing to recommended pressure in convenient stretches and attending the bursts if any occurred during the test, excluding the cost of pipes including other incidental and operational charges etc. complete for the 450mm D.I. pipes	430	Mtrs.	Mtr.			
11	Lifting and removing to stores of 450 mm dia. Pipe	6	Mtrs.	Mtr.			
12	Disposal of surplus earth etc. complete.	70	Cu.m.	Cu.m			
Total Rupees in Figures							
Total Rupees in Words							
NOTE: Payment will be made as per the actual quantity used in the site during execution. Any excess materials to be taken by the contractor and no payment will be made for the excess materials not used in the work.							

Signature of the Contractor with seal:

WORK SCHEDULE

Name of Work: Shifting of 800mm dia M.S., with 800mm dia D.I., 450mm dia D.I., and 100mm dia D.I., water mains for the proposed construction of Grade Separator in G.N.T. Road (Moolakadai Junction), Depot - 2, Area - I.

Bill No.III -- Supplying and laying 100mm dia D.I. pipes and specials (including Labour and Materials)

Contract No.CNT / WSS / MWB / DEP / 2000 / 2010

Sl. No.	Description of work	Qty. or No.	Per	Rate in Rs. Ps.		Amount
				In Figures	In Words	
1	Making trial pits for locating the existing alignment including cutting , excavation and refilling etc., complete.	6	Nos.	Each		
2	Cutting asphaltic Road and concrete road by using tractor mounted compressor machine including operators, fuel etc complete.	220	Hrs.	Hr.		
3	Supplying and conveying to the site of 450 mm & 100 mm DI pipe of Class K-9 confirming to IS 8329-2000 or its latest revision, loading, unloading and transporting charges including Laying, jointing of DI pipes of size 450 mm &100 mm dia. from the site of stacking to the site of construction including open cut earth work excavation for trenches in hard stiff clay stiff black cotton hard red earth, shales, murams, gravel stoney earth and earth mixed with small size boulders and hard gravelly soil, depositing the earth on bank with initial lead of 10 m and pumping sub-soil water ,lowering the pipes in to the trenches, aligning and refilling the trenches with excavated earth, watering, ramming to consolidation etc. complete					

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
a)	450 mm dia DI pipe - Average depth of 1.25 m	5.5	Mtrs.	Mtr.			
b)	100 mm dia DI pipe - Average depth of 1.00 m	280	Mtrs.	Mtr.			
c)	100 mm dia DI pipe - Average depth of 1.25 m	100	Mtrs.	Mtr.			
4	Barricade work along one side of the Trenches for laying the pipe line with casurina post at 1.52 m c/c (8 to 10 cm dia and 1.52 m height) verticals, painting the vertical posts in different colours, tying with coir rope, fixing danger flags, danger lights, reflectors including watching during night etc. complete	380	Mtrs.	Mtr.			
5	Cutting 450 mm and 100 mm dia DI pipe						
a)	450 mm dia	2	Nos.	Each			
b)	100 mm dia	18	Nos.	Each			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
6	Supplying and conveying to the site of 450 and 100 mm diameters of DI specials of such as Tees, Tapers, Bends, Branches, Tailpieces and collars etc., confirming to IS 9523-2000 or its latest revision, loading, unloading and transporting charges including fixing DI.Specials like Tee branches, bends and tapers including earth work excavation and refilling at any depth.						
a)	450x450x100 mm all soc tee	1	No.	Each			
b)	100X100X100 mm all soc tee	6	Nos.	Each			
c)	450 mm dia DI MJ collar	1	No.	Each			
d)	100 mm DI MJ collar	12	Nos.	Each			
7	Supplying and fixing of sluice valves with tail pieces including fixing the surface boxes / valves,covers etc. complete as per IS 14846-2000 for 100mm dia.	3	Nos.	Each			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
8	Supplying and conveying to the site of size 450 and 100 mm dia meters of Rubber gaskets (EPDM) confirming to IS 5382-1985 or its latest revision with ISI mark, loading, unloading and transporting charges etc., complete. For 100 mm & 450 mm dia. DI pipes. with making Rubber joint						
a)	450 mm	4	Nos.	Each			
b)	100 mm	115	Nos.	Each			
9	Interconnection work to the existing main including cutting the existing main fixing branches, collars, jointing, baling out of water and including earth work excavation and refilling etc. complete.						
a)	Cutting 450 mm dia DI pipe and fixing 450mm dia branch.	1	No.	Each			
b)	Cutting 100 mm dia DI pipe and fixing 100mm dia branch.	6	Nos.	Each			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
10	Testing of DI. pipes with hydraulic testing equipment by filling with water and testing to recommended pressure in convenient stretches and attending the bursts if any occurred during the test, excluding the cost of pipes including other incidental and operational charges etc., complete for the 100 mm DI.pipes	380	Mtrs.	Mtrs.			
11	Lifting and returning to stores						
a)	450 mm dia. Pipe	5.5	Mtrs.	Mtr.			
b)	100 mm dia. Pipe	12	Mtrs.	Mtr.			
12	Construction of SV chamber of size 100 mm dia. to 250 mm dia. (As per standard type design) for 100mm dia sluice valve.	3	Nos.	Each			
13	Supplying and fixing of 600mm dia FRC doors and frames.	3	Nos.	Each			

Signature of the Contractor with seal:

Sl. No.	Description of work	Qty. or No.		Per	Rate in Rs. Ps.		Amount
					In Figures	In Words	
14	Labour charges for HSC - 40 nos.						
a)	for 1 st 1.0 m length	40	Mtrs.	Mtr.			
b)	for laying additional length	160	Mtrs.	Mtr.			
15	Disposal of surplus earth etc. complete.	3	Cu.m	Cu.m			
Total Rupees in Figures							
Total Rupees in Words							
NOTE: Payment will be made as per the actual quantity used in the site during execution. Any excess materials to be taken by the contractor and no payment will be made for the excess materials not used in the work.							

Signature of the Contractor with seal:

