RAJKOT MUNICIPAL CORPORATION

TENDER No. : RMC/WW/CZ/18-19/01

Bid Documents For

Designing and construction of 2.00 Lac Liter RCC Elevated service reservoir (ESR) for Bad Backwash at Nyari filter plant

VOLUME II
TECHNICAL SPECIFICATION

The last date of e-Tendering are as under:	
1. Downloading of e-Tender documents	11-02-2019 to 05-03-2019 upto 1800 Hours
2. Pre-Bid Meeting at Central Zone in the O/o ADD. CITY Engineer	19-02-2019 at 1200 Hours
3. Online submission of e-Tender	05-03-2019 upto 1800 Hours
4. Physical submission of EMD, Tender fee and other documents.	07-03-2019 upto 1800 Hours
5. Verification of submitted documents (EMD, e-Tender fee, etc.)	08-03-2019 at 1100 Hours
6. Opening of online tender (Technical bid)	08-031-2019 at 1100 Hours
7. Opening of Price Bid if possible	11-03-2019 at 1100 Hours
8. Bid Validity	180 Days
For further particulars, visit us on www.rmc.nprocure.com	

ADD. CITY ENGINEER
RAJKOT MUNICIPAL CORPORATION
Dr.AMBEDKAR BHAVAN
DHEBARBHAI ROAD
RAJKOT - 360 001

EXTENT OF WORK

1.0 GENERAL

The extent of the work that may have to be provided by the bidders as given below is only suggestive. The bidder can review and refine the components so as to ensure the inlet at below mentioned locations not less than specified.

2.0 PLOT AT NYARI FILTER PLANT

The average ground level (existing) at Nyari Filter plant based on present survey data.

3.0 CONNECTION WITH NEW HEAD WORKS

The battery limit of the present contract commences from off take from existing 300 mm dia MS pipeline laid along filter plant. The size of connecting main is 200 mm dia MS.

4.0 DETAILS OF PROPOSED HEAD WORKS

4.1 Capacity of ESR

- ESR capacity – 2.0 lac litre capacity ESR with 12 mt. staging height along with inlet outlet over flow and wash out arrangement.
- Supply and laying of 219.10 mm dia M.S. pipeline with 200 mm dia Sluice valves.
- Using existing pumping machinery for intake in ESR

4.2 General Arrangement (DELETED)

4.3 Design Considerations

ESR shall be constructed of RC construction in M30 concrete with all the pipe works, valves, and accessories. ESR shall be watertight. The grade of HYSD reinforcing steel in the sump structure shall be of CRS – Fe-415 confirming to IS-1786 or its latest edition. The design shall take into account the worst combination of loads and forces ensuring total structural safety including seismic forces.

5.0 PURE WATER PUMP HOUSE AT PROPOSED HEADWORKS (DELETED)

5.1 General Arrangement

5.2 Design Considerations (DELETED)

6.0 PUMPING PLANT FOR PURE WATER PUMPING (DELETED)

6.1 General requirements

7.0 PURE WATER TRANSMISSION SYSTEM

7.1 General Arrangement DELETED

7.2 Design Considerations

7.2.1 The pipe shall be of CI.

7.2.2 Appropriate bedding /concrete encasement in accordance with loading on pipeline, anchor /thrust blocks, saddle supports for pipeline above ground level and other accessories shall also be considered for design.

7.2.3 Deleted

7.2.4 The technical requirements of different type of valves are as per the technical specifications.

8.0 DISCHARGING ARRANGEMENT (DLETED)

9.0 EQUIPMENT FOR PURE WATER PUMPING SYSTEM

The equipment shall include but not limited to:

a) Piping, valves, fitting and all accessories within or in connection with system units and ancillary structures.
b) All pipelines including connections, interconnecting pipeworks including making connections, tapping where necessary, procurement of all materials, fabrication of pipes, bends, tapers, flanges, manholes, fitting, valves, flushing connections, washouts, flexible couplings, dismantling/expansion joints, linking, finishes, pipe protection, supports, anchorage, etc.

The old pumping machinery is to be joined for pumping to ESR from Nyari Filter Plant. All necessary connection and pumping machinery is to be erected as directed. No extra payment is to be made for the same including electrification.

10.0 PUMPING PLANTS AND DESIGN PARAMETERS (DELETED)

The plant shall be designed, selected and installed taking into account site ambient conditions, local conditions and locations.

11.0 WORKS LIFE EXPECTANCY (DELETED)

12.0 ELECTRICAL SYSTEMS (DELETED)

13.0 SUPERVISORY /ANNUNCIATION SYSTEMS (DELETED)

14.0 SERVICE WATER INSTALLATIONS (DELETED)

SUBMISSION TO BE MADE ON AWARD OF CONTRACT

SUBMISSIONS TO BE MADE ON AWARD OF CONTRACT

1.0 SUBMISSION, REVIEW AND APPROVAL

1.1 Submission and Review

1.1.1 The Contractor shall submit the following designs and drawings for review and approval generally in the sequence given :

(a) General layout plan of the entire system to be executed under this contract.
(b) Using old machinery existing at Nyari filter plant and do necessary arrangement from pumping at ESR

(c) Manufacturer's data-sheets, catalogues, leaflets, brochures, drawings for bought-out items.
(d) General arrangement drawings for all units of works.
(e) Structural design calculations and drawings for all units of work.

(f) Any other drawing, document mentioned elsewhere in this tender specification.

1.1.2 After review, the Employer will convey comments which the Contractor shall incorporate by modifying designs and drawings accordingly.

1.1.3 In no case will design calculations/drawings be considered complete or acceptable, if

(a) They are not approved and duly signed by collaborator, if applicable.
(b) They are not thoroughly checked and duly signed in the appropriate places by Contractor and Sub Contractor (if any) and the authorised designers / consultants of the contractors.
(c) Detailed design calculations are not accompanied by supporting engineering drawings or appropriate sketches.
(d) Design calculations are incomplete or not fulfilling the design requirements or are shabbily done or are without adequate reference, or other necessary back-up data.
(e) Any comments previously made are not incorporated on revised drawings/calculations.

1.1.4 Such unaccepted drawings / designs as described above shall be summarily rejected and the Contractor will be informed. The Contractor shall arrange to re-submit the same duly checked, revised and signed. No claim from the Contractor for extension of time or for extra cost on this account will be entertained under any circumstances.

1.1.5 The review of civil engineering design calculations and drawings shall be carried out only in respect of correctness of centre-to-centre distances, elevations, important / typical details, orientation and sizes of important members, general design principles and approach, adherence to requirements of the relevant IS or other statutory codes, compliance with the Technical Specifications, general or specific notes and with the requirements of good engineering practice and whether the details shown on drawings conform to design calculations. Check for any interference and taking remedial action is the responsibility of the Contractor.

1.1.6 No check will be specifically carried out by the Employer to verify arithmetical / numerical accuracy of the calculations, which shall remain entirely the Contractor's responsibility, irrespective of any approval that may have been accorded thereto by the Employer.

1.1.7 All values / dimensions / elevations, etc. without supporting back-up data adopted/ assumed by the Contractor in his calculations / drawings shall be taken by the Employer to be correct unless they are specified.

2.0 LITERATURE, MANUALS AND CERTIFICATES

2.1 Where certificates are required by the specifications or relevant Reference standard, the original and one copy of each such certificate shall be provided by the Contractor.

2.2 Manufacturer's and supplier's test certificates shall be submitted as soon as the tests have been completed and in any case not less than seven calendar days prior to the time that the materials represented by such certificate are needed for incorporation into the Works.

2.3 Certificates of test carried out during the construction or on completion of parts of the Works shall be submitted within 7 days of the completion of the test.

3.0 INSTRUCTION MANUALS

3.1 General Instructions

3.1.1 The instructions shall be written in a simple language. Wherever possible, instructions shall be presented in a tabular form easy to understand.

3.2 Manual for Erection, Testing and Commissioning. (DELETED)

3.3 Manual of Operating Instruction (DELETED)

3.4 Manual of Maintenance Instruction (DELETED)

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1 DRAWINGS, DOCUMENTS, CERTIFICATE, MANUALS

1.1 Submission and review of Engineering Documents

1.1.1 The Contractor shall submit the following designs and drawings for review and approval of the ADD. CITY Engineer/ Consultant generally in the sequence given :

(a) General layout plan.
(b) Designs and drawings for all structures.
(c) General arrangement drawings.
(d) Structural design calculations and drawings for all work.

1.1.2 After review, ADD. CITY Engineer/Consultant will convey comments which the Contractor shall incorporate by modifying designs and drawings accordingly.

1.1.3 All values / dimensions / elevations, etc. without supporting back-up data adopted / assumed by the Contractor in his calculations / drawings shall be taken by the Consultant / Department to be correct unless they are specified.

1.2 Form of Drawings

1.2.1 All drawings submitted for approval shall be ISO standard size sheets, prepared on computer AutoCAD 14. Every drawing shall have a title block in the bottom right corner showing:

Employer	:	ADD. CITY Engineer Rajkot Municipal Corporation
Contract No.	:	RMC/ WW/CZ/18-19/01
Consultant	:	
Contractor	:	
Project	:	Construction of 2.0 Lacs litres capacity ESR at Nyari Filter Plant.
Drawing Title	:	
Drawing Number	:	
Revision Number	:	
Date	:	

1.2.2 Each drawing shall bear the signature of the Project Manager on behalf of the Contractor to the effect that the drawing (whether his own or from any other source) has been checked by the Contractor before submission to the ADD. CITY Engineer.

1.2.3 Each revision shall be properly recorded to show the number, date, specific description of revision/s carried out, and signature of the Project Manager in the revision block. The Contractor shall be responsible for incorporating all the comments issued by the ADD. CITY Engineer in the subsequent revision.

1.3 Programme of Submission

1.3.1 The Contractor shall furnish a programme for submitting all designs, drawings, and documents to ADD. CITY Engineer / Consultant within three weeks of award of Contract for pre-construction review. The program shall make reasonable provision for re-submission of unapproved designs, drawings and documents and for the time needed to review and transmit such designs, drawings and documents. No designs, drawings and

documents will be accepted for review until the programme for submission has been approved by ADD. CITY Engineer**.**

1.3.2 The Contractor shall provide three copies of all submissions for review / approval. Two copies will be returned to the Contractor with comments / approval.

1.3.3 The review period of pre-construction documents shall be as per conditions of contract Part-I Clause 5.2.

1.3.4 After approval, the Contractor shall submit to ADD. CITY Engineer one tracing, computerised drawing soft copy and five copies of all approved drawings with the date of approval marked.

1.4 Approval of Designs and Drawings

1.4.1 Approval from ADD. CITY Engineer to the Contractor's design or drawings shall not relieve the Contractor of any of his contractual obligations or liabilities under the Contract or his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits, performance particulars and conformity of the suppliers with the Indian statutory laws as may be applicable, nor does it limit the ADD. CITY Engineer's rights under the Contract.

1.4.2 Should it be found at any time after approval has been given by ADD. CITY Engineer that any designs, drawings or documents submitted by the Contractor are not consistent with any design, drawings or documents submitted or approved previously or deviate from any major aspect of the Contract Document, then such alternations or additions as may be deemed necessary by the ADD. CITY Engineer shall be made therein by the Contractor and the works carried out accordingly.

1.4.3 No revision shall be made by the Contractor after a design, drawing or document is "approved" by the ADD. CITY Engineer. In case the Contractor desires to incorporate any minor amendments in an "approved" drawing, he shall re-submit the same for formal approval. Contractor shall not make any revision in design/drawings, which is not related to the comments conveyed by ADD. CITY Engineer.

1.4.4 The approval of all the design will be given within 7 days. The Employer will accept the same within maximum 10 days for review with maximum one set of revisions.

1.5 Certificates

1.5.1 Where certificates are required by the Specification or relevant Reference standard, the original and one copy of each such certificate shall be provided by the Contractor.

1.5.2 Manufacturer's and supplier's test certificates shall be submitted as soon as the tests have been completed and in any case not less than seven calendar days prior to the time that the materials represented by such certificate are needed for incorporation into the Works.

1.5.3 Certificates of test carried out during the construction or on completion of parts of the Works shall be submitted within 7 days of the completion of the test.

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CIVIL

TECHNICAL SPECIFICATIONS
CIVIL
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SR NO	PARTICULARS	

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1.0 CIVIL AND BUILDING WORKS

1.1 Design Submissions

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted to ADD. CITY Engineer. Separate calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by ADD. CITY Engineer.

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Contractor shall also take care to check the stability of partly completed structures.

1.2 Design Standards

All designs shall be based on the latest Indian Standard (I.S.) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by ADD. CITY Engineer. In case of any variation or contradiction between the provisions of the I.S. Standards or Codes and the specifications given along with the submitted tender document, the provision given in this Specification shall be followed.

All reinforced concrete structural design shall generally conform to the following publications of the Indian Standards Institution :

I.S. 456	Code of Practice for plain and reinforced concrete
I.S. 875	Code of Practice for design loads for buildings and structures (Part 1 to 5)
I.S. 3370	Code of Practice for concrete structures for the storage of liquids (Part I to IV)
I.S. 1893	Criteria for earthquake resistant design of structures
I.S. 2974	Code of Practice for design and construction of machine foundations (Part 1 to 4)

All structural steel design shall generally conform to the following publications of the Indian Standards Institution:

I.S. 800:	Code of Practice for general construction in steel
I.S. 806:	Code of Practice for use of steel tubes in general building construction

1.3 Design Life

The design life of all structures and buildings shall be 60 years.

1.4 Design Loading

All buildings and structures shall be designed to resist the worst combination of the following loads / stresses under test and working conditions; these include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads, impact load and other specific loads.

1.4.1 Dead Load

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery.

The following minimum loads shall be considered in design of structures :

Weight of water		9.81 kN/m^3
Weight of soil (irrespective of strata available at site and type of soil used for filling etc). However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered.		20.00 kN/m^3
Weight of plain concrete		24.00 kN/m^3
Weight of reinforced c		25.00 kN/m^3
Weight of brickwork (exclusive of plaster)		22.00 N/m^2 per mm thickness of brickwork
Weight of plaster to masonry surface		18.00 N/m^2 per mm thickness
Weight of granolithic terrazzo finish or rendering screed, etc.		24.00 N/m^2 per mm thickness

1.4.2 Live Load

Live loads shall be in general as per I.S. 875. However, the following minimum loads shall be considered in the design of structures:

i) Live load on roofs (accessible) : 1.50 kN/m^2
(Non-accessible) : 0.75 kN/m^2

ii) Live load on floors supporting equipment such as pumps, blowers, compressors, valves, etc. : 10.00 kN/m^2

iii) Live load on all other floors walkways, stairways and platforms. : 5.00 kN/m^2

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of ADD. CITY Engineer prior to starting the design work. Apart from the specified live loads or any other load due to material stored, any other equipment load or possible overloading during maintenance or erection / construction shall be considered and shall be partial or full whichever causes the most critical condition.

1.4.3 Wind Load

Wind loads shall be as per I.S. 875.

1.4.4 Earthquake Load

This shall be computed as per I.S. 1893 considering earthquake 2001. An importance factor appropriate to the type of structure shall be considered for design of all the structures.

1.4.5 Dynamic Load

Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

1.5 Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the structure. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for all walls and rafts.

Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in all walls, floors and roof slabs of water retaining structures.

Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 1-m height. PVC water-stops of 150 mm width shall be used for walls and 230 mm width for base slabs. Alternatively contractor can use G.I. Sheets of 18 gauge and 200 mm wide.

Expansion joints for non-liquid retaining structures shall be provided as per IS 3414.

1.6 Design Conditions for Underground or Partly Underground Liquid Retaining Structures (Deleted)

1.7 Foundations (Deleted)

1.8 Design Requirements

The following are the design requirements for all reinforced or plain concrete structures:

a) All binding and leveling concrete shall be a minimum 100 mm thick in concrete grade M-15.

b) All structural reinforced concrete for water retaining structures shall be of a minimum M30 grade with a maximum 20 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural members. For non water retaining structures the concrete shall be of M 30 grade. The structures shall have to be designed as per IS : 3370 (Part I-IV).

c) The reinforced concrete for water retaining structures shall have a minimum cement content of 410 kg/m^3 with a maximum 20 mm size aggregate and 330 kg/m^3 with a maximum 40 mm size aggregate as per IS : 3370 (Part I-IV) or its latest edition.

d) The minimum reinforcement for water retaining structures in each direction should be 0.35% of cross section. The minimum clear cover to all reinforcement including stirrups and links shall be 50 mm for all water retaining structures.

e) All pipes & conduits laid below the structural plinth & road works shall be embedded in reinforced concrete of grade M15 of minimum thickness 150 mm.

f) Approved quality water proofing compound (chloride free) shall be added during concreting of all liquid containing structure in the proportions specified by manufacturer or 2 % by weight of cement whichever is higher.

The following minimum thickness shall be used for different reinforced concrete members, irrespective of design thickness:

(i) Walls for liquid retaining structures	:	As per IS Design Code
(ii) Roof slabs for liquid retaining structures (other than flat slabs)	:	As per IS Design Code
(iii) Bottom slabs for liquid retaining structures:		As per IS Design Code
(iv) Floor slabs including roof slabs, walkways, canopy slabs	:	As per IS Design Code
(v) Walls of cables / pipe trenches, underground pits etc.	:	As per IS Design Code
(vi) Column footings	:	As per IS Design Code
(vii) Parapets, chajja	:	As per IS Design Code
(viii) Precast trench cover	:	As per IS Design Code

- In Mix design, the water cement ratio should not exceed 0.45. The exposer condition to be considered severe as chlorinated water is to be stored.

- The inside surface of the container of ESR shall be provided 20 mm thick water proof cement mortar plaster in CM 1:3 whereas outside surface of ESR i.e. container, shaft, etc. shall be exposed finished.

1.9 Materials in General

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.

Except as may be otherwise specified for particular parts of the works the provision of clauses in "Materials and Workmanship" shall apply to materials and workmanship for any part of the works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

As soon as practicable after receiving the order to commence the Works, the Contractor shall inform ADD. CITY Engineer of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval of ADD. CITY Engineer which may be withheld until samples have been submitted and satisfactorily tested. The Contractor shall thereafter keep ADD. CITY Engineer informed of orders for and delivery dates of all materials.

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.

1.10 Samples and Tests of Materials

The Contractor shall submit samples of such materials as may be required by ADD. CITY Engineer and shall carry out the specified tests directed by ADD. CITY Engineer at the Site, at the supplier's premises or at a laboratory approved by ADD. CITY Engineer. ADD. CITY Engineer may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by ADD. CITY Engineer.

The Contractor shall give ADD. CITY Engineer seven 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 ADD. CITY Engineer. Representative of ADD. CITY Engineer shall attend the test at the appointed place within seven 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 ADD. CITY Engineer to carry out such a test on a mutually agreed date in his presence. The Contractor shall in any case submit to ADD. CITY Engineer's Representative within seven days of every test such number of certified copies (minimum six) of the test results as ADD. CITY Engineer may require.

Approval by ADD. CITY Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice any of ADD. CITY Engineer's powers under the Contract.

The provisions of this clause shall also apply fully to materials supplied under any nominated sub-contract.

1.11 Standards

Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current on the date of submission of the tender. All the governing items, materials, goods and equipments shall bear ISO-9001-2000 certification.

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

The specifications, standards and codes listed below are considered to be part of this Bid specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

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

a) Materials

IS : 269	Specification for 33 grade ordinary Portland cement
IS : 383	Specification for coarse and fine aggregates from

natural sources for concrete

IS : 428	Specification for distemper, oil emulsion, colour as required
IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (Parts 1 & 2)
IS : 455	Specification for Portland slag cement
IS : 458	Specification for precast concrete pipes(with and without reinforcement)
IS : 650	Specification for standard sand for testing of cement
IS : 651	Specification for salt glazed stoneware pipes and fittings
IS : 777	Specification for glazed earthenware tiles
IS : 808	Specification for dimensions for hot rolled steel beam, column, channel and angle sections
IS : 814	Specification for covered electrodes for manual metal arc welding of Carbon and Carbon Manganese steel
IS : 1003	Specification for timber paneled and glazed shutters(Parts 1 & 2)
IS : 1038	Specification for steel doors, windows and ventilators
IS : 1077	Specification for common burnt clay building bricks
IS : 1398	Specification for packing paper, water proof, bitumen laminated
IS : 1489	Specification for Portland pozzolana cement (Parts 1&2)
IS : 1566	Specification for hard drawn steel wire fabric for concrete reinforcement
IS :1580	Specification for bituminous compounds for water proofing and caulking purposes
IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS : 1852	Specification for rolling and cutting tolerances for hot rolled steel products
IS : 1948	Specification for aluminium doors, windows and ventilators
IS : 1977	Specification for structural steel (ordinary quality)
IS : 2062	Specification for steel for general structural purposes
IS : 2185	Specification for concrete masonry units (Parts 1 & 2)
IS : 2202	Specification for wooden flush door shutters (Parts 1 & 2)
IS : 2645	Specification for integral cement water proofing compounds
IS : 2750	Specification for steel scaffoldings
IS : 2835	Specification for flat transparent sheet glass
IS : 3384	Specification for bitumen primer for use in waterproofing and damp roofing
IS : 3502	Specification for steel chequerred plates
IS : 4021	Specification for timber door, window and ventilator frames
IS : 4350	Specification for concrete porous pipes for under drainage
IS : 4351	Specification for steel door frames
IS : 4990	Specification for plywood for concrete shuttering work
IS : 8112	Specification for 43 grade ordinary Portland cement
IS : 9862	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting
IS : 10262	Recommended guidelines for concrete mix design
IS : 12269	Specification for 53 grade ordinary Portland cement
IS : 12330	Specification for sulphate resisting Portland cement

IS : 12709 Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply

b) Tests

IS : 516 Method of test for strength of concrete
IS : 1182 Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS : 1199 Methods of sampling and analysis of concrete
IS : 2386 Methods of test for aggregates for concrete(Parts 1 to 8)
IS : 2720 Methods of test for soils (Parts 1 to 39)
IS : 3025 Methods for sampling and test (physical and chemical) for water and wastewater (Parts 1 to 44)
IS : 3495 Method of test for burnt clay building bricks(Parts 1 to 4)
IS : 3613 Acceptance tests for wire flux combination for submerged arc welding
IS : 4020 Methods of tests for wooden flush doors Type tests
IS : 4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)
IS : 5807 Method of test for clear finishes for wooden furniture (Parts 1 to 6)
IS : 7318 Approval tests for welders when welding procedure approval is not required (Parts 1 and 2)

c) Codes of Practice

IS :456 Code of practice for plain and reinforced concrete
IS : 783 Code of practice for laying of concrete pipes
IS : 800 Code of practice for general construction in steel
IS : 806 Code of practice for use of steel tubes in general building construction
IS : 816 Code of practice for use of metal arc welding for general construction in mild steel
IS : 817 Code of practice for training and testing of metal arc welders
IS : 875 Code of practice for design loads (other than earthquake) for building structures(Parts 1 to 5)
IS : 1081 Code of practice for fixing and glazing of metal (steel and aluminum) doors, windows and ventilators
IS : 1172 Code of practice for basic requirements for water supply, drainage and sanitation
IS : 1477 Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
IS : 1597 Code of practice for construction of stone masonry (Parts 1 &2)
IS : 1742 Code of practice for building drainage
IS : 1893 Criteria for earthquake resistant design of structures
IS : 2065 Code of practice for water supply in buildings
IS : 2212 Code of practice for brickwork
IS : 2338 Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
IS : 2394 Code of practice for application of lime plaster finish
IS : 2395 Code of practice for painting, concrete, masonry and plaster surfaces (Parts1 & 2)
IS : 2470 Code of practice for installation of septic tanks (Parts 1 & 2)
IS : 2502 Code of practice for bending and fixing of bars for concrete reinforcement
IS : 2571 Code of practice for laying in situ cement concrete flooring
IS : 2595 Code of practice for radiographic testing
IS : 2751 Recommended practice for welding of mild steel plain and deformed bars for reinforced construction

IS : 2974	Code of practice for design and construction of machine foundations (Parts 1 to 4)
IS : 3114	Code of practice for laying of Cast Iron pipes
IS : 3370	Code of practice for concrete structures for the storage of liquids (Parts 1 to 4)
IS : 3414	Code of practice for design and installation of joints in buildings
IS : 3558	Code of practice for use of immersion vibrators for consolidating concrete
IS : 3658	Code of practice for liquid penetrant flaw detection
IS : 3935	Code of practice for composite construction
IS : 4000	Code of practice for High strength bolts in steel structures
IS : 4014	Code of practice for steel tubular scaffolding (Parts 1 & 2)
IS : 4111	Code of practice for ancillary structures in sewerage system (Parts 1 to 4)
IS : 13920	Code of practice for laying of glazed stoneware pipes
IS: 4326	Code of practice for Earthquake Resistant Design and Construction of Buildings
IS : 4353	Recommendations for submerged arc welding of mild steel and low alloy steels
IS : 5329	Code of practice for sanitary pipe work above ground for buildings
IS : 5334	Code of practice for magnetic particle flaw detection of welds
IS : 5822	Code of practice for laying of welded steel pipes for water supply
IS : 7215	Tolerances for fabrication of steel structures
IS : 9595	Recommendations for metal arc welding of carbon and carbon manganese steels
IS : 10005	SI units and recommendations for the use of their multiples and of certain other units

d) Construction Safety

IS : 3696	Safety code for scaffolds and ladder (Parts 1 & 2)
IS : 3764	Safety code for Excavation work
IS : 7205	Safety code for erection of structural steel work

1.12 Orientation

The works shall be laid out within the confines of the Site in order to interface to the existing infrastructure of roadways and inlet and outlet pipe work Underground services requiring to be relocated in order to accommodate the proposed site layout shall, with the approval of ADD. CITY Engineer, be relocated by the Contractor.

