

Technical Specification

GUJARAT WATER SUPPLY AND SEWERAGE BOARD

NAME OF WORK:- “Construction of RCC U/G sump, Providing Supplying, Lowering, Laying & Jointing 140 mm dia and 90 mm dia PVC Pipeline, Construction of Pump Room, Electricity for Dahisara Village, Tal. Bhuj under Rejuvenation Programme, YR 2025-26.”

Technical Specification

ITEM NO.1

RCC GSR (description of item turnkey tender)

Preparing structural design of RCC under ground/partially under ground /above high ground level reservoir if required capacity as per relevant IS standards and constructing the same ,including excavation in all types of soil starta including rock including shoring strutting if required for loose soil/to protect from colapse casting 100 mm thick P.C.C leveling course in M-15 ,refiling the pit with proper soil and disposing of the surplus stuff at all lead including cement plaster in CM 1:2 with approved water proofing compound to all over inside container (i.e walls,base,top slab/dome bottam etc all)including at types of labour and material charages of lowering ,laying ,eracting /hosting and jointing of pipe assembly to inlet ,oulet overflow washout and bye pass arrangement as per hydraulic design .Providing and fixing accesseries ,CI manhole frame and cover water level indicator,adequater cowl type ventilators or lantern type ventilator with stainless steel jai.RCC chambers for valves providing and applying three coats of cement paint /snowcem to the out side face of structure.it a so includes sacisfactory water tightness test as per relevant I.S code and painting name of scheme and capacity on the tank as per oriection of engineer in charge.

List of Indian Standards for Design of GSR / SUMP:-

The structural design of GSR shall be in accordance with provisions relevant I.Ss.

- (1) I.S. 3370 part I & II 2009 or latest revised
- (1.1) I.S. 3370 part III & IV 1965 or latest revised
- (2) I.S. 456 – 2000 or latest revised.
- (3) I.S. 1893 – 2000 – 1984 or latest revised.
- (4) I.S. 875, Part – 1 to 3, 1987 or latest revised.

General Specifications:-

- (1) Water depth in container shall be adopted as per data of tender. Capacity shall be calculated excluding free board of the reservoir. If water depth is not specified, the suitable water depth / acceptable to field engineer in accordance with hydraulic
- (2) Shape of container (in plan) specified by in data shall ve adopted in absence circular shape shall be adopted.
- (3) Size shall be fixed as per availability of space (land area) at site / acceptable engineer in charge.
- (4) Effect of overlapping of pressure bulbs on soil due near by structure and proposed sump should be considered.
- (5) Care shall be taken that no damage should occur to nearby existing structure. Compensation shall be paid for the same by agency.
- (6) The minimum concrete grade for RCC shall be M-30.
- (7) HYSD Fe 415 / 500 grade reinforcing bars confirming to I.S. 1786 / 139 shall be considered in design. CRS / TMT bars shall be provided. In saline atmosphere corrosion resistance stainless steel / HCR rebar shall be provided. Any other steel can be used with approval of C.E./ in situation of non availability in market without extra cost.
- 8) Minimum size (or thickness) of various components shall be provided as per tender criteria / specifications in absence as per I.S./ Std. practice of G.W.S.S.B. Minimum dimensions specified for various components in tender data / specifications shall be provided without fail.

(9) The safe bearing capacity (SBC) shall be referred from SBC test report. In absence of report it shall be referred from data sheet. If poor soil is found / water table is met with during excavation SBC shall be scientifically ascertained and design shall be revise. No extra shall be paid for increase in quantity.

(10) DI pipes and special shall only be used if type is not specified in tender.

(11) The rate shall include cost of dewatering during excavation making all arrangement when water table meets within depth.

(12) The structure shall be designed properly to resist uplift due to ground water table specified in data or actual ground water table meets with during excavation. If GWT / Uplift is mentioned in tender and during excavation it dose not meet 7.5% rate shall be reduced.

(13) SS pipes railing shall be provided over sump periphery when sump height is ≥ 1.5 meter above ground level.

(14.a) RCC staircase/RCC Steps should be provided from GL to sump top slab based on the height of the GSR above/below the ground.

(14.b) RCC Staircase with SS railing to be provided inside reservoir container. BB Masonry stair cabin to be provided to cover the same with MS safety door having locking arrangement.

(15) Appearance of structure should be aesthetically good looking acceptable to authority.

(16) Any change in size, shape, depth below GL, height above GL, water depth, F.B., size of member etc can be permitted in exceptional case due to site condition or hydraulic design requirement by C.E. No extra shall be paid for change.

(17) Any change in data, dimensions, shape, water depth, reduction in size if permitted by competent authority and if it reduces quantity then payment shall be reduced prorated.

(18) When capacity of GSR / Sump is > 20 lakh litres two or suitable compartments acceptable to executive engineer shall be designed and provided.