1.13 Buildings and Structures (Deleted)

2.0 EARTHWORKS

2.1 Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

a)	IS 783 - 1985	-	Code of practice for laying of concrete pipes.
b)	IS 3764 - 1992	-	Excavation work - Code of Safety .
c)	IS 2720	-	Methods of test for soils:
	(Part-1) - 1983	-	Part 1 Preparation of dry soil samples for various tests.
	(Part-2) - 1986	-	Part 2 Determination of Water Content.
	(Part-4) - 1985	-	Part 4 Grain size analysis.
	(Part-5) - 1985	-	Part 5 Determination of liquid and plastic limit.
	(Part-7) - 1980	-	Part 7 Determination of water content - dry density relation using light compaction.
	(Part-9) - 1971	-	Part 9 Determination of dry density - moisture content by constant weight of soil method.
	(Part-14) – 1983	-	Part 14 Determination of density index (relative density) of cohesionless soils.
	(Part-22) – 1978	-	Part 22 Determination of organic matter.
	(Part-26) – 1987	-	Part 26 Determination of pH Value.
	(Part-27) – 1987	-	Part 27 Determination of total soluble sulphates.
	(Part-28) – 1974	-	Part 28 Determination of dry density of soils in place, by the sand replacement method.
	(Part-33) – 1971	-	Part 33 Determination of the density in place by the ring and water replacement method.

(Part-34) – 1972	-	Part 34 Determination of density of soil in place by rubber balloon method.
(Part-38) – 1976	-	Part 38 Compaction control test (Hilf Method).

2.2 General

The Contractor shall furnish all tools, plant, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Employer's Requirements.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and levelling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as approved by the Employer's Representative. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

Topsoil shall be stock piled separately for later re-use.

2.3 Clearing

The area to be excavated/filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Employer's Representative. Where earthfill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

2.4 Excavation

All excavation work shall be carried out by mechanical equipment unless, in the opinion of Employer's Representative, the work involved requires it to be carried out by manual methods.

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings provided by the Contractor or such other lines and grades as may be agreed with the Employer's Representative. Rough excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care.

Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Employer's Representative. The final excavation should be carried out just prior to laying the blinding course.

To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the drawings provided by the Contractor as agreed with the Employer's Representative. Should any excavation be taken below the specified elevations, the Contractor shall fill it up with concrete of the same class as in the foundation resting thereon, upto the

required elevation at no cost to the Employer.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Employer's Representative shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

2.5 Rock

2.5.1 General

'Rock' means a natural aggregate of mineral crystals which for its excavation would normally require the use of heavy pneumatic/hydraulic breaker and/or cutting equipment or explosives. the term shall exclude any material that can be removed by ordinary excavating machinery and which in any individual mass has a volume not exceeding $1m^3$ or $0.25m^3$ where the net width of excavation is less than 2 m. Ordinary excavating machinery means a hydraulic back hoe with rated output of 50 kW or less.

Before classification of material as rock the Contractor shall demonstrate to the satisfaction of the Employer's Representative his inability to excavate it without resort to heavy percussion tools complete with rock bits, hydraulic wedges or blasting. Excavation by the use of explosive will not normally be permitted except for pipeline.

Material shall not be classified as rock unless the Employer's Representative has agreed to such classification on the basis of such a demonstration before its excavation. Excavations where rock has been encountered and classified as such shall not be backfilled before examination of the excavated faces by the Employer's Representative to enable the extent of the rock excavation to be determined.

2.5.2 Excavation by the Use of Explosives (NOT PERMISSIBLE)

2.6 Stripping Loose Rock

All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Employer's Representative, to fall or otherwise endanger the workmen, equipment, or the work shall be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion which was originally sound and safe.

Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Employer's Representative, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed.

2.7 Fill, Backfilling and Site Grading

2.7.1 General

(a) All fill material shall be subject to the Employer's Representative's approval. If any material is rejected by Employer's Representative, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Employer's Representative after the fill work is completed.

No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Employer's Representative.

2.7.2 Material

To the extent available, selected surplus spoil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Employer's Representative. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Top soil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer's Representative. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

2.7.3 Filling in pits and trenches around foundations of structures, walls, etc.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Employer's Representative. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Employer's Representative is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Employer's Representative.

2.7.4 Plinth Filling

Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 15cm, watered and compacted with mechanical compaction machines. The Employer's Representative may, however, permit manual compaction by hand tampers where he is satisfied that mechanical compaction is not possible. The finished level of the filling shall be trimmed to the level/slope specified.

The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300mm. The Contractor will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used and the approval of the Employer's Representative obtained prior to commencing filling.
The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated, then filled and consolidated.

2.7.5 Sand Filling in Plinth and Other Places

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer's Representative has inspected and approved

the fill.

2.7.6 Filling in Trenches

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated taking due care so that no damage is caused to the pipes.
Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of the centre line of the pipes shall be done with selected earth by hand compaction, or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling upto a level 30 cm above the top of the pipe shall be done with fine materials such as earth, murum, etc. The filling up to the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centre line of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

2.8 General Site Grading

Site grading shall be carried out as indicated in the drawings and as approved by the Employer's Representative. Excavation shall be carried out as specified in the Employer's Requirements. Filling and compaction shall be carried out as specified under Clause 2.7 and elsewhere unless otherwise indicated below.

If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and levelled uniformly and compacted as indicated in Clause 2.7 before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.

The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the slip.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 ton roller. No less than twelve passes of the roller shall be accepted before

subsequent similar operations are taken up.

2.9 Fill Density

The compaction, under the plant road area and building plinths shall comply with minimum 95% compaction by Standard Proctor at moisture content differing not more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained. In other areas the soil should be backfilled and compacted suitably as specified by the Engineer.

2.10 Timber Shoring

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 cm x 4 cm sections or as approved by the Employer's Representative. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 metre spacings, strutted with ballies or as approved by the Employer's Representative. The length of the ballie struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by the Employer's Representative. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

Timber shoring may also be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer's Representative.
The withdrawal of the timber shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm x 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacings shall be subject to the approval of the Employer's Representative. In all other respects, the Employer's Requirements for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

2.11 Dewatering

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the

excavations/trenches required for further work. The method of pumping shall be approved by Employer's Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer's Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Employer's Representative. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a build up of water in the opinion of the Employer's Representative obstructs the progress of the work, leads to insanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Employer's Representative, to be large, a well point system-single stage or multistage, shall be adopted. The Contractor shall submit to the Employer's Representative, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

2.12 Rain Water Drainage

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Employer's Representative.

3. CONCRETE

3.0 Applicable Codes

3.0.1 Materials

1) IS.269 Specification for 33 grade ordinary portland cement.
2) IS.455 Specification for portland slag cement.
3) IS.1489 Specification for portland-pozzolana cement (Part 1&2).
4) IS:8112 Specification for 43 grade ordinary portland cement.
5) IS:12269 Specification for 53 grade ordinary portland cement.
6) IS:12330 Specification for sulphate resisting portland cement.
7) IS:383 Specification for coarse and fine aggregates from natural sources for concrete.
8) IS:432 Specification for mild steel and medium (tensile steel bars and hard-drawn steel) wires for concrete reinforcement. (Part 1 and 2)
9) IS:1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.
10) IS:1566 Specification for hard-drawn steel wire fabric for concrete reinforcement.
11) IS:9103 Specification for admixtures for concrete.
12) IS:2645 Specification for integral cement water- proofing compounds.
13) IS:4990 Specification for plywood for concrete shuttering work.

3.0.2 Material Testing

1) IS.4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)
2) IS:4032 Method chemical analysis of hydraulic cement.
3) IS:650 Specification for standard sand for testing of cement.
4) IS:2430 Methods for sampling of aggregates for concrete.
5) IS.2386 Methods of test for aggregates for concrete (Parts 1 to 8)
6) IS:3025 Methods of sampling and test (physical and chemical) for water used in industry.
7) IS:6925 Methods of test for determination of water soluble chlorides in concrete admixtures.

3.0.3 Material Storage

1) IS:4082 Recommendations on stacking and storing of construction materials at site.

3.1.4 Concrete Mix Design

1) IS:10262 Recommended guidelines for concrete mix design.

2) SP:23 (S&T) Handbook on Concrete Mixes

3.1.5 Concrete Testing

1) IS.1199 Method of sampling and analysis of concrete.
2) IS:516 Method of test for strength of concrete.
3) IS:9013 Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.

4) IS:8142 Method of test for determining setting time of concrete by penetration resistance.
5) IS:9284 Method of test for abrasion resistance of concrete.
6) IS:2770 Methods of testing bond in reinforced concrete.

3.1.6 Equipments

1) IS:1791 Specification for batch type concrete mixers.
2) IS:2438 Specification for roller pan mixer.
3) IS:4925 Specification for concrete batching and mixing plant.
4) IS:5892 Specification for concrete transit mixer and agitator.
5) IS:7242 Specification for concrete spreaders.
6) IS:2505 General Requirements for concrete vibrators: Immersion type.
7) IS:2506 General Requirements for screed board concrete vibrators.
8) IS:2514 Specification for concrete vibrating tables.
9) IS:3366 Specification for pan vibrators.
10) IS:4656 Specification for form vibrators for concrete.
11) IS:11993 Code of practice for use of screed board concrete vibrators.
12) IS:7251 Specification for concrete finishers.
13) IS:2722 Specification for portable swing weigh batchers for concrete (single and double bucket type).
14) IS:2750 Specification for steel scaffoldings.

3.1.7 Codes Of Practice

1) IS:456 Code of practice for plain and reinforced concrete.
2) IS:457 Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
3) IS:3370 Code of practice for concrete structures for storage of liquids (Parts 1 to 4)
4) IS:3935 Code of practice for composite construction.
5) IS:2204 Code of practice for construction of reinforced concrete shell roof.
6) IS:2210 Criteria for the design of reinforced concrete shell structures and folded plates.
7) IS:2502 Code of practice for bending and fixing of bars for concrete reinforcement.
8) IS:5525 Recommendation for detailing of reinforcement in reinforced concrete works.
9) IS:2751 Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
10) IS:9417 Specification for welding cold worked bars for reinforced concrete construction.
11) IS:3558 Code of practice for use of immersion vibrators for consolidating concrete.
12) IS:3414 Code of practice for design and installation of joints in buildings.
13) IS:4326 Code of practice for earthquake resistant design and construction of building.
14) IS:4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)
15) IS:2571 Code of practice for laying insitu cement concrete flooring.
16) IS:7861 Code of practice for extreme weather concreting : Part 1 Recommended practice for hot weather concreting.

3.1.8 Construction Safety

1) IS.3696 Safety code for scaffolds and ladders. (Parts 1 &
2) IS:7969 Safety code for handling and storage of building materials.
3) IS:8989 Safety code for erection of concrete framed structures.

3.2 General

The ADD. CITY Engineer shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment and the quality control system. Such an inspection shall be arranged and the ADD. CITY Engineer's approval obtained, prior to starting of concrete work. This shall, however, not relieve the Contractor of any of his responsibilities. All materials which do not conform to the Specifications shall be rejected.

Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall generally be used. Other materials may be used after approval of the ADD. CITY Engineer and after establishing their performance suitability based on previous data, experience or tests.

3.3 Materials

3.3.1 Cement

Unless otherwise called for by the ADD. CITY Engineer, cement shall be ordinary portland cement conforming to IS:269, IS:8112 or IS:12269.

Where Portland pozzolana or slag cements are used, it shall be ensured that consistency of quality is maintained, there will be no adverse interactions between the materials and the finish specified is not marred.

Only one type of cement shall be used in any one mix. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without approval from the ADD. CITY Engineer.

Cement which is not used within 90 days from its date of manufacture shall be tested at a laboratory approved by the ADD. CITY Engineer and until the results of such tests are found satisfactory, it shall not be used in any work.

3.3.2 Aggregates (General)

Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/ organic impurities/deleterious materials and conform to IS:383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

Aggregates shall be washed and screened before use where necessary or if directed by the ADD. CITY Engineer.

Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long term effects, on the concrete.

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.

The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

Plums 160 mm and above of a reasonable size may be used in mass concrete fill where directed. Plums shall not constitute more than 20% by volume of the concrete.

3.3.3 Water

Water used for both mixing and curing shall conform to IS:456. Potable waters are generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

3.3.4 Reinforcement

All reinforcement steel shall be tore steel conforming to relevant I.S. for water retaining structure with CRS - Fe-500 confirming to IS - 1786.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

3.3.5 Admixtures

Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS:9103 and integral water proofing admixtures to IS:2645.

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the ADD. CITY Engineer. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedments.

Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

3.3.6 SPECIFICATIONS (DELETED)

3.4 Samples and Tests

All materials used for the works shall be tested before use.

Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the ADD. CITY Engineer samples shall also be got tested by the Contractor in a laboratory approved by the ADD. CITY Engineer at no extra cost to Employer. ADD. CITY Engineer may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

Sampling and testing shall be as per IS:2386 under the supervision of the ADD. CITY Engineer.

Water to be used shall be tested to comply with requirements of IS:456.

The Contractor shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed, the admixture shall be got tested at an approved laboratory at no extra cost.

3.5 Storing of Materials

All materials shall be stored in a manner so as to prevent its deterioration and contamination which would preclude its use in the works. Requirements of IS:4082 shall be complied with.

The Contractor will have to make his own arrangements for the storage of adequate quantity of cement. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by the ADD. CITY Engineer. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt.

Each size of coarse and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

The Contractor shall make his own arrangements for storing water at site in tanks to prevent contamination.

The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/water. Each type and size shall be stacked separately.

3.6 Concrete

3.6.1 General

Concrete grade shall be as designated on drawings. In concrete grade M-250 etc. the number represents the specified characteristic compressive strength of 150 mm cube at 28 days, expressed in N/sq.mm as per IS:456. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete works of grade M5, M7.5 and M10 shall be NOMINAL MIX CONCRETE whereas all other grades, M15 and above, shall be DESIGN MIX CONCRETE.

3.6.2 Design Mix Concrete

(a) Mix Design & Testing

For Design Mix Concrete, the mix shall be designed according to IS:10262 and SP:23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS:456. The design mix shall be cohesive and does not segregate and should result in a dense and durable concrete and also capable of giving the finish as specified. For liquid retaining structures, the mix shall also result in water tight concrete. The Contractor shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

The minimum cement content for Design Mix Concrete shall be as per

Appendix-A of IS:456 or as given below, whichever is higher.

Grade of Concrete	Minimum Cement Content in Kg/Cu.m of Concrete
M15	300
M20	360
M25	380
M30	410

The minimum cement content stipulated above shall be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The CONTRACTOR's quoted rates for concrete shall provide for the above eventuality and nothing extra shall become payable to the CONTRACTOR in this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the CONTACTOR.

It shall be the Contractor's sole responsibility to carry out the mix designs at his own cost. He shall furnish to the ADD. CITY Engineer at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS:516 shall comply with the requirements of IS:456.

Grade of Concrete	Minimum Compressive Strength N/sq. mm at 7 days	Specified Characteristic Compressive Strength N/sq.mm at 28 days
M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the ADD. CITY Engineer is given below :

Structure/Member	Slump in millimeters	
	Maximum	Minimum
Reinforced foundation walls and footings		
Plain footings, caissons and substructure walls	75	25
Slabs, Beams and reinforced walls	100	25
Pump & miscellaneous Equipment Foundations	75	25
Building columns	100	25
Pavements	50	25
Heavy mass construction	50	25
	50	25

(b) Batching & Mixing of Concrete

Proportions of aggregates and cement, as decided by the concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by the ADD. CITY Engineer shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

Arrangement should be made by the Contractor to have the cubes tested in an approved laboratory or in field with prior consent of the ADD. CITY Engineer. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456, IS 3370.

3.6.3 Nominal Mix Concrete

(a) Mix Design & Testing

Mix design and preliminary tests are not necessary for Nominal Mix Concrete. However works tests shall be carried out as per IS:456. Proportions for Nominal Mix Concrete and w/c ratio may be adopted as per Table 3 of IS:456. However it will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

(b) Batching & Mixing of Concrete

Based on the adopted nominal mixes, aggregates shall be measured by volume. However cement shall be by weight only.

3.7 Formwork

Formwork shall be all inclusive and shall consist of but not be limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, falsework, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the ADD. CITY Engineer, the drawings and calculations for the design of the formwork shall be submitted to the ADD. CITY Engineer for approval.

Formwork shall be designed to fulfill the following requirements :

(a) Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.
(b) Made of suitable materials.
(c) Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.
(d) Capable of withstanding without deflection the worst combination of selfweight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.
(e) Capable of easy striking out without shock, disturbance or damage to the concrete.
(f) Soffit forms capable of imparting a camber if required.
(g) Soffit forms and supports capable of being left in position if required.
(h) Capable of being cleaned and/or coated if necessary immediately prior to casting the

concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of the ADD. CITY Engineer. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of the ADD. CITY Engineer. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left insitu shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

For liquid retaining structures, sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

Where specified all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

Forms for substructure may be omitted when, in the opinion of the ADD. CITY Engineer, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the ADD. CITY Engineer, than that required as per drawing to compensate for irregularities in excavation.

The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as approved by the ADD. CITY Engineer. The Contractor shall temporarily and securely fix items to be cast (embedments/ inserts) in a manner that will not hinder the striking

of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at Contractor's cost.

The striking time for formwork shall be determined based on the following requirements:

(a) Development of adequate concrete strength;

(b) Permissible deflection at time of striking form work;

(c) Curing procedure employed - its efficiency and effectiveness;

(d) Subsequent surface treatment to be done;

(e) Prevention of thermal cracking at re-entrant angles;

(f) Ambient temperatures; and

(g) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Under normal circumstances (generally where temperatures are above 20^{o}C) forms may be struck after expiry of the time period given in IS:456 unless approved otherwise by the ADD. CITY Engineer. For Portland Pozzolana/slag cement the stripping time shall be suitably modified as approved by the ADD. CITY Engineer. It is the Contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

3.8 Reinforcement Workmanship

Reinforcing bars supplied bent or in coils shall be straightened cold without damage. No bending shall be done when ambient temperature is below 5^{o}C. Local warming may be permitted if steel is kept below 10^{o} C.

All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by ADD. CITY Engineer.
Re-bending or straightening incorrectly bent bars shall not be done without the approval of the ADD. CITY Engineer.

Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by the ADD. CITY Engineer prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spalling of the concrete cover.

Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

Substitution of reinforcement, laps/splices not shown on drawing shall be subject to ADD. CITY Engineer's approval.

3.9 Tolerances

Tolerance for formwork and concrete dimensions shall be as per IS:456 unless specified otherwise.

Tolerances specified for horizontal or vertical building lines or footings shall not be construed to permit encroachment beyond the legal boundaries.
The formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings within the tolerances given below :

(a)	Deviation from specified dimensions of cross section of columns and beams	- 6 mm + 12 mm
(b)	Deviations from dimensions of footings (Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels	
1)	Dimension in plan	- 12 mm + 50 mm
2)	Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm
3)	Thickness	± 0.05 times the specified thickness

3.10 Preparation Prior to Concrete Placement

Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

All arrangements-formwork, equipment and proposed procedure, shall be approved by the ADD. CITY Engineer. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

3.11 Transporting, Placing and Compacting Concrete

Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms the Contractor shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.0m.

Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and shall never be allowed to fall freely through the water.

While placing concrete the Contractor shall proceed as specified below and also ensure the following:

(a) Continuously between construction joints and pre- determined abutments.

(b) Without disturbance to forms or reinforcement.
(c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.
(d) Without dropping in a manner that could cause segregation or shock.
(e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.
(f) Do not place if the workability is such that full compaction cannot be achieved.
(g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.
(h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.
(i) Ensure that there is no damage or displacement to sheet membranes.
(j) Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration shall be avoided.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by the ADD. CITY Engineer. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as approved by the ADD. CITY Engineer. Concrete shall be protected against damage until final acceptance.

3.12 Mass Concrete Works

Sequence of pouring for mass concrete works shall be as approved by the ADD. CITY Engineer. The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

3.13 Curing

Curing and protection shall start immediately after the compaction of the concrete to protect it from:

(a) Premature drying out, particularly by solar radiation and wind;
(b) leaching out by rain and flowing water;
(c) rapid cooling during the first few days after placing;
(d) high internal thermal gradients;
(e) low temperature or frost;

(f) vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

All concrete, unless approved otherwise by the ADD. CITY Engineer, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessain or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

Where a curing membrane is approved to be used by the ADD. CITY Engineer, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be approved by the ADD. CITY Engineer before use and shall be applied with spraying equipment capable of a smooth, even textured coat.

Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

3.14 Construction Joints and Keys

Construction joints will be as shown on the drawing or as approved by the ADD. CITY Engineer. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of the ADD. CITY Engineer.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as approved by the ADD. CITY Engineer.

Before resuming concreting on a surface which has hardened all laitance and loose stone shall be thoroughly removed by wire brushing/hacking and surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and horizontal layers.

When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this, a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

3.15 Foundation Bedding

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy areas shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as approved by the ADD. CITY Engineer. The surfaces of absorptive soils shall be moistened.

Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

3.16 Finishes

3.16.1 General

The formwork for concrete works shall be such as to give the finish as specified. The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the

requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

3.16.2 Surface Finish Type F1

The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper and effective application of waterproofing material specified for use.

3.16.3 Surface Finish Type F2

The appearance shall be that of a smooth dense, well- compacted concrete showing the slight marks of well fitted shuttering joints. The Contractor shall make good any blemishes.

3.16.4 Surface Finish Type F3

This finish shall give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discolouration, blemishes, arises, airholes etc. Only lined or coated plywood with very tight joints shall be used to achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by the Contractor.

3.16.5 Integral Cement Finish on Concrete Floor

In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the ADD. CITY Engineer shall be supplied and used as recommended by the manufacturer.

3.17 Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be inspected by the ADD. CITY Engineer who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Employer.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the ADD. CITY Engineer.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the ADD. CITY Engineer as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the ADD. CITY Engineer.

3.18 Vacuum Dewatering of Slabs

Where specified floor slabs, either grade or suspended, shall be finished by vacuum dewatering

including all operations such as poker vibration, surface vibration, vacuum processing, floating and trowelling as per equipment manufacturers recommendation. The equipment to be used shall be subject to the ADD. CITY Engineer's approval.

3.19 Hot Weather Requirements

Concreting during hot weather shall be carried out as per IS:7861 (Part I).

Adequate provisions shall be made to lower concrete temperatures which shall not exceed 40^{o} C at the time of placement of fresh concrete.

Where directed by the ADD. CITY Engineer, the Contractor shall spray non-wax based curing compound on unformed concrete surfaces at no extra costs.

Cold Weather Requirements

Concreting during cold weather shall be carried out as per Is : 7861 (Part II).

The ambient temperature during placement and upto final set shall not fall below 5 Deg.C. Approved antifreeze/accelerating additives shall be used where directed.

For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

3.20 Liquid Retaining Structures

The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.

The minimum level of surface finish for liquid retaining structures shall be Type F2. All such structures shall be hydro-tested.

The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

The Contractor shall also make all temporary arrangements that may have to be made to ensure stability of the structures during construction.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the ADD. CITY Engineer. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the ADD. CITY Engineer at no extra cost to the EMPLOYER.

3.21 Testing Concrete Structures for Leakage

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the ADD. CITY Engineer, as described below :

In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the watertightness of the structure. The ADD. CITY Engineer shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

Each compartment/segment of the structure shall be tested individually and then all together.

For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

3.22 Optional Tests

If the ADD. CITY Engineer feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the Specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the ADD. CITY Engineer, as per relevant IS Codes. Contractor shall have to pay for these tests.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the ADD. CITY Engineer reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. The ADD. CITY Engineer also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the Employer. Alternately ADD. CITY Engineer also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

3.23 Grouting

3.23.1 Standard Grout

Grout shall be provided as specified on the drawings.

The proportion of Standard Grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. Surfaces to be grouted shall be thoroughly roughened and cleaned. All structural steel elements to be grouted, shall be cleaned of oil, grease, dirt etc. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete shall be saturated with water and just before grouting, water in all pockets shall be removed. Grouting once started shall be done quickly and continuously. Variation in grout mixes and procedures shall be permitted if approved by the ADD. CITY Engineer. The grout proportions shall be limited as follows :

Use	Grout Thickness	Mix Proportions	W/C Ratio (max)
a) Fluid mix	Under 25mm	One part Portland Cement to one part sand	0.44
b) General	25mm and over	One part Portland	0.53

mix	but less than 50mm	Cement to 2 parts of sand	
c) Stiff mix	50mm and over	One part Portland Cement to 3 parts of sand	0.53

3.23.2 Non-Shrink Grout

Non –shrink grout where required shall be provided in strict accordance with the manufacturer's instructions / specifications on the drawings

General

Inspection

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of ADD. CITY Engineer. Materials rejected by ADD. CITY Engineer shall be expressly removed from site and shall be replaced by Contractor immediately.

Clean-Up

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

Acceptance Criteria

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

a) properties of constituent materials;
b) characteristic compressive strength;
c) specified mix proportions;
d) minimum cement content;
e) maximum free-water/cement ratio;
f) workability;
g) temperature of fresh concrete;
h) density of fully compacted concrete;
i) cover to embedded steel;
j) curing;
k) tolerances in dimensions;
l) tolerances in levels;
m) durability;
n) surface finishes;
o) special requirements such as;
    i) water tightness
    ii) resistance to aggressive chemicals
    iii) resistance to freezing and thawing
    iv) very high strength
    v) improved fire resistance
    vi) wear resistance
    vii) resistance to early thermal cracking

The ADD. CITY Engineer's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the Contractor.

For work not accepted, the ADD. CITY Engineer may review and decide whether

remedial measures are feasible so as to render the work acceptable. The ADD. CITY Engineer shall in that case direct the Contractor to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the Contractor. Nothing extra shall become payable to the Contractor by the Employer for executing the remedial measures.

3.24 Waterstops

3.24.1 Material

The material for the PVC water stops shall be a plastic compound with the basic resin of polyvinyl chloride and additional resins, plasticizers, inhibitors, which satisfies the performance characteristics specified below as per IS:12200. Testing shall be in accordance with IS:8543.

a)	Tensile strength	:	3.6 N/mm^2 minimum
b)	Ultimate elongation	:	300% minimum
c)	Tear resistance	:	4.9 N/mm^2 minimum
d)	Stiffness in flexure	:	2.46 N/mm^2 minimum
e)	Accelerated extraction		
	i) Tensile strength	:	10.50 N/mm^2 minimum
	ii) Ultimate elongation	:	250% minimum
(f)	Effect of Alkali	:	7 days
	i) Weight increase	:	0.10% maximum
	ii) Weight decrease	:	0.10% maximum
	iii) Hardness change	:	± 5 points
(g)	Effect of Alkali	:	28 days
	i) Weight increase	:	0.40% maximum
	ii) Weight decrease	:	0.30% maximum
	iii) Dimension change	:±1%	

PVC water stops shall be either of the bar type, serrated with centre bulb and end grips for use within the concrete elements or of the surface (kicker) type for external use.

PVC water stops shall be of approved manufacture. Samples and the test certificate shall be got approved by the ADD. CITY Engineer before procurement for incorporation in the works. Alternatively G.I. sheet of 18 gage (1.3mm) thick and 200mm wide can be used by the contractor as construction joints.

Alternatively contractors can use G.I sheet 200mm wide and 18 gauage thick as constructions joints

3.24.2 Workmanship

Waterstops shall be cleaned before placing them in position. Oil or grease shall be removed thoroughly using water and suitable detergents.

Waterstops shall be procured in long lengths as manufactured to avoid joints as far as possible. Standard L or T type of intersection pieces shall be procured for use depending on their requirement. Any non-standard junctions shall be made by cutting the pieces to profile for jointing. Lapping of waterstops shall not be permitted. All jointing shall be of fusion welded type as per manufacturer's instructions.

Waterstops shall be placed at the correct location/level and suitably supported at intervals with the reinforcement to ensure that it does not deviate from its intended position during concreting and vibrating. Care shall also be taken to ensure that no

honey-combing occurs because of the serrations/end grips, by placing concrete with smaller size aggregates in this region. Projecting portions of the waterstops embedded in concrete shall be thoroughly cleaned of all mortar/ concrete coating before resuming further concreting operations. The projecting waterstop shall also be suitably supported at intervals with the reinforcement to maintain its intended position during concreting so as to ensure that it does not bend leading to formation of pockets. In addition, smaller size aggregates shall be used for concreting in this region also.

3.25 Preformed Fillers and Joint Sealing Compound

3.25.1 Materials

Preformed filler for expansion/isolation joints shall be non-extruding and resilient type of bitumen impregnated fibres conforming to IS:1838 (Part I).

Bitumen coat to concrete/masonry surfaces for fixing the preformed bitumen filler strip shall conform to IS:702. Bitumen primer shall conform to IS:3384.

Sealing compound for filling the joints above the preformed bitumen filler shall conform to Grade 'A' as per IS:1834.

3.25.2 Workmanship

The thickness of the preformed bitumen filler shall be 25mm for expansion joints and 50mm for isolation joints around foundation supporting rotatory equipment's. Contractor shall procure the strips of the desired thickness and width in lengths as manufactured. Assembly of small pieces/thicknesses of strips to make up the specified size shall not be permitted.

The concrete/masonry surface shall be cleaned free from dust and any loose particles. When the surface is dry, one coat of industrial blown type bitumen of grade 85/25 conforming to IS:702 shall be applied hot by brushing at the rate of 1.20 kg/sq.m. When the bitumen is still hot the preformed bitumen filler shall be pressed and held in position till it completely adheres. The surface of the filler against which further concreting/masonry work is to be done shall similarly be applied with one coat of hot bitumen at the rate of 1.20 kg/sq.m.

Sealing compound shall be heated to a pouring consistency for enabling it to run molten in a uniform manner into the joint. Before pouring the sealing compound, the vertical faces of the concrete joint shall be applied hot with a coat of bitumen primer conforming to IS: 3384 in order to improve the adhesive quality of the sealing compound.

Expansion joints between beams/slabs shall be provided with 100mm wide x 4mm thick mild steel plate at the soffit of RCC beams/slabs to support and prevent the preformed joint filler from dislodging. This plate shall be welded to an edge angle of ISA 50 x 50 x 6mm provided at the bottom corner, adjacent to the expansion joint of one of the beams/slabs, by intermittent fillet welding. Steel surfaces shall be provided with 2 coats of red oxide zinc chrome primer and 3 coats of synthetic enamel paint finish.

CONCRETE POUR CARD						
POUR NO. : DRG. NO. : CONCRETE GRADE/QUANTITY/ : SLUMP :				DATE : STRUCTURE : MAX. AGGREGATE SIZE / START / COMPLETION TIME :		
SL. NO.	**ITEM**					**Remarks If Any**
1.	BEFORE CONCRETING	CENTRELINES CHECKED		YES/NO		
2.		FORMWORK AND STAGING CHECKED FOR ACCURACY, STRENGTH & FINISH		YES/NO		
3.		REINFORCEMENT CHECKED		YES/NO		
4.		COVER TO REINFORCEMENT CHECKED		YES/NO		
5.		VERIFIEDTEST CERTIFICATE FOR CEMENT/STEEL		YES / NO		
6.		ADEQUACY OF MATERIALS / EQUIPMENT FOR POUR		YES / NO		
7.		EMBEDDED PARTS (LOCATION & PLUMB) CHECKED	CIVIL	YES/NO		
			MECH.	YES/NO		
			ELEC.	YES/NO		
8.	SOFFIT(S) & POUR TOP(T) LEVELS CHECKED BEFORE (B) & AFTER (A) FORM REMOVAL (ONLY OF BEAMS OF OVER 10 M SPAN & IMPORTANT STRUCTURE LIKE T.G. ETC.)			S(B) T(B) S(A) T(A)		
9.	CONSTRUCTION JOINTS LOCATION & TIME (IF NOT AS PER DRAWING)					
10.	CEMENT CONSUMPTION IN KGS.					
11.	NUMBER OF CUBES AND IDENTIFICATION MARKS					
12.	TEST CUBE RESULTS (7 DAYS / 28 DAYS)					
13.	CONCRETE CONDITION ON FORM REMOVAL			V.GOOD/GOOD/FAIR/POOR		

Contractor's Representative **ADD. CITY Engineer's Representative**

NOTES: 1. EACH POUR TO HAVE SEPARATE CARDS, IN TRIPLICATE ONE EACH FOR CLIENT,CONTRACTOR & SITE OFFICE.

UNDER REMARKS INDICATE DEVIATIONS FROM DWGS. & SPECIFICATIONS, CONGESTION IN REINFORCEMENT IF ANY, UNUSUAL OCCURRENCES SUCH AS FAILURE OF EQUIPMENTS, SINKING OF SUPPORTS / PROPS. HEAVY RAINS AFFECTING CONCRETING, POOR COMPACTION, IMPROPER CURING, OTHER DEFICIENCIES, OBSERVATIONS ETC.

4.0 STRUCTURAL STEEL WORK

4.1 Applicable Codes and Specifications

The supply, fabrication, erection and painting of structural steel works shall comply with the following specifications, standards and codes unless otherwise specified herein. All standards, specifications and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

IS : 808	Dimensions for Hot Rolled Steel sections
IS : 814	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Maganese Steel
IS : 800	Code of Practice for General Construction in Steel
IS : 801	Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction
IS : 806	Code of Practice for Use of Steel Tubes in General Building Construction
IS : 7205	Safety Code for Erection of Structural Steel Work
IS : 7215	Tolerances for Fabrication of Steel Structures
IS : 4000	High Strength Bolts in Steel Structure – Code of Practice
AISC	Specifications for Design, Fabrication and Erection of Buildings
IS : 1161	Steel Tubes for structural purposes
IS:10 IS:102	Ready Mixed paint, Brushing, Red Lead, Non-setting, Priming.
IS:110	Ready Mixed paint, brushing, grey filler for enamels for use over primers.
IS:117	Ready Mixed paint, Brushing, Finishing, Exterior Semigloss for general purposes, to Indian Standard colours.
IS:158	Ready Mixed paint, Brushing, Bituminous, Black, Lead free, Acid, Alkali and heat resisting.
IS:159	Ready Mixed paint, Brushing, Acid resisting for protection against acid fumes, colour as required.
IS:341	Black Japan, Types A, B and C
IS:2339	Aluminium paint for general purposes, in Dual container
IS:2932	Specification for enamel, synthetic, exterior, type 1, (a) undercoating, (b) finishing
IS:2933	Specification for enamel, exterior, type 2, (a) undercoating, (b) finishing
IS:5905	Sprayed aluminium and zinc coatings on Iron and Steel.
IS:6005	Code of practice for phosphating of Iron and Steel.
IS:9862	Specification for ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water & chlorine resisting.
IS:13183	Aluminium paint, Heat resistant.
SIS-05-5900	(Swedish Standard)
IS : 1239	Mild steel tubes, tubulars and other Wrought steel fittings Part 1 – Mild steel tubes Part 2 – Mild steel tubulars and other wrought steel pipe fittings
IS : 1363 (Parts 1 to 3)	Hexagon Head Bolts, Screws and Nuts of product Grade C (Size range M5 to M64)

IS : 1367 (All parts)	Technical Supply Conditions for Threaded Fasteners
IS : 1852	Rolling and Cutting Tolerances for Hot Rolled Steel Products
IS : 1977	Structural Steel (Ordinary Quality)
IS : 2062	Steel for General Structural Purposes
IS : 2074	Ready Mixed Paint, Air drying, Red Oxide Zinc Chrome and Priming
IS : 3502	Steel Chequered Plate
IS : 3757	High Strength Structural Bolts
IS : 5369	General Requirements for Plain Washers and Lock Washers
IS : 5372	Taper Washers for Channels
IS : 5374	Taper Washer for 1 Beams
IS : 6610	Heavy Washers for Steel Structures
IS : 8500	Structural Steel-microalloyed (medium and high strength qualities)
IS : 803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded storage tanks
IS : 816	Code of Practice for use of Metal Arc Welding for General construction in Mild Steel
IS : 822	Code of Procedure for Inspection of Welds
IS : 1182	Recommended Practice for Radiographic examination of Fusion – Welded Butt Joints in Steel Plates
IS : 1200	Method of Measurement in Building Civil Works
IS : 1477	Code of Practice for Painting of (Parts 1&2) Ferrous Metals in Buildings
IS : 2595	Code of Practice for Radiographic Testing
IS : 3658	Code of Practice for Liquid Penetrant Flaw Detection
IS : 5334	Code of Practice for Magnetic Particle Flaw Detection of Welds
IS : 9595	Recommendations for Metal Arc Welding of Carbon and Carbon Manganese Steel

4.2 Steel Materials

Steel materials shall comply with the referred to in **Sub-Clause 4.1**.
All materials used shall be new, unused and free from defects.
Steel conforming to IS:1977 shall be used only for the following :

Fe410-0(St 42-0)	For structures not subjected to dynamic loading other than wind loads such as :Platform roofs, foot over bridges, building, factory sheds etc.
Fe500-0(St 42-0)	Grade steel shall not be used
	a) If welding is to be employed for fabrication b) If site is in severe earthquake zone c) If plastic theory of design is used

Drawings prepared by the VENDOR/CONTRACTOR

The VENDOR/CONTRACTOR shall prepare all fabrication and erection drawings for the entire work. All the drawings for the entire work shall be prepared in metric units. The drawings shall preferably be of one standard size and the details shown there in shall be clear and legible.

All fabrication drawings shall be submitted to the ADD. CITY Engineer for approval.

No fabrication drawings will be accepted for ADD. CITY Engineer's approval unless checked

and approved by the VENDOR/CONTRACTOR's qualified structural engineer and accompanied by an erection plan showing the location of all pieces detailed. The VENDOR/CONTRACTOR shall ensure that connections are detailed to obtain ease in erection of structures and in making field connections.

Fabrication shall be started by the VENDOR/CONTRACTOR only after ADD. CITY Engineer's approval of fabrication drawings. Approval by the ADD. CITY Engineer of any of the drawings shall not relieve the VENDOR/CONTRACTOR from the responsibility for correctness of engineering and design of connections, workmanship, fit of parts, details, material, errors or omissions or any and all work shown thereon. The ADD. CITY Engineer's approval shall constitute approval of the size of members, dimensions and general arrangement but shall not constitute approval of the connections between members and other details.

The drawings prepared by the VENDOR/CONTRACTOR and all subsequent revisions etc. shall be at the cost of the VENDOR/CONTRACTOR for which no separate payment will be made.

4.3 Fabrication

4.3.1 General

All workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined/ground smooth true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Unless otherwise approved by the ADD. CITY Engineer, reference may be made to relevant IS codes for providing standard fabrication tolerance. Material at the shops shall be kept clean and protected from weather.

4.3.2 Connections

Shop/field connections shall be as per approved fabrication drawings.
In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. In case of high strength friction grip bolts, hardened washers be used under the nuts or the bolt heads whichever are turned to tighten the bolts. The length of the bolt shall be such that atleast one thread of the bolt projects beyond the nut, except in case of high strength friction grip bolts where this projection shall be at least three times the pitch of the thread.

In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

All connections and splices shall be designed for full strength of members or loads. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

All bolts, nuts, washers, electrodes, screws etc., shall be supplied/brought to site 10% in excess of the requirement in each category and size. Rates shall cover the cost of this extra quantity.

All members likely to collect rain water shall have drain holes provided.

4.3.3 Straightening

All materials, shall be straight and, if necessary, before being worked shall be straightened and/or flattened by pressure and shall be free from twists. Heating or forging shall not be resorted to without the prior approval of the ADD. CITY Engineer in writing.

4.3.4 Rolling and Forming

Plates, channels, R.S.J. etc., for circular bins, bunkers, hoppers, gantry girders, etc., shall be accurately laid off and rolled or formed to required profile/shape as called for on the drawings. Adjacent sections shall be match-marked to facilitate accurate assembly, welding and erection in the field.

4.3.5 High Strength Friction Grip Bolting

Inspection after tightening of bolts shall be carried out as stipulated in the appropriate standards depending upon the method of tightening and the type of bolt used.

4.3.6 Welding

Welding procedure shall be submitted to the ADD. CITY Engineer for approval. Welding shall be entrusted to qualified and experienced welders who shall be tested periodically and graded as per IS 817, IS : 7310 (Part 1) and IS : 7318 (Part 1).

While fabricating plated beams and built up members, all shop splices in each component part shall be made before such component part is welded to other parts of the members. Wherever weld reinforcement interferes with proper fit-up between components to be assembled off welding, these welds shall be ground flush prior to assembly.

Approval of the welding procedure by the ADD. CITY Engineer shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

No welding shall be done when the surface of the members is wet nor during periods of high wind.

Each layer of a multiple layer weld except root and surfaces runs may be moderately penned with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from overpeening.

No welding shall be done on base metal at a temperature below –5 Deg.C. Base metal shall be preheated to the temperature as per relevant IS codes.

Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32 mm and above.

All welds shall be inspected for flaws by any of the methods described under **Sub-clause 4.6.3**. The choice of the method adopted shall be agreed with the ADD. CITY Engineer.

The correction of defective welds shall be carried out in a manner approved by the ADD. CITY Engineer without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means approved by the ADD. CITY Engineer shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. The cost of all such tests and operations incidental to correction shall be borne by the Contractor.

4.4 Tolerances

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS : 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerances for fabrication of structural steel shall be as per IS : 7215.

Cutting, punching, drilling, welding and fabrication tolerances shall be generally as per relevant IS codes.

4.5 End Milling

Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

4.6 Inspection

4.6.1 General

The Contractor shall give due notice to the ADD. CITY Engineer in advance of the works being made ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for the ADD. CITY Engineer's inspection. The fact that certain material has been accepted at the Contractor's shop shall not invalidate final rejection at site by the ADD. CITY Engineer if it fails to conform to the requirements of these specifications, to be in proper condition or has fabrication inaccuracies which prevent proper assembly nor shall it invalidate any claim which the Employer may make because of defective or unsatisfactory materials and/or workmanship.

No materials shall be painted or despatched to site without inspection and approval by the ADD. CITY Engineer unless such inspection is waived in writing by the ADD. CITY Engineer.

The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the ADD. CITY Engineer.

Inspection and tests on structural steel members shall be as set forth below.

4.6.2 Material Testing

If mill test reports are not available for any steel materials the same shall be tested by the Contractor to the Employer's Representative's satisfaction to demonstrate conformity with the relevant specification.

4.6.3 Tests on Welds

(a) Magnetic Particle Test

Where welds are examined by magnetic particle testing, such testing shall be carried out in accordance with relevant IS codes. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and retested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the permission of the ADD. CITY Engineer.

(b) Liquid Penetrant Inspection

In the case of welds examined by Liquid Penetrant Inspection, such tests shall be carried out in accordance with relevant IS Code. All defects shown shall be repaired and rechecked.

(c) Radiographic Inspection

All full strength butt welds shall be radiographed in accordance with the recommended practice for radiographic testing as per relevant IS code.

4.6.4 Dimensions, Workmanship & Cleanliness

Members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment, surface finish and painting are in accordance with the requirements shown in the Contractor's approved fabrication drawings.

4.6.5 Test Failure

In the event of failure of any member to satisfy inspection or test requirement, the Contractor shall notify the ADD. CITY Engineer. The Contractor must obtain permission from the ADD. CITY Engineer before any repair `is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the ADD. CITY Engineer.

The ADD. CITY Engineer has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the Employer, only in case of successful testing.

The Contractor shall maintain records of all inspection and testing which shall be made available to the ADD. CITY Engineer.

4.7 Shop Matching

For structures like bunkers, tanks, etc. shop assembly is essential. For other steel work, such as columns along with the tie beams/bracings may have to be shop assembled to ensure satisfactory fabrication, obtaining of adequate bearing areas etc., if so desired by the ADD. CITY Engineer. All these shop assemblies shall be carriedout by the Contractor.

4.8 Drilling Holes for other works

As a part of this Contract, holes in members required for installing equipment or steel furnished by other manufacturers or other contractors shall be drilled by the VENDOR/CONTRACTOR at no extra cost of the EMPLOYER. The information for such extra holes will be supplied by the EMPLOYER/ADD. CITY Engineer.

4.9 Marking of Members

After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible.

All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

Erection marks on like pieces shall be in identical locations. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

4.10 Errors

Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the ADD. CITY Engineer as defective workmanship. Where the ADD. CITY Engineer rejects such material or defective workmanship, the same shall be replaced by materials and workmanship conforming to the Specifications by the Contractor, at no cost to the Employer.

4.11 Painting of Steel Work

All fabricated steel material, except those galvanised shall receive protective paint coating as specified in specification, which is described below.

4.11.1 Materials

Red-oxide – zinc chrome primer shall conform to IS:2074.
Synthetic enamel paint shall conform to IS : 2932.
Aluminium paint shall conform to IS:2339.
All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the ADD. CITY Engineer for the brand of manufacture and the colour/shade. All the materials shall be brought to the site in sealed containers.

4.11.2 Workmanship

Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS:1477 (Part 2).

The type of paint, number of costs etc. shall be as specified in the respective items of work.

Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS:1477 (Part – I) and as indicated in the item of work.

It is essential to ensure that immediately after preparation of the surfaces, the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from `holidays'.

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied by brushing and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

Atleast 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the ADD. CITY Engineer.

4.12 Acceptance of Steel, its Handling & Storage

The Contractor shall carefully check the steel to be erected at the time of acceptance. Any fabrication defects observed should be brought to the notice of the ADD. CITY Engineer.

No dragging of steel shall be permitted. All steel shall be stored 300mm above ground on suitable packing to avoid damage. It shall be stored in the order required for erection, with erection marks visible. All storage areas shall be prepared and maintained by the Contractor. Steel shall not be stored in the vicinity of areas where excavation or grading will be done and, if so stored temporarily, this shall be removed by the Contractor well before such excavation and/or grading commences to a safe distance to avoid burial under debris.

Scratched or abraded steel shall be given a coat of primer in accordance with the Specifications for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suit able coating and also from damage.

4.13 Anchor Bolts & Foundations

The Contractor shall carefully check the location and layout of anchor bolts embedded in foundations constructed, to ensure that the structures can be properly erected as shown on the drawings. Any discrepancy in the anchor bolts/foundation shall be reported to the ADD. CITY Engineer.

Leveling of column bases to the required elevation may be done either by providing shims or three nuts on the upper threaded portion of the anchor bolt. All shim stock required for keeping the specified thickness of grout and in connection with erection of structures on foundations, crane brackets or at any other locations shall be of good M.S. plates and shall be supplied by the Contractor at his cost.

A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by the Contractor at no extra cost. here beams bear in pockets or on walls, bearing plates shall be set and levelled as part of the work. All grouting under column base plates or beam bearing plates will be carried out by the Contractor.

4.14 Assembly & connections

Field connections may be effected either by riveting, bolting, welding or by use of high strength friction grip bolts as shown on the design and erection drawings.

All field connection work shall be carried as per the drawings. All bolts, nuts, washers, rivets, electrodes required for field connections shall be supplied by the Contractor free of cost.
All assembling shall be carried on a level platform.

Drifts shall be used only for drawing the work to proper position and must not be used to such an extent as to damage the holes. Size of drifts larger than the normal diameter of hole shall not be used. Any damaged holes or burrs must be rectified to the satisfaction of the ADD. CITY Engineer.

Corrections of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets shall be considered as a part of erection. Any error in the shop, which prevents proper fit on a moderate amount of reaming and slight chipping or cutting, shall be immediately reported to the ADD. CITY Engineer.

4.15 Erection

All structural steel shall be erected as shown on the drawings prepared by the Contractor. Proper size steel cable slings, etc., shall be used for hoisting. Guys shall not be anchored to existing structures, foundations, etc., unless so permitted by the ADD. CITY Engineer in writing. Care shall be taken to see that ropes in use are always in good condition.
Steel columns in the basement, if any, are to be lowered and erected carefully with the help of a crane and/or derrick without damaging the basement walls or floor.

Structural steel frames shall be erected plumb and true. Frames shall be lifted at points such that they are not liable to buckle and deform. Trusses shall be lifted only at node points. In the case of trusses, roof girders, all of the purlins and wind bracing shall be placed simultaneously and the columns shall be erected truly plumb on screed bars over the pedestals. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety and stability.

Chequered plates shall be fixed to supporting members by tack welding or by countersunk bolts as shown/specified in relevant drawings and/or as approved by the ADD. CITY Engineer. The edges shall be made smooth and no burrs or jagged ends shall be left. While splicing, care should be taken so that there is continuity in pattern between the two portions. Care should also be taken to avoid distortion of the plate while welding. The erection of chequered plates shall include :

a) Welding of stiffening angles/vertical stiffening ribs
b) Cutting to size and making holes to required shape wherever necessary to allow service piping and/or cables to pass through
c) Splicing as shown in relevant drawings
d) Smoothening of edges
e) Fixing of chequered plates by tack welding or by countersunk bolts
f) Providing lifting hooks for ease of lifting.

As erection progresses, the work shall be securely bolted to take care of all dead load, wind, seismic and erection stresses.

No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by the ADD. CITY Engineer. No cutting, heating or enlarging of the holes shall be carried out without the prior written approval of the ADD. CITY Engineer.
Test certificates shall be furnished by the Contractor.

4.16 Inspection

The ADD. CITY Engineer shall have free access to all parts of the job during erection and all erection shall be subjected to his approval. In case of faulty erection, all dismantling and re-erection required will be at the Contractor's cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by the ADD. CITY Engineer.

4.17 Tolerances

4.17.1 General

Tolerances mentioned below shall be achieved after the entire structure or part thereof is in line, level and plumb.

4.17.2 Columns

Deviation of column axes at foundation top level with respect to true axes :

(a) In longitudinal direction ±5 mm

(b) In lateral direction ±5 mm

Deviation in the level of bearing surface of columns at foundation top with respect to true level ±5mm

Out of plumbness (verticality) of column axis from true vertical axis, as measured at column top:

(a) For columns upto and including 15 metres in height ±1/1000 of column height in mm or ±15 mm whichever is less

(b) For columns exceeding 15 metres in height ±1/1000 of column height in mm or ±20 mm whichever is less

Deviation in straightness in longitudinal and transverse planes of column at any point along the height	±1/1000 of column height in mm or ±10 mm whichever is less
Difference in erected position of adjacent pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance	±10mm
Deviation in any bearing or seating level with respect to true level	±5 mm
Deviation in differences in bearing level of a member on adjacent pair of columns both across and along the building	±10 mm

4.17.3 Trusses And Beams

Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord	±1/250 of height of truss in mm or ±15 mm whichever is less
Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss	±1/1500 of span of truss in mm or ±15 mm whichever is less
Lateral shift in location of truss from its true vertical position	±10 mm
Lateral shift in location of purlin true position	±5 mm
Deviation in difference of bearing levels of trusses or beams from	i) ±20 mm for trusses ii) For beams : the true difference Depth < 1800mm : ±6mm Depth > 1800mm : ±10mm
Deviation in sag in chords and diagonals	1/1500 of length in mm or of truss between node points 10mm whichever is smaller
Deviation in sweep of trusses, beams etc.	1/1000 of span in mm subject in the horizontal planeto a maximum of 10 mm

4.17.4 Crane Girders & Rails

Shift in the centre line of crane rail with ±5 mm

respect to centre line of web of crane girder	
Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point	±5 mm
Difference in alignment of crane rail in plan measured between any two points 2 metres apart along rail	±1 mm
Deviation in crane track with respect to Time gauge	
For track gauges upto and Including 15 metres	±5 mm
For track gauges more than 15 metres	± [5 + 0.25 (S-15)] where S in metres is true gauge
Deviation in the crane rail level at any point from true level	±1/1200 of the gauge distance or ±10mm whichever is less
Difference in the crane rail actual levels between any two points 2 metres apart along the rail length	±2 mm
Difference in levels between crane track Rails at	
(a) Supports of crane girders	±15 mm
(b) Mid span of crane girders	± 20 mm
Relative shift of crane rail surfaces at a joint in plane and elevation	2 mm subject to grinding of surfaces for smooth transition
Relative shift in the location of crane stops (end buffers) along the crane tracks with track gauge S in mm	1/1000 of track gauge S in mm subject to maximum of 20 mm

Painting

After steel has been erected, all bare and abraded spots, rivet heads, field welds, bolt heads and nuts shall be spot painted with primer. Before paint is applied, the surface shall be dry and free from dust, dirt, scale and grease. All surfaces inaccessible after erection shall receive two coats of the approved paint before erection.

4.18 Clean up of Work site

During erection, the Contractor shall at all times keep the working and storage areas used by him free from accumulation of waste materials or rubbish. Before completion of erection, he shall remove or dispose of in a satisfactory manner all temporary structures, waste and debris and leave the premises in a condition satisfactory to the ADD. CITY Engineer.

PARTICULAR TECHNICAL REQUIREMENTS FOR CIVIL WORKS

Table No.1
Design Requirement of RCC ESR

Sr No	Parameters	At Nyari Filter Plant
A)	**RCC ESR**	
1	Finished grade level of pumping station plot	As per existing GL
2	Outlet level of ESR Staging Height	As per existing back wash tank
3	Minimum water level in the ESR (m) RL	As per IS Design Code
4	Maximum water level in the ESR (m) RL	As per IS Design Code
5	Water depth in ESR	As per IS Design Code
6	Free board	As per IS Design Code
7	Capacity of ESR	Approx. 2.0 lacs lit.
8	Inlet, Outlet, Overflow and wash out of CI double flange pipes 1 Inlet .. .. 2 Outlet .. .. 3 Overflow .. .. .. 4 Washout	 200 mm dia. 200 mm dia. 200 mm dia. 150 mm dia.
9	Type of structure	In RCC container - M300 Supporting structure M300
10	access Arrangement	Spiral staircase in RCC M-300
11	Miscellaneous	Cowl type ventilator, Lightening Arrester, Doors, Windows, Water Level Indi-cator, CI Specials, Duct Foot Bend, Cripling Flange Pieces, Bell Mouth Pieces, Nut bolts, G I Railing heavy duty etc.
12	CI Manholes cover and frame.	As per Design

2.3.2. Construction Requirement:

The supporting structure shall be constructed in RCC M:300, container and top ring beam in RCC M300. Reinforcement shall be HYSD-CRS-Fe-500 Grade confirming to IS-1786. The structure shall have to be designed with seismic forces as per zone-IV. As during last earthquake in Rajkot on 26th January 2001, the magnitude of earthquake was very high.

6.4.4 Specification for Sluice valve:

Standards: IS 780 – for – 50 dia & 300 dia –class – II
IS 2906 – for- 350dia and above class –I

Ends : Flanged plate race and drilled in accordance with IS 538

Material of construction :

A)	Body	CL-IS 210 Gr FG 200
B)	Bolted bonnet	-do-
C)	Rising stem	High tensile brass/bronze
D)	Solid wedge disc	CI-210 Cr. FG 200
E)	Triangle body and seat ring	Leaded gunmetal or bronze
F)	Stem packing (renewable with valve open on stem)	Graphic indicated
G)	Hand wheel	Malleable lron ASTM A338
H)	Bonnet bolts	ASTM A 307 Gr. B
I)	Bonnet nuts	ASTM A 307 Gr. B
J)	Bonnet gasket	Compressed asbestos

6.5 Specification for Plumbing :

01	IS : 1172	Code of basic requirements for water supply, drainage and sanitation (Fourth revision)
40.	SP : 35(S &T) - 1987	Hand book on water supply and drainage.

All the plumbing for toilet block shall be followed above said standards with good sanitation items available in the market.

Water-Proofing

5.25.1 General

The work shall include waterproofing for the building roofs, terraces, toilets, floor slabs, walls, planters, chajjas, sills and any other areas and at any other locations and situations as directed by the Employers Representative.

The waterproofing treatment shall be carried out on top of lime concrete (brick bat coba) laid to slope on roof surfaces. The brick bat coba shall be covered as specified below.

The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the MUNICIPAL COMMISSIONER, RAJKOT.

5.25.2 Modified Bituminous Membrane

Modified Bituminous Membrane shall be “SUPER THERMOLAY” 4 mm thick weighing 4 Kg/sqm, manufactured using APP Polymer modified bitumen with a central core of non-woven polyester reinforcement (200 gms/sqm) and with top and bottom layers of thermo fusible film (top layer could also be sand finished) made by STP Limited in collaboration with Bitumat Company Limited. “PLYFLEX” of Bitumat Company Limited, Saudi Arabia supplied by STP limited shall also be acceptable or other equivalent specification.

5.25.3 Waterproofing of Roofs with Lime Concrete

(a) Materials

Broken brick coarse aggregates prepared from well/over burnt bricks shall be well graded having a maximum size of 25 mm and shall generally conform to IS : 3068.

Lime shall be class C lime (fat lime) or factory made hydrated lime conforming to IS : 712.

(b) Workmanship

Lime concrete shall be prepared by thoroughly mixing the brick aggregates inclusive of brick dust obtained during breaking with the slaked lime in the proportions of 2 ½ (two and a half) parts of brick aggregates to 1 part of slaked lime by volume. Water shall be added just adequate to obtain the desired workability for laying. Washing soap and alum shall be dissolved in the water to be used. the quantity of these materials required per cum of lime concrete shall be 12 kg of washing soap and 4 kg of alum. Brick aggregates shall be soaked thoroughly in water for a period of not less than six hours before use in the concrete mix. lime concrete shall be used in the works within 24 hours after mixing.

The roof surface over which the water-proof treatment is to be carried out shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated in IS : 3067.

The slope of the finished waterproofing treatment shall be not less than 1 in 60 for efficient drainage. This shall be achieved either wholly in the lime concrete layer.

The average thickness of lime concrete, slope and the finish on top of machine made burnt clay flat terracing tiles conforming to Is : 2690 (Part I) shall be as specified in the items of work to be prepared by the Contractor. Cement concrete flooring tiles in lieu of clay terracing tiles shall be provided if so specified in the items of work prepared by the Contractor, duly considering the traffic the terrace the terrace will be subjected to.

The minimum compacted thickness of lime concrete layer shall be 75 mm and average thickness shall not be less than 100 mm. in case, the thickness is more than 100 mm, it shall be laid in layers not exceeding 100 mm to 125 mm.

Laying of lime concrete shall be commenced form a corner of the roof and proceeded diagonally towards centre and other sides duly considering the slopes specified for effectively draining the rain-water towards the down take points.

Lime concrete fillet for a minimum height of 150 mm shall be provided all along the junction of the roof surface with the brick masonry wall / parapet / column projections. These shall then be finished on top with provision of clay terracing tiles/cement concrete tiles.

After the time concrete is laid it shall be initially rammed with a rammer weighing not more than 2 Kg and the finish brought to the required evenness and slope. Alternatively, bamboo strips may be used for the initial ramming. Further consolidation shall be done using wooden THAPIES with rounded edges. The beating will normally have to be carried on for at least seven days until the THAPI makes no impression on the surface and rebounds readily form it when struck. Special care shall be taken to properly compact the lime concrete at its junction with parapet walls or columns projections.

During compaction by hand-beating, the surface shall be sprinkled liberally with lime water (1 part of lime putty and 3 to 4 parts of water) and a small proportion of sugar solution for obtaining improved water-proofing quality of the lime concrete. On completion of beating, the mortar that comes on the top shall be smoothened with a trowel or float, if necessary, with the addition of sugar solution and lime putty. The sugars solution may be prepared in any one of the following ways as directed by the MUNICIPAL COMMISSIONER, RAJKOT.

a) By mixing about 3 kg of Jaggery and 1.5 Kg of BAEL fruit to 100 litres of water.
b) By mixing about 600 gm of KADUKAI (the dry nuts shall be broken to small pieces and allowed to soak in water), 200 gm of jaggery and 40 litres of water for 10 sq.m of work. This

solution shall be brewed for about 12 to 24 hours and the resulting liquor decanted and used for the work.

The lime concrete after compaction shall be cured for a minimum period of seven days or until it hardens by covering with a thin layer of stpure or resin which shall be kept wet continuously.

Machine made flat terracing tiles shall be of the size and thickness as specified. Tiles shall be soaked in water for at least one hour before laying. Bedding for the tiles shall be 12 mm thick in cement mortar 1 : 3. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and set to plane surface true to slope, using a trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angle to the direction of run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by at least 50 mm. the joints shall be completely filled and flush pointed with cement mortar 1 :2 mixed with water proofing compound as per manufacturer's instructions. Curing shall be carried out for a minimum period of seven days.

Finishing on top with cement concrete tiles or in-situ cement concrete floor topping shall be carried out in similar fashion as described for clay tiles in above paragraph. Tiles to be used shall be supplied after the first machine grinding of the surface.

5.24.4 Waterproofing of Roofs/Terraces etc.

(a) Water proofing of Horizontal Surfaces
The waterproofing shall be applied as follows :

A coat of Blown Bitumen 85/25 shall be applied at the rate of 1.45 Kg/sq. km

A roll of Modified Bituminous Membrane shall be unrolled over the primed surface and completely bonded to the substrate by pressing down evenly for the full width of the roll using a wooden roller. Torching shall be done, where recommended by the manufacturer and where directed by the MUNICIPAL COMMISSIONER, RAJKOT, as the unrolling progresses.

The side overlaps shall be minimum 100 mm whereas the end overlaps shall be minimum 200 mm; both shall be bonded and sealed by flame torching.

Care shall be taken that the membrane is lapped with the treatment along the vertical surface and roof gutter treatment for at least 500 mm.

The membrane shall be properly overlapped/terminated at all openings, rainwater down takes etc. to ensure that such junctions do not become sources of leakage.

Top of membrane finally shall be painted with anti glouse reflective paint.

(b) Waterproofing of Vertical Surfaces at Roof Level and Gutters

The water proofing shall be applied as described in (a) above.

Modified Bituminous membrane shall be unrolled and bonded to the substrate after applying a coat of bitumen and by pressing down evenly for the full width of the roll. Light torching shall be done to ensure complete bonding.

The membrane shall be overlapped with treatment for the horizontal surface by at least 500 mm.

The membrane shall be taken up to a pre-cut chase anchored and sealed.

Khurras and Rainwater Down Pipes

Down pipes shall be isolated from RCC work with 6 mm polyethylene foam fixed with adhesive (Araldite) and sealed with silicone sealant prior to laying membrane. A water proofing flashing composed of one layer of Hessian based self finished felt Type 3 Grade 1 and two layers of aluminum foil of 0.075 mm thickness shall be provided. This flashing shall be carried into the down take pipes for at least 150 mm and sealed with hot bitumen. The Contractor shall closely coordinate the work with the agency providing and fixing the rainwater down take pipes.

5.25.6 Testing

The treated area (flat and horizontal only) shall be tested by allowed water to stand on the treated areas to a depth of 150 mm for a minimum period of 72 hours.

The treated area (flat and horizontal) shall have continuous slope towards the rainwater outlets and no water shall pond any where on the surface.

Cement Plastering Work

5.26.1 Materials

The proportions of the cement mortar for plastering shall be 1 : 3 (One part of cement to three parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS : 1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the MUNICIPAL COMMISSIONER, RAJKOT. if so desired by the MUNICIPAL COMMISSIONER, RAJKOT sand shall be screened and washed to meet the specifications. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re-tempered by adding water as required to restore consistency but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

5.26.2 Workmanship

Preparation of surfaces and application of plaster finishes shall generally conform to the requirement's specified in IS : 1661 and Is : 2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels, pipes, conduits etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10 mm / 20 mm/ for brick/stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should n not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

Interior plain faced plaster – This plaster shall be laid in a single coat of 13 mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster

machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the DRAWING and as directed by the MUNICIPAL COMMISSIONER, RAJKOT.

Plain Faced Ceiling plaster – This plaster shall be applied in a single coat of 6 mm thickness. Application of mortar shall be as stipulated in above paragraph.

Exterior plain faced plaster – This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14 mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The rendering coat shall be cured for at least two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.

Interior plain faced plaster 20 mm thick if specified for uneven faces of brick walls or for random/coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in above paragraph exterior sand faced plaster this plaster shall be applied in 2 coats. The first coat shall be approximately 14 mm thick and the second coat shall be 6 mm thick. These coats shall be applied as stipulated above. However, only approved quality white sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

Wherever more than 20 mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the MUNICIPAL COMMISSIONER, RAJKOT duly satisfying the requirements of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for at least 7 days.

In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the MUNICIPAL COMMISSIONER, RAJKOT.

Where specified in the DRAWINGS to be prepared by the Contractor prepared by the Contractor, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the DRAWINGS to be prepared by the Contractor prepared by the Contractor.

Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturers instruction while preparing the cement mortar.

For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking

points like doors/window etc. ceiling plaster shall be completed first before commencing wall plastering.

Double scaffolding to be used shall be as specified in clause 7.2.2.

The finished plaster surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 mm length placed against the surface.

To overcome the possibility of development of cracks in the plastering work following measures shall be adopted.

a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.

b) Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement.

c) Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

Cement Pointing

5.26.3 Materials

The cement mortar for pointing shall be in the proportion of 1:3 [One part of cement to three parts of fine sand]. Sand shall conform to IS : 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by MUNICIPAL COMMISSIONER, RAJKOT and if so directed it shall be washed / screened to meet specification requirements.

5.27.2 Workmanship

Where pointing of joints in masonry work is specified, the joints shall be raked at least 15 mm / 20 mm deep in brick/stone masonry respectively as the work proceeds when the mortar is still green.

Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat , sunk or “V” as may be specified in the respective items of work. No false joints shall be allowed.

The work shall be kept moist for at least 7 days after the pointing is completed. Whenever colored pointing has to be done, the coloring pigment of the color require shall be added to cement in such proportions as recommended by the manufacturer and as approved by the MUNICIPAL COMMISSIONER, RAJKOT.

Water-Proofing Admixtures

Water-proofing admixture shall conform to the requirements of IS : 2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be

used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the MUNICIPAL COMMISSIONER, RAJKOT.

Painting of Concrete, Masonry & Plastered Surfaces

5.29.1 Materials

Oil bound distemper shall conform to IS : 428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

Cement paint shall conform to IS : 5410. The primer shall be a thinned coat of cement paint.

Lead free acid, alkali and chlorine resisting paint shall conform to IS : 9862.

Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/tint as approved by the MUNICIPAL COMMISSIONER, RAJKOT.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the MUNICIPAL COMMISSIONER, RAJKOT for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

5.29.2 Workmanship

Contractor shall obtain the approval of the MUNICIPAL COMMISSIONER, RAJKOT regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.

Painting of new surfaces shall be deferred as much as possible to allow for through drying of the sub-strata.

The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS : 2395.

Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

5.29.3 White Wash

The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

5.29.4 Color Wash

Color wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs on peeling/powdery and come off readily on the hand when rubbed.

5.29.5 Cement Paint

The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 Kg/sq.m . A minimum of 2 coats of the same color shall be applied. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

5.29.6 Oil bound Distemper

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application for the second coat. Board, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

2.29.7 Acid, Alkali Resisting Paint

A minimum of 2 coats of acid/alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer cost shall be as per manufacture's instructions.

Plastic Emulsion Paint

The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of emulsion paint. The quantity of thinner shall be as per manufacturer's instructions. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally take about 2 to 3 hours. A minimum of 2 finishing coats of the same color shall be applied unless otherwise specified. Paint may also be applied using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

5.29.9 Acrylic Emulsion Paint
Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

Painting & Polishing of Wood Work

5.30.1 Materials
Wood primer shall conform to IS : 3536.
Filler shall conform to IS : 110.
Varnish shall conform to IS : 337.

French polish shall conform to IS : 348.

Synthetic enamel paint shall conform to IS : 2932.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the MUNICIPAL COMMISSIONER, RAJKOT for the brand of manufacture and the color/shade. All materials shall be brought to the site of works in sealed containers.

5.30.2 Workmanship

The type of finish to be provided for woodwork of either painting or polishing, the number of coats, etc. shall be specified in the respective items of work to be prepared by the Contractor.

Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

Painting shall be either by brushing or spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirements of IS : 2338 (Part I).

All the wood surfaces to be painted shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it across the grains and dusted off. Wood primer coat shall then be applied uniformly by brushing. The number of primer coats shall be as specified in the item of work to be prepared by the Contractor. Any slight irregularities of the surface shall then be made up by applying an optimum coat of filler conforming to IS : 110 and rubbed down with an abrasive paper for obtaining a smooth surface for the undercoat of synthetic enamel paint conforming to IS : 2932. Paint shall be applied by brushing evenly and smoothly by means of crossing and laying off in the direction of the grain of wood. After drying, the coat shall be carefully rubbed down using very fine grade of sand paper and wiped clean before the next coat is applied. At least 24 hours shall elapse between the application of successive coats. Each coat shall very slightly in shade and this shall be got approved by the MUNICIPAL COMMISSIONER, RAJKOT. The number of coats of paint to be applied shall be as specified in the item of work to be prepared by the Contractor.

All the wood surfaces to be provided with clear finishes shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it in the direction of the grain s and dusted off. Any slight irregularities of the surface shall be made up by applying an optimum coat of transparent liquid filler and rubbed down with an abrasive paper for obtaining a smooth surface. All dust and dirt shall be thoroughly removed. Over this prepared surface, varnish conforming to IS : 337 shall be applied by brushing. Varnish should not be retouched once it has begun to set. Staining if required shall be provided as directed by the MUNICIPAL COMMISSIONER, RAJKOT. when two coats of varnish is specified, the first coat should be a hard-drying undercoat of flatting varnish which shall be allowed to dry hard before applying the finishing coat. The number of coats to be applied shall be as specified. For works where clear finish of French polish is specified the prepared surfaces of wood shall be applied with the polish and rubbed hard on the surface in a series of overlapping circles to give an even finish over the entire area. The surface shall be allowed to dry before applying the next coat. Finishing shall be carried out using a fresh clean cloth over the pad, slight dampening with methylated sprit and rubbing lightly and quickly in circular motions. The finished surface shall have a uniform texture and high gloss. The number of coats to be applied shall be as specified.

Painting of Steel Work

Materials
Red-oxide – zinc chrome primer shall conform to IS : 2074.
Synthetic enamel paint shall conform to IS : 2932.

Aluminum paint shall conform to IS : 2339.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the MUNICIPAL COMMISSIONER, RAJKOT for the brand of manufacture and the color/shade. All the materials shall be brought to the site in sealed containers.

5.31.21 Workmanship

Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose s recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS : 1477 (Part 2).

The type of paint, number of costs etc. shall be specified in the respective items of work.

Primer and finish pant shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.

All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The method to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS : 1477 (Part – I) and as indicated in the item of work.

It is essential to ensure that immediately after preparation of the surfaces, the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from "holidays".

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface become dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied by brushing and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

At least 24 hours shall elapse between the application of successive coats. Each coat shall very slightly in shade and this shall be got approved by the MUNICIPAL COMMISSIONER, RAJKOT.]

Excavation in trenches from 0.0 mtr to 1.50 mtr depth including lifting and laying in 90 mtr lead area as instructed etc. complete:
For Soft soil, Murrum or Sand
For Hard Murrum
For Soft Rock
For Hard Rock

1.0. General:

1.1. Any soil which generally yields to the application of pickaxes and shovels, phawaras, rakes or any such ordinary excavating implement or organic soil, gravel, silt, sand turfloam, clay, peat etc., fall under this category.

2.0 Clearing the site :

2.1 The site on which the structure is to be built shall be cleared and all obstructions, loose stone, materials and rubbish of all kind, bush, wood and trees shall be removed as directed: The materials so obtained shall be property of the Government and be conveyed and stacked as directed within 50 M. lead. The roots of the trees coming in the sides shall be cut and coated with a hot asphalt.

2.2 The rate of site clearance is deemed to be included in the rate of earth work for which no extra will be paid.

3.0 Setting out: After clearing the site, the center lines will be given by the Engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the tractor shall assume fu; responsibility for alignment elevation and dimension of each and all parts of the work. Contractor shall supply labourers, materials, etc. required for setting out the reference marks and bench marks and shall maintain them a long as required and directed.

4.0 Excavation : The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and shutting or providing necessary slopes to a safe angle, at his own cost. The payment for sue precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be evelled both longitudinally and transfersely as directed by removing and watering as required. No earth filling will be allowed for bringing it to level, if by mistake or any; other reason excavation is made deeper or wider that shwon on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation upto
3.0 m. depth shall be measured under this item.

Blasting:

1.0. Workmanship

1.1. The relevant specification shall be followed except that the excavation for foundation work shall be carried out in hard rock.

1.2. Excavation shall be done by blasting to the dimensions shown in the drawings or as directed. The blasting shall be carried out only with
written permission of the Engineer-in-charge. All the laws, regulations etc,-
pertaining to the precautions, acquisition, transport, landing and use of explosive shall be rigidly followed. The Magazine for the storage for the explosive shall be built to the design and specifications of explosive authority and located at the approved site No unauthorised persons shall be admitted into the magazine and when not in use it shall be kept securely locked No matches or inflammable materials shall be allowed in Magazine. The Magazine shall have an-effective lightning conductor. The rules of explosive
1940 revised from time 10 time shall be followed strictly for obtaining starting, handling, undertaking blasting work.

1.3. The contractor shall be responsible for damage to property, workmen public due to any accident due to use of explosives and operations

1.4. Precautions

1.4.1. The blasting operation shall remain in charge of competent and experienced supervisor and workmen who are thoroughly acquainted
with the detail of handling explosive and blasting operations. The
blasting shall be carried our during fixed hours of the day, preferably during the mid-day lunch hours or at the close of the work as ordered in writing by the Engineer-m-charge. The hours of blasting shall be notified in advance to the people in

the vicinity. All the charges shall be prepared by the man in charge only.

1.4.2. Red danger flags shall be displayed prominently in all direction during the blasting operations.

1.4.3. People except those who actually light the fuse shall be prohibited from entering into this area. The flags shall be stationed at 200 m.
from the firing-site in all directions and all persons including workmen shall be excluded form the flagged area at least 1.0 minutes before the
firing warning whistle being sounded for this purpose

1.4.4. During excavation in rock by blasting, the lowest 15 cm. of stratus shall be blasted with light charge so as not to shatter or weaken the underlying rock on which the foundation will be actually laid If excavation in rock in done to large widths and length than those shown on the drawings or as directed, no payment shall be made for such over break. If excavation is done to depths greater than shown on the drawings or directed, excess depth shall be made up with foundation grade concrete as directed at the contractor's cost.

1.4.5. The charged hole shall be drilled to the required depth and in suitable places when blasting is done with powder, the fuse cut to the required length shall be inserted in the holes and the powder dropped in. The powder shall be gently tamped with copper rod with rounded ends. Theexplosive powder shall then be covered with trapping materials which shall be tamped lightly out firmly. When blasting is done with dynamite and other high explosive, dynamite cartridges shall be prepared by inserting the square cut ends of fuse into the detonator, and finished with dippers at the open ends The detonator should be gently pushed into the detonator and finished with dippers at the opened ends. The detonator should be gently pushed explosive. Bore holes shall be of such size that the cartridges can be easily passed down. The holes shall be cleared of all debris and explosive inserted The space for about 20 cams, above the charge shall then be gently filled with dry clay pressed home and rest of tamping is with firmed any convenient materials gently packed with a wooden cover.

1.4.6. At a time not more than 10 such charge shall be prepared and fired.
The man in charge shall blow a whistle in a recognised manner for cautioning the people. All the people shall then be required to move to number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go to the work site.

1.4.7. The contractor shall be fully responsible to strictly follow the prevailing rules and procedures regarding blasting procedures

1.5. Misfire

1.5.1. In case of a misfire the following procedure shall be observed:

1.5.2. Sufficient time shall be allowed to account for the delayed blast.
The man in charge shall inspect all the charges and determine the missed charge.

1.5.3. If it is the blasting powder charge it shall be completely flooded with water. A new hole shall be drilled at, about 45 cm. from the old
and fired. This should blast the old charge Should^ it not blast the old
charge, the procedure shall be repeated till the old charge is blasted.

1.5.4. In case of charge of gelatins, dynamite etc, the man in charge shall gently remove the tamping and the primer with detonator and primer shall then be used to blast the charge. Alternatively the hole may be cleared of one foot oftamping and the direction then ascertained by placing a stick in the hole Another hole may then be drilled 15 cm away and parallel to it. The man in charge shall report to the office all cased of misfire and cause of the same and what steps ware taken in connection therewith.

1.5.6. If a misfire has been found to he due to defective or dynamite, the whole quantity

in the box from which defective article was taken must be sent to authority as directed for inspection to ascertain whether all the remaining materials in the box are also defective or not.

1.6. Accidents:

1.6.1. The contractor shall be solely responsible for any accident during the entire procedure of handling explosive and blasting and shall pay necessary compensation to persons affected or damage to lands or property etc,due to the blasting, without extra claims on the department.

1.7. Account:

1.7.1. A careful and day to day account of explosives shall be maintained by the contractor in an approved manner and shall be open to inspection of the Engineer-in charge Surprise visits may also be paid by the Engineer-in-charge to the storage and in case of any unaccountable shortage or unsatisfactory accounting, the contractor shall be liable to be penalised by forfeiture of part or whole of his Security Deposit or by cancellation of tender in which case he shall not be entitled for any compensation.

1.8. Disposal of Excavated Materials:

1.8.1 No materials excavated from foundation trenches of whatever kind they may be, are to be placed even temporarily nearer than 1.5 m. or distance prescribed by the Engineer from the outer edge of excavation. All materials excavated shall remain the property of Government. Rate for excavation includes sorting out of useful materials and stacking them separately as directed within the specific lead. Materials suitable and useful for backfilling or other use shall be stacked in convenient places but not in such a way as to obstruct free movement of men, animals and vehicles or encroach upon the area required for constructional purpose. The site shall be left clean of all debris on completion.

1.8.2. Disposal of excavated materials is subject to the following: Unsuitable materials obtained from clearing site and excavation shall be disposed off within a lead of 50 meters as directed. Useful materials obtained from clearing site and excavation shall be stacked within a lead of 50 M beyond the building areas is directed. Materials suitable for back- filling shall be stacked at convenient places within a lead of 50 M. from the structure for reuse. Useful stones from rock excavation shall be stacked neatly. within a lead of 50 M. and will be allowed to be used by the contractor on payment at rates laid down n the contract or if not so laid down, at scheduled rates of the Division or at a mutually agreed rates if there are no such rates in the schedule of rates.

1.8.3.If surplus materials are required to be conveyed beyond 50 M, conveyance will be paid for under a separate item

2.0. Mode of measurements & Payment

2.1. The work shall be measured for the work limited to the dimensions shown on drawings or directed Excavation to dimension in excess of the above will not be measured or paid for and if so ordered by the Engineer the contractor shall have to fill up the excess depth with cement concrete specified for foundation without extra payment.

2.2. Driving of sounding bars, drill holes to explore the nature of substratum up to a total length of meter distributed in 2 or 3 places in each foundation if necessary, will be considered incidental work and will not be paid for separately.

2.3. Removal of slips and blows in the foundation trenches will not be measured or paid for.

2.4. If it is necessary in the opinion of the Engineer-in-charge to carry foundation below the levels shown on the plans, the excavations for the 1.5 M of addition depth will be included in the quantity for the particular classification and will be paid for as extra at rate to be decided under the general conditions of

contract unless, the contractor is willing to accept payment as tendered rates.

2.5. The rate shad be for a unit of one cubic meter

Supplying of 219.10 mm OD having Thickness 6.3 mm, Submerged Arc welded M.S. Pipe outside coated with best quality bituminous paint having beveled ends plate or coil Confirming to IS 3589 :2001 or its latest revision/ ammendment. With Excise Duty.

Lowering, laying & Jointing of 219.10 mmØ MS Pipe (Bare Pipes) in position to correct line & level on prepared formation or prepared bedding in trenches. (This rate includes Generator,Welding Machine & Hydro-Crane rent)- 4 mm to 7 mm thick (excluding excavation & sand bedding) etc comp.

SPECIFICATION FOR M.S. PIPELINE

SCOPE
APPLICABLE CODES AND SPECIFICATIONS
MATERIALS
INSPECTION
MANUFACTURE OF MS PIPES TRANSPORTING
OF PIPES, SPECIALS ETC.
PROCEDURE FOR RECEIVING STEEL PIPES
LAYING OF PIPELINE
CEMENT MORTAR LINING FOR INTERNAL SURFACE OF PIPELINE **(This work of item is not in the scope of work)**
CLEANING AND PAINTING OF PIPES AND SPECIALS **(Outside bituminous and inside epoxy painting confirming to drinking water standards and as per ANNEX-B of IS 3589-2001 is in the scope)**
GUNITING TO UNDERGROUND PIPELINE **(outer surface 25mm Thick gunniting is in the scope)**
CLEANING, DISNFECTIONING AND COMMISSIONING OF THE PIPELINE.

PIPELINE, PIPE WORK AND SPECIALS.

1.0 SCOPE

This specification covers the general requirements for supply, fabrication, outside 406 micron tk epoxy lining and inside bituminous paint with delivery at site laying, jointing, testing and commissioning of all Submerged Arc welded M. S. pipeline **5.00 mm thickness** of plate confirming to IS 3589-2001, above/below ground, including Civil works required for the same as mentioned in Schedule B of tender document.

2.0 APPLICABLE CODES & SPECIFICATIONS

The following specifications, standards and codes are made a part of the specification. All standards, tentative specifications, specification's, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

1.	IS : 2062	Steel for general structural purposes.
2.	IS : 808	Dimensions for hot rolled steel beam, column, channel and angle sections.

3.	IS : 814	Covered Electrodes for manual Metal Are Welding of carbon and C-Mn steel.
4.	BS EN 499	Welding Consumables. Covered Electrodes for Manual Metal Are Welding of Non Alloy and Fine Grain Steel. Classification
5.	AWS : A-5.1	Specification for Mild Steel Covered Are Welding Electrodes.
6.	IS : 3613	Acceptance Tests for wire Flux combinations for Submerged – Arc Welding.
7.	AWS : A-5.17	Specification for Bare Mild Steel Electrodes and Fluxes for Submerged are Welding IS : 1367 – technical Supply conditions for threaded Fasteners
8.	IS : 1367	Technical Supply Conditions for Threaded Fasteners (Parts 1 to 3)
9.	IS : 2016	Plain Washers.
10.	IS : 2074	Ready Mixed Paint, Red Oxide Zinc Chrome and Priming.
11.	IS : 102	Ready Mixed Paint, Brushing, Red Lead, non setting, Priming
12.	IS : 1786	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement
13.	IS : 432	Specification for Mild Steel & (Part – 1) Medium Tensile bars and hard dpuren steel wire for concrete reinforcement : mild Steel & Medium tensile steel bars.
14.	IS : 432	Specification for mild steel & (Part-II) Medium Tensile steel bars and hard dpuren steel wires for concrete reinforcement : Hard dpuren steel wire
15.	IS : 269	Specification for Ordinary and Low heat portland cement
16.	IS : 8041	Specification for Rapid hardening Portland Cement
17.	IS : 383	Specification for coarse and fine aggregate from natural source for concrete
18.	IS : 12330	Specification for Sulphate Resisting Portland Cement
19.	IS : 456	Code of practice for plain and reinforced concrete
20.	IS : 800	Code of practice for General construction in Steel.
21.	IS : 816	Code of practice for use of Metal are Welding for General Construction in mild Steel.
22.	IS : 4353	Submerged are Welding of Mild steel & Low Alloy Steel Recommendations.
23.	IS : 817	Code of practice for Training and Testing of Metal Are Welders.
24.	IS : 1182	Recommended practice for Radiographic examination of Fusion Welded Butt Joints in steel plants
25.	IS : 2595	Code of practice for Radiographic Testing.
26.	IS : 3658	Code of practice for liquid Penetrant Flaw Detection
27.	IS : 5334	Code of practice for Magnetic Particle Flaw Detection of welds.
28.	ASTM E 94	Guide for Radiographic Testing

29.	ASTM E 709	Guide for Magnetic Particle Examination.
30.	ASTM E 165	Test Method for Liquid Penetrant Examination.
31.	IS : 3600	Method of Testing Fusion Welded Joints and weld metal in steel (Parts 1 to 9)
32.	IS : 4853	Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints in Steel Pipes.
33.	IS : 3589	Seamless or Electrically welded steel pipes for water Gas and Sewage (168.3 to 2032 Outside Diameter)
34.	IS : 6631	Steel pipes for Hydraulic Purposes
35.	IS : 7343	Code of practice for ultrasonic testing of Ferrous Welded Pipes and Tubular Products
36.	IS : 2598	Safety Code for Industrial Radiographic Practice
37.	IS : 5822	Code of Practice for Laying of Electrically Welded steel pipes for water supply
38.	IS : 1608	Mechanical testing of Metals.
39.	IS : 9595	Metal are Welding of Carbon and Carbon Manganese Steels.
40.	IS : 2825	Code of unfired Pressure Vessels

3.0 MATERIALS

3.2.1 3.1 Steel Plates – The steel plates for pipes, fittings, specials and stiffeners shall be of mild steel conforming to IS:2062, Grade Fe-410 with 5.00 mm thickness of plate.

3.2.2 Welding Consumables – such as electrodes, filler rods and wires shall conform to IS : 814, IS 3613, IS : 6419 and IS : 7280.

3.3 Cement The cement used shall be of one of the following : (a) Ordinary Portland Cement conforming to IS : 269
(b) Sulphate Resisting Portland Cement Conforming to IS : 12330.

3.4 Aggregate – The Aggregates shall conform to IS : 383.

3.5 Water – The water used in preparation of concrete mix shall conform to the requirements of mixing water given in IS : 456.

3.6 Steel for Reinforcement shall conform to IS : 1785 or IS : 432 (Parts I and II)

Before fabrication of pipes and specials/fittings is commenced, the copies of the mill sheets and the manufacturer's test certificates for plates and other materials required for the fabrication, shall be submitted by the Contractor to the Engineer for his approval.

West requested by the Engineer, the Contractor shall supply free of charge to the Employer, for testing suitable samples of the materials to be used/used in the Works. The cost of such tests shall be borne by the Contractor and shall be included in his item rates.

4.0 INSPECTION

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

4.2 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.

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

4.4 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.

4.5 4.5 The Contractor shall furnish to the Employer's inspector 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.

4.6 The Contractor shall supply free of cost and required specimen of materials for testing by the Owner at any time during the progress of work and shall bear the cost of all such tests or retests to the satisfaction of Engineer.

4.7 The Contractor shall provide 2 (two) sets of accurate "Go" and "No Go" ring gauges to measure the diameter of pipes specials and fitting for the use of the Engineer at no extra cost.

5.0 MANUFACTURE OF M. S. PIPE

5.1 General

5.1.1 All pipes and specials shall be manufactured out of new mild steel plates/coil which shall be free from any cracks, surface flaws, laminations, excessive pittings or any other defects. The pipes shall be truly cylindrical, and straight in axis. The ends shall be accurately cut and prepared for filed welding. The external circumference of the pipe pieces which are to be fixed adjacent to flange adapter with fixed outer diameter shall not deviate from theoretical one by more than 1 mm. to obtain this accuracy the pipe shall be rolled several times, if necessary, as pipe pieces should be truly cylindrical. The external longitudinal welding of this pipe shall be ground smooth flush with surface to the satisfaction of the Engineer, for a length of 200 mm. no extra cost shall be charged by the Contractor for this grinding work.

5.1.2 Pipes shall be manufactured as Submerged Arc welded MS pipes having beveled ends plate or coil confirming to **IS 3589-2001 with its latest revision.**

5.1.3 Minor repair by welding or otherwise shall be permitted at the discretion of the Engineer, but such repairs shall be done only after obtaining the previous permission of the Engineer. any pipe or part thereof which develops injurious defects during shop

welding or other operations, shall be rejected.

5. 2 Fabrication

5.2.1 The Contractor shall get the fabrication work done in a duly valid licensed factory of his own or that of an approved nominated sub-contractor. This factory meant for fabrication of pipes, specials etc. shall also be involved with testing etc., machining as well as painting. For completing the work under the present contract within the contract period, the factory shall be equipped with adequate number of various equipment and plant such as :

i) Plate bending machines for rolling of pipe drums
ii) Automatic welding machines (Suitable for circumferential as well as longitudinal welding)
iii) Hydraulic Testing Machines
iv) Travelling gantry or crane of capacity 10 Tonnes or above.
v) Mobile cranes for loading / unloading of plates, pipes etc. 15 tonnes capacity each
vi) Lathe for machining of the flanges rings, plates etc.
vii) Equipment for sand blasting and applying paint by spray gun.
viii) Equipment for cold pressing of plates up to 25 mm thick to the required curvature (domes, plug plates, M.H. cover etc.)
ix) Bending machine of adequate capacity for manufacturing ring girders and other necessary equipment's.

5.2.2 The factory shall have adequate area, and shall also have stacking yard for the stacking of plates, structural fabricated pipes etc. and the scrap.

5.2.3 The Bidder shall furnish with his bid the details of the factory where he intends to get the fabrication done, such as it's location and the equipment, plant and other facilities available in the factory for the manufacture of M. S. Pipes and special required under this Contract.

5.3 Cutting Plates to Size :

5.3.1 The plates shall be indented in such length as to have minimum wastage and so as to make the pipe as far as possible with one longitudinal joint.

5.3.2 Before cutting, all the edges of the plates shall be cleaned by brushing / grinding on both the sides.

5.3.3 After the plates are cut, the edges shall be made smooth and even by polishing with an electrical or pneumatic grinder to remove all inequalities. Care shall be taken to see that the cut edges of the plates are perfectly

straight. Jigs to be used for this purpose shall depend upon the types of cutting machine used. the plates cut to the required shape shall be checked for correctness before they are rolled into pipe drums. If any corrections are required, the Contractor shall do the same by re-cutting, if necessary. If any plate or flat is found to be warped, to have corrugations, the defects shall be removed by putting the plate or plate or flat into a roller press, and no extra payment for this rectification works shall be made. The laminated or heavily corroded plate shall not be used in the manufacturing of the pipe.

5.4 Rolling of Plates

The plates cut to the exact size shall be put into a rolling machine to form a pipe of the required diameter. The Contractor shall adjust the rolling machine so as to give a uniform curvature to the pipe throughout its circumference. The curvature obtained shall be checked by the Contractor's foreman during the process of rolling and if proper curvature is not obtained at any place including the ends, the rolling operation shall be repeated at this stage or even after the longitudinal welding of the drum where directed. Heating of plates to obtain the desired curvature shall not be permitted.

5.5 Tacking the Drums

The rolled drums shall be kept on an assembly platform for tacking, care being taken to ensure that the tacked drums have their end faces at right angles to the axis of the pipe. While tacking the drum, a gap of 2 mm to 4 mm shall be maintained, where hand welding is permitted. However, where the welding is to be done on automatic welding machine, there is no need of maintaining such gap depending on the penetration through complete thickness of the welding required. to achieve this objective, clamp spiders, tightening rings and or any other approved gadgets shall be used. each such drum, before being taken to the assembly platform, shall be numbered on the inside with oil paint, stating the plate thickness as well.

5.6 Assembly of Drums Into Pipes

5.6.1 The tacked drums shall then be transported to an assembly platform where they shall be tack-welded together to from suitable pipe-lengths. Plate shall be bent in the maximum possible width to reduce the number of circumferential joints.

5.6.2 The longitudinal joints shall be staggered at 90 deg. The drums when tacked together shall have no circumferential gap when the welding is done on automatic welding machine. But when hand welding is adopted as gap of 2 mm to 4 mm shall be maintained to obtain a good butt welded joint.

5.6.3 The assembly shall be truly cylindrical and without any kinks. The faces shall be at right angles to the axis of the cylinder. A suitable arrangement for testing the correctness of the face shall be provided by the Contractor at the assembly platform.

5.6.4 Alternatively factory made spirally welded pipes are also permitted.

5.7 Welding

5.7.1 All components of a standard shell, either straight or bent etc. shall be welded, wherever possible by use of automatic are welding machine by Submerged are welding are process with alternating current. Hand welding

shall not be permitted except for sealing runs and such other minor works at the discretion of the Engineer. The strength of the joints shall be at least equal to that of the parent material.

5.7.2 The Contractor shall use electrodes either of Advani-Orlecon make or other equivalent approved make and size, the size depending on the thickness of plate and the type of joint. It shall also use with standard current and are voltage required for the machine in use with such modifications as may be found necessary after experimental welding. For this purpose, samples of welded joints shall be prepared and tested in the presence of the Engineer. the values once determined shall be maintained throughout the work and if any modifications are to be made, a written permission of the Engineer shall be obtained. in the case of thin sheets, electric are welding may not give satisfactory results and gas welding shall be resorted to. Gas welding shall be subject to the same specifications and tests as those for electric welds. Welding should be carried out inside as well as outside.

5.7.3 All the shop and filed shall be welded, all welding shall conform to the requirements of IS 823 and IS 4353.

5.7.4 All longitudinal and circumferential joints shall be double welded butt joints.
Field joints shall be from outside, with a sealing weld from inside. End preparation for such welding shall conform to IS : 2825.

5.7.5 All circumferential welds involving plates of unequal thickness shall be so kept that the inside surfaces of plates match to provide stream lined joints without alteration in the internal diameter. As far as practicable, welding of dissimilar thickness of shells shall be carried out in the shops.

5.7.6 The welding shall be of the best workmanship free from flaws, burns, etc. and the Contractor shall provide for his own electrodes and equipment's, ovens to keep the electrodes at the desired temperatures and dry. In order to maintain a good standard in welding, welders shall be tested by the Contractor before they are entrusted with the job. Qualification standard for welding procedures, welders and welding operation shall conform to the requirements of IS : 7307 and IS : 7310 and IS : 7310 (latest). Periodical tests as regards their efficiency shall also be taken at intervals of about 6
MONTHS and those found inefficient shall be removed from the job. Only those who pass the test, shall be posted on the job. If an incompetent welder
has already welded some pipes, all welding done by him previously shall be fully checked by X-ray in addition to the regular X-ray inspections. The
defects if any, shall be set right to the satisfaction of the Engineer. All such check tests and rectification's of defects shall be entirely at the cost of the Contractor. No pipe or steel sections shall be erected unless the work of the
welder concerned has been proved to be satisfactory. Site welds shall be done by specially selected welders.

5.7.7 A record shall be maintained showing the names of welders and operators who have worked on each individual joint. Hand-welding shall preferably by carried out by a pair of welders so that, by observing proper sequence, distortion can be avoided. A joint entrusted to a particular individual sealing run. No helper or other un authorised person shall be permitted to do any

welding whatsoever. In case of infringement of above, the persons shall be punished as directed by the engineer.

5.7.8 The welded joints after welding should not become brittle or sensitive to blows and there should be no loss of toughness due to welding or heat treatment. The material after welding and heat treatment is to be tougher than the base metal and is to retain its original ductility. No allowance will be made for thinning of weld and the weld should in no point be less than the nominal thickness of plate.

5.7.9 Upon receipt of the order and prior to the start of fabrication, the Contractor shall submit to the Engineer for his approval the "Welding procedure" he intends to use in the shop work. Similarly, prior to the start of the field welding, procedure for the field welding must be submitted to the Engineer for his approval. Manual welding shall be adopted only when machine welding is not possible.

5.8 Non Destructive test of Welded joints

5.8.1 For the mild steel pipes manufacture in factory / workshop, fabricated from mild steel plate **15%** of the welded joints shall be subjected to ultrasonic test.

5.9 Tolerance

5.9.1 The shall in the completed work shall be substantially round. The difference between maximum and minimum inside diameters at any cross section shall not exceed 1 % of the nominal diameter of the cross section under consideration subject to a maximum of 10 mm.

5.9.2 Machined parts shall be within the limits specified by IS 3589

5.9.3 Straight pipes shall have their faces perpendicular to the axis of the section with a maximum deviation of 2 mm on either side of the plane. Pipe ends shall be beveled as per IS : 3589.

5.9.4 In the shell thickness, no negative tolerances are acceptable.

5.10 Shop Testing

5.10.1 After fabrication, but before application of protective coatings all pipes and special shall be subjected to a shop hydraulic test. Standard lengths of pipes shall be directly subjected to test and non-standard pipe and elbows can be tested as standard pipe before being cut to size.

5.10.2 The test pressure shall ensure that the plate material is stressed to 40 % of the minimum yield strength and atleast 2 times the allowable working pressure. Each pipe shall be filled with water and the pressure slowly and uniformly increased until the required test pressure is reached.

5.10.3 The pipe to be tested shall be given a serial no. which shall be painted on its inside together with details such as pipe No. Shell thickness, diameter, length etc. as directed. It shall be entered in the register to be maintained by the Contractor.

Prior to testing, the pipe shall be inspected thoroughly and all the apparent defects in welding such as jumps, porosity etc. shall be repaired by gouge and re-welding.

The hydraulic test shall be carried out under cover at the fabrication shop, in the presence of and to the satisfaction of the Engineer or the inspection agency appointed by the Employer.

For indicating the pressure inside the pipe an accurate pressure gauge of approved make duly tested and calibrated for the accuracy of readings shall be mounted on one of the closures which close the pipe ends.

5.10.4 The pressures shall be applied gradually by approved means and shall be maintained for atleast 10 seconds or till the inspection of all welded joints is done during which time the pipe shall be hammered throughout its length with sharp blows, by means of a 1 kg, hand hammer.

The pipe shall withstand the test without showing any sign of weakness, leakage, oozing or sweating. If any leak or sweating is observed in the welded joints, the same shall be repaired by gouging and re-welding after dewatering the pipe. The repaired pipe shall be re-tested to conform to the specified pressure.

5.10.5 If any leak or sweating is observed in pipe shell the pipe under test shall be rejected temporarily. The Contractor shall stack such rejected pipes separately in his yard. The Engineer shall inspect the same and after taking cuts if necessary, shall determine the nature of repairs to be carried out thereon and shall then decide as to how and where they shall be used. no payment shall be made for handling or carrying out repairs, but, payment for the fabrication and hydraulic testing of the pipe shall be released only after acceptance of the pipe with necessary repairs and subsequent testing etc. are carried out by the Contractor to the satisfaction of the Engineer. The Engineer shall be supplied with two copies of the results of all the tests carried out.

5.10.6 Testing of Site Welded Joints

(i) The welded joints shall be tested for Tensile test, Bend test & Tre-panned plug in accordance with procedure laid down in IS No. 3600 of 1966 "Code of procedure for testing of fusion welded joints and weld metals in steel".

(ii) Test pieces shall be taken by the contractor from the welded joints at the position on fabricated pipes pointed out by the Engineer in-charge.

(iii) The sample so taken shall then be cut to the exact shape and dimensions and machined as described below and handed over to the Engineer-in-charge for testing. All the work up to and including machining and arranging for test shall be done by the contractors.

5.11 Submission of Daily Progress Report

5.11.1 The Contractor shall submit to the Engineer a daily progress report in the preformed approved by the Engineer, wherein all the details of the work carried out in the factory shall be fully recorded. Similarly, works done in the various units in the factory shall be separately mentioned. The Contractor shall maintain a register of all the finished materials giving dates of carrying out important operations such as testing, transport, etc.

The register shall be presented at least once a week to the Engineer who shall initial the entries after verification.

5.12 TRANSPORTING OF PIPES, SPECIALS etc.

5.12.1 All pipes and specials fabricated in the factory and temporarily staked in the Contractor's yard shall be transported to the site of laying after cleaning them internally etc. The loading in the factory shall be carried out by means of either a crane, gantry or shear legs, so as not to cause any damage to the finished material. similarly, while unloading and stacking, great care shall be taken to ensure that the material is not damaged or dented. The contrivances to be used for unloading will be different in different situations and in each case the one approved by the Engineer shall be adopted. The material stacked at site shall be jointly inspected by the Engineer and the Contractor and defect or damage noticed shall be repaired to the satisfaction of the engineer before payment is admitted.

5.12.2 Props of approved designs shall be fixed to the pipes during transit to avoid undue sagging and consequent distortion. After the pipes are carefully stacked, props may be removed and re-used for subsequent operations. The stacking ground, both in the Contractor's yard and at the site of laying shall be selected in such a way as not to get waterlogged during monsoon. If this cannot be done, the pipes shall be supported on sleepers to avoid contact with wet earth and subsequent rusting. In order to prevent sagging during transit, savings of steel plates can be utilized by cutting to the required length and tacking the same to the pipe ends, in place of props, if approved by the Engineer.

5.12.3 As explained in earlier paragraphs, materials such as pipes, tapers, etc. may be transported to the site of laying as soon as the material is finished in all respects with the permission of the Engineer to avoid congestion in the Contractor's yard. However, materials such as expansion joints, composite bends, T branches and other complicated materials shall be stacked in the Contractor's yard until they are required for laying in the field. In view of this, the work of fabrication of such materials shall be properly synchronised as far as possible with the laying operations.

5.12.4 Fabricated materials such as manhole covers, appurtenances, bolts, nuts, distance pipes, flanges, saddles, collars by pass arrangements etc. shall be transported to the site of laying from the fabrication shop according to the needs of the laying operations only. In regards access roads, the Contractor shall note that access road may lead up to some points on the alignment the Contractor shall have to make his own arrangement for connecting approaches to transport the pipes cross country to the actual site of laying at his own cost. Whatever may be the mode of transport he uses it shall be incumbent on the Contractor to carry and stack the pipes and specials along the alignment as close as possible to the site of laying.

5.13 PROCEDURE FOR RECEIVING STEEL PIPES

5.13.1 General

To ensure that the work of erecting pipes is not held up at any stage and place, the Contractor shall maintain an adequate stock of standard specials, flange rings, plug plates, manhole covers, etc. and short length of smaller diameter pipelines, etc. at site in his field stores, in consultation with the Engineer. Wherever possible, the

Contractor shall arrange one full month's requirement of pipes, specials, etc. stacked along the alignment.

5.13.2 Stacking of pipes, etc. and inspection

The Contractor shall keep in each section a responsible representative to take delivery of the pipes, specials and appurtenances, etc. transported from the fabricating stockyard or received from any other work site to the site of laying and to stack along the route on timber skids. Padding shall be provided between coated pipes and timber skids to avoid damage to the coating. Suitable gaps in the pipes stacked shall be left at intervals to permit aces from one side to the other. The pipes, specials, appurtenances so received on site shall be jointly inspected and defects recorded, if any, such as protrusions, grooves, dents, notches, damage to the internal coating etc. shall be pointed out immediately to the Engineer at the site and in the acknowledgment challans. Such defects shall be rectified or repaired to the satisfaction of the Engineer entirely at the Contractor's risk and cost.

5.13.3 Handling of Pipes, special appurtenances etc.

It is essential to avoid damage to the pipes, fittings and specials, etc. or their coatings at all stages during handling. The pipes and specials shall be handled in such a manner as not to distort their circularity or cause any damage to their surface treatment. Pipes shall not be thrown down from the trucks not shall they be dragged or rolled along hard surfaces. Slings of canvas or equally non-abrasive materials of suitable width of special attachment shaped to fit the pipe ends shall be used to lift and lower coated pipes to prevent damage to the coating.

Great care shall be taken in handling the pipe right from the first operation of manufacture until they are laid and jointed. The contractor will provide temporary props in order to prevent any sagging of the pipes while they are stacked in their yard and while transporting to the site of delivery, i.e. laying. The props shall be retained until the pipes are laid. If at any time these props are found to be dislodged or disturbed, the Contractor shall immediately reinstate them in such a way that the true shape of the pipe shall or specials is maintaned to the satisfaction of the Engineer. no defective or damaged pipe or special shall be allowed to be used in the work without rectification to the satisfaction of the Engineer. any damage to the coating shall be repaired by the Contractor at his own cost to the satisfaction of the Engineer.

5.13.4 Dents

Whenever any dent, i.e. a significant alteration of the curvature of the pipe shall is noticed, the depth of the dent shall be measured between the lowest point of the dent and the pipe shall curvature line. All dents exceeding 2 percent of the outer diameter of the pipe shall be removed by cutting out a cylindrical portion of the pipe and replacing the same by an undamaged piece of the pipe. The Engineer may permit insert patching if the diameter of the patch is less than 25 percent of the nominal diameter of the pipe. Repairs by hammering with or without heating shall not be permitted. Any damage to the coating shall also be carefully examined and rectified.

5.13.5Marking

The component parts of the pipes shall be carefully marked for identification in the filed. The marking shall be on the side which will be the inside of the pipe after bending.

5.13.5.1 The marking operation shall be conducted with full size rulers and templates. Only blunt nose punches should be used.

5.13.5.2. The plats used for fabrication of pipes shall be laid out in such a way that when the shells are completed one set of original identification markings for the material will be plainly visible. In case these markings are unavoidably cut out, they shall be accurately transferred by the Contractor to a location where these markings will be visible on the completed work.

5.13.5.3. After the hydraulic tests on the specials and other items, the number of the shell in the line as it will be erected and the direction of flow shall be stamped in a prominent manner on each piece.

5.13.5.4. A register shall be maintained in suitable proforma giving the following information for each shell tested :

(a.) Serial No.
(b.) Shell No.
(c.) Date of test
(d.) Thickness and specification of steel
(e.) Weight of shell tested
(f.) Maximum test pressure
(g.) Details of test performance
(h.) Details of radiographic examination of welds
(i.) Name of Engineer's representative witnessing tests

5.13.5.5 A copy of these details shall be furnished to the owner free of cost. No separate payment will be made for these markings and the rates for the items concerned shall be deemed to include the cost of such markings.

5.A LAYING OF PIPE LINE

5.A.1 General

5.A.1.1. Unless specified otherwise, the pipeline shall be buried with minimum cover at top. No material shall be erected unless it has been previously passed by the Engineer. The pipes shall be laid on 15 cm thick sand bedding.

5.A.1.2. Erection of fabricated shells shall be carried out by the Contractor who shall equip himself, at his cost, with all necessary tools, machinery, labour etc. required for the purpose.

5.A.1.3.Welding

Except for routine welding of joints, no other work shall be done in the absence of Contractor's engineer, either during the day time or at night.

Chipping shall not be kept in arrears for more than 15 joints.

Saddle pieces shall be fixed in position after checking bolts holes, by means of templates. These works shall be done together with the pipe laying work, if pipeline is to be laid above ground in unavoidable circumstances.

5.A.1.4.Temperature

The components of the pipeline such as base plates, top plates and pedestals have been so designed that the centers of the plates and pedestals shall coincide at the Mean Temperature (30^{o}).

For this reason, all works such as fixing flange, base plate etc. in true alignment, and in correct position and tack welding pipes shall be done at the mean temperature.

For ascertaining the temperature, the Contractor shall provide mercury cups and fix them to the pipe shell from outside and shall also provide thermometers of the required type and range extra payment shall be made for this.

5.A.2 Saddle supports

Unless otherwise specified pipeline shall be underground. However at unavoidable reaches it shall be on R. C. C. saddles spaced at about 6 m center to center. The material and construction of R. C. C./Steel structures such as saddles, anchor blocks, crossing etc. associated with the work of pipe line shall conform with the relevant I. S. codes, good engineering practice and as directed by the Engineer. the pipes to be laid on saddle supports

shall be erected at mean temperature. Saddle supports shall either be sliding type or fixed type. For both the types of supports a 10 mm thick double plate shall be wooded to the part circumference of the pipeline that will make contact with the saddle and another similar plate shall also be embedded in the concrete saddle with necessary arrangement to facilitate welding it to the double plate welded to the pipe, in case of fixed support. In case of sliding support, the pipe shall be allowed to slide freely over the plate embedded in the saddle. Alternatively to achieve fixit, the pipe shall be anchored by providing suitable anchor block. The rate for laying the pipe on saddle support shall include for laying, aligning, tack welding, provision of rigging screws with screw eyes etc., complete.

a) In addition to above, the pipe shall be held in position on saddle with two numbers 50 mm x 8 mm thick holding down traps fixed to the saddles with holding down bolts and nuts which shall be paid separately under relevant item of bill of quantities.

5.A.3 Erection of Shells

5.A.3.1 The erection shall be true to position, lines and grade as shown in the DRAWINGS or as modified by the Engineer. The Contractor shall provide at his cost necessary saddles, pads, spider etc., all necessary instruments and other materials and labour required for proper erection of shells in position and for the Engineer in checking the correctness of the erection.

5.A.3.2 Alignment of sections at edges to be butt welded shall be such that the maximum offset is not greater than the value given below :-

Thicknes s "t" (mm)	**Off set in Longitudinal joints (mm)**	**Offset in Girth joints (mm)**
Up to 12	0.25 t	0.25 t
12 to 20	3 mm	0.25 t
20 to 40	3 mm	5 mm
40 to 50	3 mm	1/8 t
Over 50	**Lesser of 0.0625 t or 10 mm**	Lesser of 0.125 t or 20 mm

5.A.3.3. The best of welders as selected from their work in the Contractor's workshop shall be selected for in-situ welding of the shells. The relevant provision under welding such as qualification standard for welding procedures, tests on welder's work and removal of defects etc., shall also apply to in-situ welding.

5.A.4 General Sequence of operations

5.A.4.1 Before commencing the work of pipe laying, the Contractor shall study the L-section of the pipeline for the section concerned. He shall also study the details of laying i.e. underground or aboveground. The underground pipeline shall be laid on sand cushioning / bedding as shown on the DRAWING. The difference in depth due to uneven excavations shall be made up by sand cushioning.

5.A.4.2. Pipe laying shall generally start from the fixity points on either side, the expansion joints if required for pipeline above ground being provided last. Fixing points are at all anchor blocks. Where such blocks are not required for long lengths, fixity shall be achieved by fixing the pipeline to the special type of R. C. C. or steel saddles as specified in 6.8.2 above. The distance between successive fixity points shall not exceed 300 m.

5.A.4.3. Anchor blocks shall be constructed before commencing the pipe laying work in any section. The construction of the blocks shall be carried out in stages: in the first stage the lower part up to 150 mm below the invert of the pipeline including concrete chairs to support it shall be constructed; in the second stage the pipeline on this part of the block shall be laid; and lastly, the remaining block around and over the pipeline shall be constructed.

5.A.4.4. The fixity saddles and ordinary saddles if the pipeline is aboveground shall be cast at least 3 weeks before the pipeline is laid on them. After all saddles between successive fixity points have been cast, a line plan showing the actual position thereof shall be prepared, after taking levels and measuring distances. In case of any errors in casting the pedestals, corrections shall be applied. The pipe laying work shall then start from the fixity points and shall proceed towards the expansion joints. The method of jointing the pipes and erecting them on previously cast R. C. C. saddles shall be determined by the Contractor depending upon the type of plant equipment and personnel available with them.

5.A.4.5. The pipe strakes shall be assembled in position on the saddles either by the cranes, portable gantries, shear legs or any other equipment approved by the Engineer. Normally, not more than two pipes shall be aligned, tacked and kept in position on temporary supports. The Contractor shall not proceed with further work, until the circumferential joints of these pipes are fully welded. During assembly, the pipeline shall be supported on wooden sleepers and wedges, with the free end of the pipeline held in position by slings to avoid deflection due to temperature variations during the day. In general, the assembly of pipe strakes and one run of welding shall be done during the day time while full welding including the external gouging and sealing runs shall be done after 5 p.m. or so. The Contractor shall maintain the continuity of the work by adding two more pipes on the second day in a similar manner, after full welding of the previous joints is completed during the night. While this new work is being done, the Contractor shall proceed with the work of providing permanent supports for the pipeline assembled and welded previously.

5.A.5 Fixing Expansion Joint

The work of laying pipeline in aboveground, laying starts from the fixity points and proceeds towards the expansion joints. It shall be continued until the gap between the pipe ends is less than the lengths of the expansion joint plus pipe strake length. At this stage, the exact gap between the pipe ends shall be measured at mean temperature of that locality. Let it be "X". Similarly, the exact length of the pipe strake and the expansion joint bought at site shall be measured at the same temperature let these be "Y" and "Z" respectively. Normally, the length of the expansion joints (Z) is standard.

(a) Case when "Y" plus "Z" is more than "X" or equal to "X" (i.e. fixing of expansion joint without strip)

At mean temperature the exact gap between pipes shall be measured. Free ends of pipes shall be brought in a correct line and level ; lateral movement, if any, shall be corrected. Then the gap between the free ends shall be made equal to the exact length of the expansion joint by cutting one of the pipe ends. Choice of the end to be cut must be made from the point of view of bringing the expansion joint to a central position.

The expansion joints are normally supplied without packing. The normal length of the expansion joint shall be reduced by about 100 mm by cutting the inside locks and inserting the inner strake by means of turn buckles. At mean temperature this expansion joint shall be inserted inside the gap (care being taken to keep the tapered portion on the down-stream side), and both ends shall be tack welded to the pipe ends, after pulling the expansion joint. (Tacks of these two joints shall be of longer length, approximately 100 mm long).

Welding of these two joints of the expansion joints shall be started only after it is ascertained by taking observations that the expansion joint is functioning properly. The procedure to be followed for taking observations is given in Clause 8.5 (c).

(b) Case when "Y" plus "Z" is less than "X" (i.e. fixing of expansion joints with strap)

The expansion joint shall be laid in locked position. Before laying the pipes adjacent to the expansion joint, the exact gap between the pipes shall be calculated by

taking measurement of the first pipe (upstream of the expansion joint), and the second pipe (downstream of the expansion joint) at Mean Temperature.

If the gap is less than 100 mm, the second pipe shall be cut to make the desired gap of at least 100 mm. if the gap is more than 200 mm, suitable distance piece of not less than 600 mm shall be inserted after cutting necessary length of the first pipe.

The second pipe shall then be laid in position. Then a strap of length equal to three times the gap length shall be welded to the pipe, overlapping the second pipe by the gap length. The other end of the strip shall be kept free.

At mean temperature the other end of the strap shall be tacked to the first pipe, after checking of the line and level. Simultaneously, all the locks of the expansion joint shall be removed and chipped off properly.

Welding of the joints between the strap and the first pipe shall be started only after observations are over and it is ascertained that the expansion joint is functioning properly.

(c) Observations

Before fixing the expansion, joint, two mercury cups – one on the left and the other on the right side shall be fixed on the pipe near the upstream side of the expansion joint.

Immediately after the expansion joint in case (a) above or the strap in case (b) above is tack welded, observations for total expansion or contraction shall be started and continued for 48 hours round the clock. Similarly, the central and end fixity pedestals shall be kept constantly under observation.

The expansion and contraction shall be measured by making a temporary marking on the inner strake (on the upstream side) and measuring the distance between this mark and the edge of the gland of the expansion joint.

The observations shall be recorded in the following proforma :

Reading No.	*Time*	*Shell temp on upstream side*	*Shell temp on downstream side*	*Atmospheric temperature*	*Dist between edge of gland and marking*
1	*2*	*3*	*4*	*5*	*6*

In case the pipeline is laid in trenches as shown on the DRAWING, after welding and field testing, the trench shall be filled with selected material up to 300 mm above pipes. This backfill shall be provided in layers not more than 150 mm, with a density more than 95 % of the standard proctor density. Samples shall be tested as

directed by the Engineer. remaining depth of trenches shall be filled with ground backfill material.

5.A.6 Specials

5.A.6.1 General

Specials, such as tees, Y-pieces, bends (single or composite), tapers, etc. shall necessarily be in steel and shall be manufactured as per standards and tested and laid in the same manner as the pipes. Small branches, single 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 to be jointed.

5.A.6.2. Bends

(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^{o} 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 will full specification's in Contractor's fabrication DRAWING.

5.A.6.3. Manholes

(a) Manholes of 600 mm dia shall be provided at both the sides of Sluice valves. Manholes in the pipeline shall be placed in suitable position 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.

5.A.6.4. Closing or Make up sections

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

5.A.6.5. 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 hydraulic test shall be deemed to cover the cost of such installations.

5.A.6.6. Walkways, Stairs, Ladders, Hand Rails etc.

Walkways, stairs, rungs, ladder, hand rails, etc. shall be provided as shown in the DRAWINGS and/or as directed by the Engineer. They shall conform to well established design and construction for each accessory concerned.

5.A.6.7. Flanges

Flanges shall be provided at the end of pipes or special where sluice valves, blank flanges, tapers, etc. have to be introduced. The flanges received from the manufacturers will have necessary bolt holes drilled. The Contractor shall assemble the flange in the exact position by marginal cutting, if necessary, so as to get the desired position of the sluice valves, etc. either vertical or horizontal and shall then fully weld the flanges from both sides in such a way that no part of the welding protrudes beyond the face of the flanges. In case the welding protrudes beyond the flanges and if the Engineer orders that such protrusions shall be removed, the Contractor shall file or chip them off. If required and when ordered by the Engineer, the Contractor shall provide and weld gusset stiffeners, as directed on site. The drilling pattern shall be matching with the drilling pattern of flanges of valves.

5.A.6.8. 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.

8.6.9 Stiffener Rings

The Contractor shall provide stiffener rings wherever required by design. The Contractor shall weld the same to the pipes with one circumferential run on each side.

All fillet welds shall have a throat thickness of not less than 0.7 times the width of welding.

5.A.7. Field Hydraulic Test

After erection at site and after the concrete anchor blocks have been constructed but prior to internal mortar lining, the entire pipeline shall be subjected to a hydraulic test as follows, to the test pressure as mentioned below :

5.A.7.1. The test pressure shall be 1.5 times the design working pressure, but not to exceed a pressure that would result in a stress greater than 40 % of the yield point of the steel plates used.

5.A.7.2. The pressure test shall be conducted in dry weather with pressure held constant for 4 hours to observe whether any pressure drop takes place. A leakage equivalent of 113 liters per meter of pipe diameter per kilometer length at required test pressure per 24 hours is allowed if the test pressure is maintained by pumping. Any leakage beyond that specified here in above shall be rectified to the satisfaction of the Engineer.

5.A.7.3. During the test, the pipe shall be struck sharp blows with 1 Kg hammer. Water shall not spout, ooze or sweat either through joints- welded or bolted or the body of the pipe. If any leakage noticed shall be repaired by the Contractor, which shall include coating and repairing of the damaged portion. Repairs and replacement and further testing including the cost of the plates and other pure materials shall be carried out by the Contractor at his own cost. If any leakages are observed during the defects liability period due to defective workmanship or material supplied by the Contractor, he shall repair the same to the entire satisfaction of the

Employer, at his won cost.

5.A.7.4. MUNICIPAL COMMISSIONER, RAJKOT shall assist the contractor in identifying the source & in obtaining permission for dpureal of water for field testing of pipe. The Contractor shall pay for the water and carry the water to the test location at his coat. The cost of hydraulic testing of the installation by providing necessary testing equipment, pumping the water, creating and maintaining pressure, and the necessary bulk head sand their fixtures, and their subsequent removal and restoring the installation to working trim shall be included in the rate for laying and testing of the pipe.

5.A.8 Progress in Laying

5.A.8.1. The tenderer shall submit along with the tender his detailed bar chart for manufacturing and laying of the pipeline. While preparing his bar chart, the tenderer shall plan his activities such that the laying of pipes shall closely follow the manufacturing schedule and no pipes shall remain stacked in factory or at site for a period more than two months.

5.A.8.2. It is mandatory that he shall submit an approach note on how he will carry out thisWork withinthe contractual period and on the compatible resources in terms of construction. Equipment and other facilities that he shall utilise to complete the tendered Work.

5.B CEMENT MORTAR LINING FOR INTERNAL SURFACE OF PIPELINE

5.B.1 Scope

This Specifications covers the requirements of providing materials and application of in-situ cement mortar lining of 12.5 mm thickness by mechanical and/or hand application to the internal surfaces of pipeline, which have been already installed under this contract. It also includes all related works required for performing a complete contract. Before or after completion of filed hydraulic test of the pipeline in all respects the Contractor shall take up the In-Situ Cement Mortar lining to the internal surface of the pipeline. The work shall be started only after obtaining the written approval of the Engineer in this respect.

5.B.2 Applicable Codes and Specifications

The following specifications, standards and codes in addition to those listed in Clause 6.2.0 of this specification are made a part of this specification. All standards, specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

1. AWWA C602-76 American Water Works Association (AWWA) Standard for Cement Mortar Lining of Water Pipelines – 4 in. and larger – In Phase.
2. IS – 3696 Safety code for scaffolds and ladders (Part 1 & II)
3. ASTM – C40 – Test for Organic Impurities in Sands for Concrete.

5.B.3 General

Engineer shall have the right to inspect the sources of materials, the operation of procurement and storage of materials, Cement mortar batching and mixing equipment and the quality control system. Such an inspection shall be arranged and the Engineer's approval obtained prior to starting of lining work.

5.B.4 Method of application

All lining work shall be done by machine/hand application. If there are areas where the lining can be done by machine but cannot perform trowel finishing, then the bidder in hid bid shall indicate such areas. By prior approval of Engineer, these areas may be machine sprayed and hand troweled.

5.B.5 Workmanship

All works shall be performed in a thorough and workmanlike manner by trained personnel with previous experience under the supervision of experienced men skilled in the in-situ application of cement-mortar lining to pipeline and under ground works such as tunnel,

shaft.

5.B.6 Programme of lining and plant and equipment

The plant and equipment proposed by the Contractor for carrying out the cement mortar lining application shall be furnished along with the Bid. The Contractor shall also furnish the method he proposed to adopt. Contractor shall furnish complete details of similar work executed by him along with the Bid.

5.B.7 Materials of Construction

a) Cement

Cement required for mortar lining shall be Portland Cement" conforming to IS : 269.

b) Admixture

To improve workability, density and strength of the mortar, admixtures as approved by the Engineer may be used by the Contractor his own cost. No admixtures shall be used that would have a deleterious effect on water flowing in the pipe, which is required for drinking proposes.

c) Sand

Sand shall consist of inert granular material. the grains shall be strong, durable, and uncoated. The sand shall be well graded and shall pass a 1.18 mm mesh screen (ASTM No. 16) with not more than 5 percent passing 150 micron sieve (ASTM No. 100). Sand shall be free from injurious amounts of dust, clay, lumps, shale, soft or flaky particles mica, loam, oil, alkali, and other deleterious substances. The total weight of such substances shall not exceed 3 percent of the combined weight of the substances and the sand that contained them. Limitations shall apply to specific substances as follows :

a)	Substance	Maximum allowable percentage by weight
b)	Shale	1
C)	Clay lumps	1
d)	Mica and deleterious substances other than shale and clay lumps	2

Organic impurities. Sand shall not how a colour value darker than the reference standard colour solution prepared as required by ASTM 6.40 "Test for Organic Impurities is Sands for Concrete".

b) Water

Water for mixing mortar shall be clean and free from injurious amount of mud, oil, organic material or other deleterious substances.

5.B.8 Design of Lining

5.B.8.1 General

Composition of mortar for the lining shall be composed of cement, sand and water mixed to such consistency as to produce a dense and homogeneous lining that will adhere firmly to the pipe surface. Bidder should indicate in his bid the details of the admixtures he proposes to use. This lining surface shall be able to deliver a guaranteed "C" value of 120 for modified Hazen Williams formula.

5.B.8.2 Proportion

Dry proportions of cement and sand shall be 1 part of cement to 1 ½ parts of sand by volume. Slight modifications in composition could be made at site to suit the characteristics of the sand used. each bag of cement shall be weighed and converted into volume for its use. Admixtures, if permitted, shall be used in strict accordance with the manufacturers recommendations. The minimum cement content shall be 1000 Kg/m^3 and water cement ratio of between 0.3:1 and 0.45:1 by mass.

5.B.8.3 Water Content

a) Water content shall be the minimum that is required to produce a workable mix, with full allowance made for water collecting on the interior of pipe surface.

5.B.8.4 Mixing

Mortar shall be well mixed and of proper consistency to obtain a dense, homogenous lining. Where premixed mortar is used, it shall be done so before initial set.

5.B.8.5 Thickness of Lining

Cement mortar lining shall be 12.5 mm thickness with a maximum plus tolerance of 3 mm.

5.B.9.Method of Construction

5.B.9.1 Access Openings

Only such openings as indicated by the Tenderer in his bid and approved by Engineer shall be provided in the pipelines. After lining is completed, closure pieces will be welded to the pipe. Mortar lining of closure pieces and adjacent area shall be included in the rates quoted for the mortar lining work.

5.B.9.2 Preparation of Pipe Surface

The interior surface of pipe to be lined shall be cleaned to remove all rust, chemical or other deposits, loose and deteriorated remains of old coating materials, oil, grease, and all accumulations of water, dirt, and debris. The cleaning of the surface shall be carried out by the use of suitable chemical or mechanical means with the approval of Engineer. The extent of cleaning shall be to the satisfaction of the Engineer.

All loose mill scale, dirt, rust, and accumulation of construction debris shall be removed from the interior off the steel pipeline. The pipeline shall be cleaned by use of a power-driven cleaner incorporating revolving brushes on rotating arms. After this cleaning the pipe shall be flushed with potable water and all standing water removed.

5.B.9.3 Machine Application of Mortar Lining Clean up ahead of machine Immediately prior to the travel of the lining machine through the pipeline, all foreign material shall be removed. This includes sand and loose mortar that might have accumulated since the work of preparation of surfaces was completed.

5.B.9.4 Lining Procedure

The lining shall be placed by centrifugal method in one course by a machine traveling through the pipe and discharging the mortar at a high velocity over all pipe sections and long radius bends. The discharge shall be from the rear of the machine so that the freshly applied mortar will not be marked. The rate of travel of the machine and the rate of mortar discharge shall be mechanically regulated so as to produce uniform thickness throughout. The mortar must be densely packed and shall adhere to the pipe wherever applied.

5.B.10 Surface Finish

Mortar lining shall be mechanically trowelled except for the places where hand trowelling is expressly permitted by the Employee.

5.B.10.1 Trowelled Lining

The lining machine shall be provided with attachments for mechanically trowelling the mortar. Both the application and trowelling of the mortar shall take place at the rear of the machine so that the freshly placed and trowelled mortar will not be damaged. The trowel attachment shall be such that the pressure applied to the pipe shall will be uniform and produce a lining of uniform thickness with a smooth and even finished surface free of spiral

shoulders. The finished surface of machine placed and trowelled linings in pipe shall be examined according to the procedure in Clause 6.9.10.2.

5.B.10.2 Examining procedures

In the stretch of pipe that has been lined the trowelled in each day's run, ten places shall be selected in straight sections of the pipe by the Engineer. In each of the ten places the thickness of the lining shall be measured as directed by the Engineer. Thickness of lining shall be ascertained frequently during placing of mortar and trowelling. Hair cracks or cracks up to 0.25 mm width in saturated linings and not over 300 mm in length are acceptable.

5.B.10.3 Un-trowelled lining

The finished surface shall be smooth and regular except that it may exhibit a slightly dimpled appearance. Edges or uneven build up caused by irregularity in the travel route of the machine will not be allowed.

5.B.11Hand Applications of Mortar Lining

5.B.11.1 Hand placed mortar shall have a uniform and smooth surface with smooth transitions to adjacent machine placed linings.

5.B.11.2 Cement mortar lining of bends, specials, areas closely adjacent to valves and other such places where machine placing may not be practical shall be performed by hand. The Engineer may order the correction for any defect by hand application.

5.B.11.3 Cement mortar for hand work shall be of the same materials at the mortar for machine placed lining.

5.B.11.4 The areas to be lined shall be thoroughly cleaned as specified earlier and, if necessary, shall be moistened with water immediately prior to placing the hand applied mortar.

5.B.11.5 Steel finishing trowels shall be used for the hand application of cement mortar, except at bends the outer edges of hand trowelled areas may be brushed in order to reduce the abutting offset.

5.B.11.6 All hand finishing work in a section of the pipeline shall be completed within 24 hours after completion of the machine application of mortar lining to that section. If necessary, application of mortar lining by machine shall be delayed or stopped to assure compliance with this schedule.

5.B.12. Special requirements at Laterals and Service connections Laterals and connections to the pipe that is being lined shall not be left obstructed by the lining operations.

5.B.12.1. Before the lining is placed, the openings is the pipeline leading to air valves, blow offs, manholes and appurtenances; as well as to laterals and connections that transmit pressure or carry water from the pipeline, shall be temporarily covered or plugged with suitable devices. These shall be removed later without damaging the cement-mortar.

5.B.13. Curing

Curing shall commence immediately after completion of the mortar lining and hand finishing of a section of pipeline. This shall, however, not be later than 8 hours after mixing of mortar. The lining shall be kept continuously in moist condition for a period of 14 days. During the operation of lining, finishing and curing, exterior surface of the pipe exposed to sunlight shall be sprinkled with enough water to keep the pipe cool. Open ends of pipes shall be suitably closed so as to maintain a moist atmosphere and prevent draught. Curing of mortar lining and simultaneous cooling of the pipeline externally shall be continued even beyond the period of 14 days as directed by the Engineer. in the opinion of Engineer, if the water for curing as per the specification may not

be available, engineer shall order the Contractor to use chemical curing which shall be carried out as per the manufacturers specifications. No extra payment will be made on this account. If the contractor desired so, use of approved curing compound will be permitted.

5.B.14. Tests of cement mortar used for lining

Test block of the same material as used for the lining shall be made in 150 m cube moulds and subjected to Works cube crushing tests. Each block shall be removed from its mould as soon as practicable and cured under the conditions of temperature and humidity identical with those in which the lining of the pipe is cured. The number of tests shall be at least 4 cube shall not be less than 300 Kg/cm^2 after 28 days of curing or 170 Kg/cm^2 of 7 days of curing. The density of the test cube shall not be less than 2300 Kg/m^3.

5.B.15 Inspection

5.B.15.1. Responsibility of Engineer and Contractor

The entire procedure of applying cement mortar lining shall be subject to continuous inspection by the Engineer but such inspection shall not relieve the Contractor of his responsibility to furnish material and perform work in accordance with this specification. All cement mortar lining not applied in accordance with this specification shall be subject to rejection by the Engineer. lining so rejected shall be removed and replaced by the Contractor at his own expense.

5.B.15.2. Defective Lining

Defects in lining including but not restricted to sand pockets, voids, over sanded areas, blisters, cracked and dummy areas, and thin spots shall be moved, and the area shall be repaired by hand application to the full required thickness of the mortar lining. Defective areas encompassing the full diameter of the pipe shall be replaced by machine wherever practical. Defective lining rejected at the time of lining shall be removed before initial set of the mortar. Defective lining rejected after initial set shall be replaced or repaired by the most practical method as determined by the Engineer.

5.B.15.3. Guarantee

If on examination by the Engineer of the cement-mortar lining work within a period of two years after final completion and acceptance of the Contract work reveals evidence of defective materials or workmanship as defined in this specification but not limited to the same, then the Contractor shall perform the remedial work at his own expense in manned acceptable to the Engineer.

5.C. LINING AND PAINTING OF PIPES AND SPECIFICATION FOR LIQUID EPOXY COATING SYSTEMS FOR INTERIOR LINING OF STEEL WATER PIPELINES

General:

Buried steel pipeline shall be coated internally, with a single coat two part solvent free high build liquid epoxy lining as per AWWA C210-07 suitable for potable water application and shall be approved by CFTRI –India / BS 6920 - UK / NSF International Standard NSF/ANSI-61 2004 to be fit for contact with potable water for human consumption. The Contractor shall perform all work in accordance with these specifications and the latest pipeline coating practices, and shall complete the work in all respects to the full satisfaction of the Owner / Owner's Representative. 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.

All steel special sections, connections fittings and field joints to be used for underground steel pipeline shall be internally coated with same liquid epoxy. Referenced Standards:
The following standards (latest revision) referenced below are a part of this specification. In case of conflict between this specification andthe referenced standards, this specification shall apply.

(a) ANSI/AWWA C210 - Standard for Liquid Epoxy Coating Systems for the Interior & Exterior of Steel Water Pipelines.
(b) NSF/ANSI 61 – Standard for Drinking Water System Components- Health Effects.
(c) ANSI /ASTM D149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
(d) ANSI/ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test.
(e) ANSI/ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test.
(f) ANSI/ASTM D4417 - Standard Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel.
(g) ANSI/ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
(h) ANSI/ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness
(i) ANSI/ASTM D5000 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
(j) SSPC-PA 2 - Measurement of Dry Paint Thickness with Magnetic Gauges
(k) SSPC-SP l - Solvent Cleaning
(l) SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning

General:
The buried steel pipeline shall be lined with factory applied single coat two part solvent free high build liquid epoxy lining suitable for potable water application.. Protective lining shall consist of a coating system consisting of 100% solids epoxy comprising of resin & hardener mixed in a proportion as recommended by the manufacturer. Epoxy lining requiring multiple layers to build to the required thickness of 406 microns shall not be permitted.

The mixed epoxy shall be applied to abrasive blasted steel surface in the coating plant using plural hot airless spray machine with extended boom to apply the lining to a smooth finish without any drip or sag. The epoxy shall also be capable of application by brush at field joint locations and repair of damages to the spray applied epoxy.

Internal lining system:

The internal epoxy lining shall consist of chemically cured resin (epoxy) & hardener (curing agent), mixed in the ratio as recommended by the manufacturer and applied to a dry film thickness (DFT) of minimum 500µ.

Table – I Physical properties of the internal lining shall be as follows.

Property	Requirement	Test Method / Reference
Long term contact with potable water	No effects for human consumption as certified by NSF International	NSF / ANSI -61/BS-6920/
Thickness (applied min)	500µ	SSPC-PA 2
Thickness deviation (min)	- 0 / + 300µ	SSPC-PA 2
Dielectric strength (min)	450 V/mil (15 V/µm)	ASTM D149
Hardness Shore D	85 (min)	ASTM D2240
Adhesion to Steel (min)	2500 psi	ASTM D4541
Tabor Abrasion	1250 cycles / mil	ASTM D4060

Compressive strength	70 MPa	ASTM C109
Tensile Strength	2500 psi	ASTMD 2370
Elongation	3%	ASTMD 2370
Flexibility	0.75^0	NACE RP-0394

Coating Application:

General:

All internal epoxy lining work for main pipeline shall be done in coating plant using two component airless plural spray machine. Pipe will be rotated at a suitable speed and the boom of the spray machine carrying the spray gun will travel inside the pipe at a pre-determined speed to ensure that thickness of minimum 406 microns is achieved in one single spray application.

For internals of miter bends, short section of pipes, tees, fittings etc., internal epoxy will be manually spray applied either in the coating plant or in the field using suitable two component airless plural spray machine.

Internal field joint coating shall be brush applied.

The internal epoxy lining shall be applied only on blasted steel surface.

Pipepreparation:

Metal surface condition:

Internal surface of the pipe shall be free from mud, mill scale, mill lacquer, wax, oil, grease, or any other foreign material. Before blast cleaning, surfaces shall be inspected and pre-cleaned 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.

After drying and removing all loosely adhering foreign materials, the pipe surface shall be cleaned by blasting with grit or steel shots to achieve a surface preparation at least equal to that specified in SSPC: SP6/NACE3. The blast anchor pattern or profile depth shall be 2 mil to 3 mils (50 µm to
75 µm) measured in accordance with ASTM D-4417.

For consistent surface finish, a stabilized working mix shall be maintained in abrasive recycling blasting machines by frequent small additions of new grit, shot infrequent large editions shall be avoided. The abrasive working mix, abrasive recycling blasting machines shall be maintained clean of contaminants by continuous effective operation of blasting machine scalping and air-wash separators.

The cleaned interior pipe surface shall be in inspected for adequate surface preparation. Surface imperfections, such as slivers, scabs, burrs, weld spatter, and gouges, shall be removed by hand filing or grinding if necessary to prevent holidays.

Blast-cleaned pipe surfaces shall be protected from conditions of high humidity, rainfall, or surface moisture. No pipe shall be allowed to flash rust before coating. To ensure a dry pipe surface at the time of liquid epoxy application, the minimum steel substrate temperature shall be 10°C and at least 3°C above the dew point.

Coating application: Main Pipe Line: Application temperature:

The temperature of the mixed coating material and of the pipe at the time of application shall be not lower than 10^0C. Preheating of the coating material by using in line heaters to heat the coating material may be used to facilitate the application. Heating shall conform to the recommendations of the epoxy coating manufacturer.

Application of epoxy:
The epoxy shall be applied directly to the abrasive roughened steel surface pipeusing a hot plural component airless spray equipment, with all necessary ancillary equipment like spraying boom etc, in accordance with the epoxy coating manufacturer's recommendations. Pipe will be rotated at a suitable speed and the boom of the spray machine carrying the spray gun will travel inside the pipe at a pre-determined speed to ensure that thickness of minimum 406 microns is achieved in one single spray application.

Curing:
After application of epoxy, curing of the epoxy shall be natural air convection. Typical dry time of the epoxy at ambient temperature of 25-40^{0}C shall be between one hour to three hours. Shore D hardness of the epoxy after 10 hours shall be > 65.

Internal coating cutback:
Internal coating cutback on either side of the pipe shall be 100 mm +/- 25 mm.

Field Joints:
After the main pipes have been welded in the trench, internal epoxy coating shall be applied on the inside of the pipeline at the girth welds using brush application. Internal epoxy for field joint coating shall be supplied by the same manufacturer as of internal line coating. The epoxy shall be supplied in small cans of appropriate size required per joint with applicator pad.

The internal surface of the field joint shall be inspected and weld spatter or slag shall be removed by grinding.

The internal surface shall then be manually abrasive blasted to a surface finish of Sa21/2 with anchor profile of 50~70 microns to remove rust / contamination etc.

The resin & hardener will be mixed and the coating applied to a minimum thickness of 500µ. The internal field joint coating shall overlap the factory applied main line internal coating by 50mm on either side.

Material acceptance, inspection and testing:
Material acceptance:
Proposed internal epoxy lining materials shall be approved by the Owner / Owner's representative. Test certificate from independent third party test laboratory shall be submitted conforming compliance to the physical properties as listed in Table I. No deviation to the physical properties shall be acceptable.

When the material is supplied, acceptance of the material shall be based on submission of certificate of conformance of the internal epoxy to this specification along with manufacturing acceptance test certificates for various lots as per manufacturer's quality assurance and quality control requirements.

Coating application inspection:

The entire internal lining 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 Owner / Owner's representative. All coating work will be done in the presence of the Owner / Owner's representative.

Thickness:
Thickness of the coating system shall be checked in accordance with SSPC- PA 2. Thickness shall be in accordance with the values given in the Table I and shall be checked at a frequency specified by the Owner / Owner's representative.

Holiday testing:

Each coated pipe section shall be electrically tested for flaws in the coating using a suitable holiday detector approved by theOwner / Owner's representative. The detector shall impress a minimum of 2000 V. Reference should be made to NACE RP-02-74. If a holiday is detected, it shall be repaired as per specifications.

Pull Off Adhesion:

The pull off adhesion of the internal epoxy lining to steel shall be checked in accordance with ASTM D-4541. The average value below the limits stated in the Table I shall constitute a failure of the system to meet the adhesion requirement. The pull off adhesion test shall be conducted at a frequency specified by the Owner / Owner's representative

Field procedures:

At all times during construction of the pipeline, the Contractor shall use caution to prevent damage to the internal lining on the inside of 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 internal coating except when necessary. In these cases, they shall wear shoes with rubber or composition soles and heels or other suitable footwear 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.

Coating repair in field:

All holidays visually or electrically discovered either at the coating plant or in the field shall be repaired by applying the same liquid epoxy coating using brush. The minimum over-lap at the damaged area shall be 100 mm all around. The repaired area shall be tested with a holiday detector as per specifications after the repair is completed. The thickness of the coating at the repair area shall be minimum 500µ.

Table – I - Physical Properties of Total System

Property	Requirement	
	Minimum	**Maximum**
Thickness		
3mm	3mm	
Dielectric breakdown	400v/mil	
Water-vapor transmission, max. Insulation resistance	0.25 perms [1.44ng/ (Pa.s.m^2)] 500,000 mega ohms (min)	
Adhesion to Primed Steel at 23deg.C as per ASTM D1000	5 pli	6 pli

5.D. CEMENT MORTAR GUNITING FOR PIPELINE

5.D.1. Protective cement mortar coating by gunite to External Surfaces

The MS pipeline shall be laid under ground to the extent possible, before lowering into the trenches, the External Surfaces of all pipes, specials and fittings shall be provided with **25 mm thick cement mortar** coating by guniting. A length of 15 cm at each end of the pipe strake shall be left ungunited to facilitate site welding. This portion shall be lined after laying, welding and filed testing of the pipeline is completed satisfactorily. If the Contractor desires so, guniting the pipe externally after lowering them in the trenches will be allowed if the Contractor evolves a suitable method and the same is approved by the Engineer. But, no extra payment will be made for widening or deepening the trenches for this purpose.

Where the pipes / specials are to be gunited externally or encased in concrete, the external surface of the pipe shall be given a coat of cement wash. The pipe surface shall be blast cleaned to the Engineer's satisfaction. Immediately after the pipe / special is blast clean, the Contractor shall commence coating of the surface with cement wash.

5.D.1.2 Mix Proportion

The proportion of cement and sand shall be 1 to 3 by volume, when the mix is dry. The cement shall be ordinary Portland cement confirming to relavant I. S. Water cement ratio shall be 0.46.

5.D.1.3 Thickness of coating

The minimum thickness of the coating shall be 25 mm with a maximum plus tolerance of 3 mm.

5.D.1.4 Reinforcement

Welded fabric 100 mm x 100 mm X 3.15 mm thick wire conforming to IS : 1566 or equivalent MS reinforcement, as approved by the Engineer. The welded fabric used shall be bent to proper shape to conform to the surface of the fitting/special pipe to be coated and shall be securely held 20 mm away from the surface of the pipe / special / fitting by means of spacer blocks made from cement mortar (1:1) and binding wire. Spacers shall be placed atleast 30 cm center to center both ways. Adjacent sheets of fabric shall lap at least 80 mm and shall be securely fastened together by binding wire at intervals not exceeding 300 mm.

5.D.1.5 Preparation for Surfaces

The external surfaces of all pipes, to be coated with ordinary Portland cement mortar, shall be thoroughly cleaned by wire brush manually

(i) Hand Cleaning

Before guniting, all oil and greases on the surface of the metal shall be removed thoroughly by flushing and wiping using suitable solvents and clean rags. The use of dirty or oily rags will not be permitted. All other foreign materials shall be moved by buffing or by scrapping and wire brushing. After cleaning, the special shall be protected and maintained free of all oil, grease and dirt that might fall upon the platform whatever source until the plate has received its cement mortar coating application of Mortar Lining by Guniting.

The pressure in the lower chamber of "Cement Gun" shall be sufficient to produce a nozzle velocity of 115 to 150m per second when a tip with 19 mm opening is used. The compressor used shall be of an adequate capacity to maintain a pressure of atleast 2.8 Kg/sq.cm at the gun end. The nozzle shall be held at such a distance (65 to 100 cm) and position that the stream of flowing materials shall impinge as nearly as possible at right angles to the surface being gunited. All deposits of loose sand shall be removed prior to placing any layer of gunite. Gunite shall be shot in one coat to the specified thickness. Every precaution shall betaken to prevent the formation of sand pockets and if any develop, they shall be cut out and replaced with satisfactory machine placed material. no hand patching will be allowed. The Contractor shall apply the coating in such a manner that no sloughing shall occur at any time during or following its application.

Gunite shall be placed in the top and sides of the pipe, then screeded to a uniform thickness and the ground lines or blocks removed. All rebound and waste materials shall then be removed by air blowing and gunite placed in the bottom of the fittings and screeded. No gunite shall be placed over rebound and in case of such condition arising, the contractor shall remove at his own cost any gunite so placed. Rebound material deposited in moulds shall be removed from the site of work. When completed, the lining shall be concentric with the barrel of an even thickness. The entire surface shall then receive a final flash coat of gunite and shall be steel trowelled to a true surface equal in smoothness to the spun lining in such a manner not to impair the bond between mortar and steel plate. The guniting and surface finishing shall complete in set and shall be applied continuously without the fuse of construction joints. In case, for any reason whatsoever, the cement does not adhere to the walls of pipes and sloughs off, swabbing the pipe with cement slurry shall not be permitted.

If for any reason it is necessary to interrupt the placing of the gunite for a length of time that will result in the material taking a permanent set, a square shoulders shall be formed at the ends of the sections and or elsewhere by shooting against a backing up strip or by cutting back with a trowel or other suitable tools the irregular edges of the material last placed to a clean unbroken surface perpendicular to the face that will provide a suitable connection or construction joints between such material and the material to be placed subsequently. When performing this work care shall be taken not to shatter or disturb the material remaining in palce or disturb the embedded wire mesh. Before placing fresh material against the surface of such joints, it shall be carefully cleaned and wetted to insure a good bond between the fresh material and that previously to permit sprinkling, it shall be thoroughly wetted by sprinkling and maintained in a moist condition.

5.D.1.6 Curing

Immediately upon the completion of lining of special fittings, the fittings shall be closed tightly at each end by bulk heads. After the mortar has set, but not later than twelve (12) hours after application of the lining, curing shall be commenced by the water spray method and continued thereafter for fourteen (14) days. The water spray method shall consist of sprinkling the mortar lining with water by means of sprinkled heads placed within the barrel of fittings, of such capacity to keep the entire surface of mortar lining continuously wet throughout the entire period of curing and storing.

The application of exterior coating shall begin not less than seventy two hours after the completion of interior lining but in any even, such water spray curing shall be continued inside without interruption during the application of exterior coatings and thereafter until the fitting is loaded for transportation to the trench regardless of the lapse of time after loading. Each fitting shall be closed at both ends during transportation and storage along the trench and the Contractor shall continue the interior water spraying and it shall be scheduled that all the fittings will be laid within 24 hours after such water spray has been discontinued. The Engineer at his discretion may order chemical curing as per manufacturer's specification, if in his opinion water quantity available may fall short for curing. Such chemical curing

shall not be paid as extra item and shall be declared to have been considered while quoting the tender amount.

The Contractor shall protect all cement mortar from damage during handling and transportation. After the internal mortar has been cured, internal bracing's shall be placed at the ends of the fitting and elsewhere, if necessary without damaging the mortar lining to preserve the roundness of the barrel of the pipe. All such bearings except those that may interfere with the joining operation shall remain in position until the fitting has been installed and back filled.

Testing of Guniting :
The required testing of guniting work will be carried out as per relevant I. S. / B. S. S. absorption o water shall be between 8 to 10 %.

5.D.1.7 **Tolerances**

Tolerance for straight pipe and fittings shall conform with the requirements of IS : 3589 or as amended.

a) Straightness
Finished pipe sections shall be truly straight with walls parallel to the axis of the pipe and not out of the alignment by more than 5 mm for every 3 mm of length.

b) Length
Straight pipe shall not very from the specified overall length or effective length by more than plus or minus 1.0 percent; where exact or cut lengths are specified the tolerance on length shall not exceed plus 15 mm or minus 0 mm.

c) Circumference
The outside circumference of the pipe shall not very by more than 0.5 percent.

d) Outside diameter
Outside diameter of a pipe of nominal diameter of over 500 mm shall not very by plus or minus 0.5 percent.

The diameter of plain end (as calculated by measurement of the outside circumference). The diameter of plain end of a pipe of nominal diameter over 500 mm shall not very by more than plus or minus 0.5 percent. Notwithstanding these tolerances and the surface irregularities permitted, any dimensional variation or surface irregularity which permits leakage past the joints shall be cause for rejection.

5.D.1.8 Handling of pipes and specials
Coated pipes and specials that are to be stored on supports shall bear on the uncoated ends only. If bearing on coating is employed the supports shall be not less than 20 cm (8 inches) wide and so arranged to prevent damage to the coating. During handling of the pipes and fittings, coating shall be protected not less than 20 cm wide and placing strips of heavy belting or other approved sheet materials not less than 20 cm wide under all ropes or fastening.

5.D.1.9 Murrum Bedding ~~or Selected earth bedding~~.

The murrum bedding of minimum 300 mm thickness and level shall be provided below pipe, prior to laying the pipe in trenches. It shall be compacted with a light hand rammer. Any reduction in thickness due to compaction shall be made up by adding sand during ramming. For the purpose of the bedding under this only murum shall be used.

5.D.1.10 Lowering and Jointing

The pipe shall be lowered into the trenches by removing only one or two struts at a time. it shall be seen that no part of the shoring is disturbed or damaged and, if necessary, additional temporary struts may be fixed during the lowering perations. It shall also be necessary to see that the gunite coating of pipe is not damaged in any way during the lowering and assembling. After the pipe is lowered in to the trench, it shall be laid in correct line and level by using the levelling instruments, sight rails, theodolite, etc. care shall be taken to see that the longitudinal joints of two consecutive pipes at each circumferential joints are staggered by 90^{o}. While assembling the pipes, the ends shall have to be brought close enough to leave a uniform gap not exceeding 4 mm. if necessary, a marginal cut may be taken to ensure a close fit of the pipe faces. For this purpose, only experienced cutters who can make uniform and straight cuts, shall be permitted to cut the faces of the pipes. No extra payment shall be made for such marginal cutting. There shall be no lateral displacement between the pipe faces to be jointed. If necessary, spiders from inside and tightening rings from outside shall be used to bring the two ends in perfect contact and alignment. It may also be necessary to use jacks for this purpose. In no case shall hammering or longitudinal slitting be permitted. When the pipe is properly assembled and checked for correct line and level, it shall be firmly supported on wooden beams and wedges and tack welded. Some portion of the trench may be refilled this stage so as to prevent the pipeline from losing its alignment. The tack welded circumferential joints shall then be welded fully. Only experienced welders, who shall be tested from time to time shall be permitted to carry out the welding work.

On completion of the pipe jointing and external protection, the trench and the welding pits shall be cleaned of guniting rebound. The welding shall be filled and compacted in 150 mm layers with the bedding material.

Back filling shall be carried out as detailed here under.

5.D.1.11 Providing Steel Props inside the Pipeline (Dia. 1200 mm and above)

In order to effectively provide cement mortar lining to the inside of the pipes and to avoid difficulties during the work, it is necessary that the roundness of the pipes is maintained circular till the lining work is taken up. To achieve the same, steel adjustable screw type props of screw or similar approved make consisting of minimum six legs shall be fixed inside the pipe. The deflection of the pipe should be limited to 2 % of the average diameter. In no case shall the limit be exceeded, even under the full load, in case of pipes laid underground. The design and DRAWINGS of the props that the Contractor intends to use should be got approve by the Engineer before starting the work. While laying the pipes underground, the

Contractor shall provide this propping arrangement from inside to maintain circularity. The se props shall be fixed vertically and at intervals of not more than 1.8 metres or as directed by the Engineer. In case the Engineer finds it necessary, they will have to be fixed in any position. The props should be kept in position at least for three days after the encasing of the pipe in that section is completed or till refilling is done to the full height of fill over the pipe in case the pipes are not encased. The props shall be removed only after obtaining permission from the Engineer. The height of earth fill over the pipe top shall normally be such as to avoid floatation sunder submerged conditions and to have a minimum earth cushion of about 1.50 metres over the pipe whichever is greater. It is also necessary that, in case of buried pipe, adequate side supports from the back filled materials is developed to keep the diametrical deflection within the specified limits. Back filling of the excavated trenches, particularly below the pipe and along the sides shall, therefore, have to be done with proper care and compaction as desired.

5.D.1.12 Precautions against Floatation

When the pipeline laid underground or above ground in along narrow cutting gets submerged in water collected in the trench of cutting it is subjected to an uplift

pressure due to buoyancy and is likely to float if completely or partly empty. In the design of pipeline, provision is made to safeguard against floatation providing sufficient overburden or by providing sufficient dead weight by means of blocks, etc. factory of safety for calculations for check against floating shall be taken as 1.2

In the case of works extending over one or more monsoon seasons, however, special care and precautions are necessary during the progress of work on this account. The Contractor shall close down pipe laying operations well in time for the monsoon. The work of providing blocks, refilling the earth to the required level, compacting the same, etc. shall always be done as soon as the pipeline in the cutting has been laid.

The Contractor shall see that the water shall not be allowed to accumulate in open trenches. Where work is in an incomplete stage, precautionary work, such as blank flanging in the open ends of the pipeline and filling the pipeline with water etc. shall be taken up as directed by the Engineer.

Such works shall be to the Contractor’s account and no separate payment shall be made for the same. The Contractor’s rate for pipe laying shall be deemed to include such precautionary measures against flotation.

Protection of the pipeline against floatation during the Contract Period shall be the responsibility of the Contractor. Should any section of the pipeline float due to his negligence, etc. the entire cost of laying it again to the correct line and level shall be to his account.

Supplying of ISI mark 200 mm dia. C.I. Sluice valve etc comp.

Labour work for Fixing of 200 mm dia. Sluice Valve / Reflux Valve on all types of pipes including all types of Jointing Materials (Excluding transportation and de-watering) etc comp.

GENERAL

This specification describes the design, construction, material, manufacture, performance and testing aspects of Sluice Valves.

CODES AND STANDARDS

The Sluice valves shall generally comply with one or more of the codes and standards.

Standard for Rubber Seated Sluice Valves.
Cast Iron and Carbon Steel Sluice Valves for general purposes. Sluice Valves for General purpose

PERFORMANCE REQUIREMENT

Sluice valve and its operator shall be of heavy duty construction and shall be designed to withstand all working conditions i.e., shall be able to open, close or hold from/at any intermediate disc position, as required, without any difficulty under different combinations of flow and pressure.

Sluice valves located within pumping stations shall be electric motor actuator operated. Sluice valves installed on transmission mains shall be manually operated and provided with gear reducer for bigger sizes (350 NB and above).

During manual operation of valves (of smaller sizes, not provided with actuator or gear reducer), the maximum manual pull to be applied at the handwheel/lever shall be limited within twenty (20) kg.

Valves fitted with power pack unit shall automatically close/open or stayput in the event of disturbance in the system in which the valve is installed so that the "fail safe" criterion is satisfied.

FIXING OF VALVES :

Loading at store and unloading at site of works shall be done carefully using suitable mechanical handling devices such as crane, chain pully etc. The arrangement of housing the valves with chambers and stable and firm foundations. The chamber and top roof cover with removable lid shall be provided so that it shall be possible to remove or replace or recondition the valves seats and to remove the parts without removing the valves from the pipe work. For this suitable flange adapters may be provided. Sluice valves shall have high nitrile rubber seats, preferably metal reinforced, unless otherwise specified and shall be installed in the pipe work in such a manner that they can be removed from the line for dismantling and replacement of rubber seats.

Where the valves are required to be operated electrically, actuators shall be sized to guarantee valves closures at maximum possible differential pressure across the valve. Each actuator shall be supplied with installation, instructions and wiring diagrams and sufficient spare parts.

Valves used on pipeline shall be straight through type and non chokable. Each valve or its operation equipment shall bear an approved name plate stating its function. All operation spindles, gears and head stocks shall be provided with adequate points for lubrications.

The tightening of nut and bolts shall be done smoothly in such a way that no excessive strain occurs on any one side. The nuts shall be tightened on diametrically opposite site at a time.

TENDER DRAWINGS

The following documents shall be submitted by Bidder along with the quotation. Preliminary outline dimensional drawings. Typical cross section drawings. Supplier's data sheet showing valve size, pressure rating, test pressures, list of tests to be conducted etc. List of spares for two years.

Mode of measurement and payment:

The rate shall be for a unit of one number.

Providing RCC 1:2:4 Thrust block with centering, shuttering, curing and finishing for 711 mm dia. M.S. pipe line as direct by Engineer incharge etc comp.

For encasing of pipe at nalla and river crossings. (M:100).

For thrust and another blocks. (M:150).

Details/dimensions of encasing pipes & thrust blocks shall be as per type design approved by the Engineer-in-charge shall be provided by the contractor at this own cost.

MATERIALS:

The specification of materials as given in IS Code is applicable here also.

C. C.M:150:

The proportion of concrete shall generally be one part of cement, two parts of sand and four parts of coarse aggregate by volume giving a strength of 150 kg/cm2 at 28 days. Curing shall be done for 7 days.

Coarse aggregates shall be of black trap crushed chips graded from 10 mm to 20 mm size.

MEASUREMENTS:

The payment shall be made on cu.m. of completed work including all operations and final finishing.

C.C. M:100:

The proportion of concrete shall be one part of cement three parts of sand and six parts of coarse aggregate by volume. Size of coarse aggregate shall be graded from 40 mm to 50 mm size black trap metal. Curing shall be done for 7 days.

MEASUREMENTS:

The payment shall be made on cu.mt. of completed work including all operations and final finishing.

Pipeline Job work:

200 & 300 mm dia. Pipeline Job work for connecting new network with excavation-filling in required length with traffic regulating, testing and all essential materials Rubber Sheet, Nut-Bolt etc. for CI / DI / PVC / HDPE / AC Pressure / RCC / GI / MS / PS Pipe (excluding valve, joints, specials etc. materials, de-watering work, cutting & welding of DI / MS / CI pipes as required) with all required equipments, in case of PL chowk up, like Steel rod / Hard rubber pipe for line cleaning to be provided by Contractor etc comp.

The payment shall be made on number basis.

Signature of contractor:

Dy.Ex.Engineer
R.M.C.

ADD. CITY Engineer
RMC.