(19) Agency shall engage qualified (at least graduate) consulting engineer for designing the structure and he / she shall visit the site for guidance of work.

(20) 75% part rate shall be payable for concrete, reinforcement and plastering items of container until satisfactory hydraulic testing for water tightness is performed as per tender condition. Till the work shall be treated as incomplete.

Above conditions / general specifications Sr. No. 1 to 20 are part and parcel of tender (contract) and prevail over other provisions in tender.

as above without water table(sub soil water below foundation)

for GSR (U/G sump)with cover slab to be constructed at site situated in seismic zone V,the above rates shall be increased by 2%

3.00 lac liter sump capacity of GSR /SUMP

Technical Specification

GENERAL

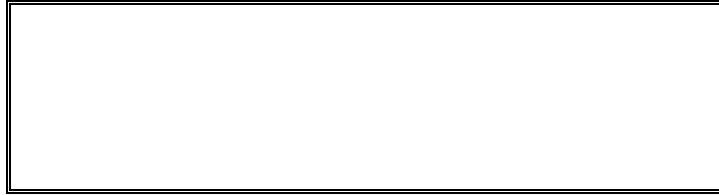
1. Employer's Drawings

1.1. The drawings listed in the Tender document are the Employer's drawings and are provided by the Employer as illustrative of the Specification.

1.2. All data and information furnished in the drawings by the Employer is given in good faith but the Employer does not accept the responsibility for the completeness and accuracy thereof. The same shall be verified by the Contractor promptly pointing out errors or discrepancies thereof to the Engineer.

2. Drawing Sheet Format

2.1. All drawings provided by the Contractor shall be on standard size sheets, prepared on computer with AutoCAD 14 and shall show the following particulars in a title block located in the lower right hand corner, in addition to the name of Contractor and equipment manufacturer, date, scale, drawing number, revision number (R0 for drawings submitted initially, R1, R2, etc. for drawings submitted subsequently) and title.



A blank space of 90 mm x 100 mm shall be provided for the Engineer's approval stamp and provision shall be made for details of revisions to be recorded.

2.2. All drawings submitted by the Tenderer/Contractor shall use the English language and preferably SI units. All drawings shall be clearly and fully cross-referenced to the other drawings as relevant.

3. Tender / Contract Drawings

3.1. Drawings submitted by the Tenderer shall show all the essential items of the Plant offered together with sufficient details to enable the general arrangement of the Plant to be determined.

3.2. The drawings and documents to be provided by the Tenderer / Contractor shall be as per the schedules of price but shall not be limited to those listed:

4. Submissions and Approval of Drawings

4.1. The following shall be the procedure for submission and approval of drawings:

4.1.1. The Contractor shall submit 4 copies of the drawings to the Employer. All the drawings are to be signed by the Contractor or his authorized representatives

4.1.2. The Engineer's Representative will review the drawings and, if found fit for approval, the Employer will return 2 copies to the Contractor duly approved.

4.1.3. In case the drawings/documents are not fit for approval but worth for review, the Engineer's Representative will mark the comments on the drawings and return 2 copies to the Contractor. In such case, the Contractor shall resubmit the revised drawings within two weeks and the same shall be repeated till the drawings are finally approved.

4.1.4. If the submitted drawings/documents are not worth for review, the Contractor will be informed accordingly.

4.1.5. On receipt of the approved drawings, the Contractor shall submit soft copies and documents to the employer.

4.1.6. After tests on completion, the Contractor shall submit, within 15 days of the conclusion of the tests, floppies of the "As Built Drawings" to the Employer.

4.2. When the drawings are received by the Engineer's Representative after revision by the Contractor, he will only review the revision made and hence the Contractor shall carefully identify all the revised details / dimensions and also describe the revisions in the revision block.

4.3. No drawings, with corrections made after taking the prints, will be accepted.

4.4. Approval of drawings by the Engineer shall not relieve the Contractor of his responsibility in terms of the Contract.

5. Delivery, Unloading and Storing at Site

5.1. The Contractor shall be responsible for checking all materials delivered to Site and shall keep the Engineer's Representative fully informed of the state of deliveries. The Contractor shall carry out, at his cost, all instructions of Engineer or his Representative for proper unloading, preservation, maintenance, storage, and security of materials delivered to Site until he fulfills all his obligations under the Contract.

5.2. The Contractor shall erect and maintain on the Site any temporary storage facility as required and approved by the Engineer.

5.3. Multiple handling and movement of materials during storage and retrieval shall be avoided.

6. Spare Parts:

6.1. Spare Parts required after the taking over the Plant shall be filled up by the bidder in the price schedule.

6.2. Spares during pre-commissioning trials, commissioning tests/maintenance, guarantee etc. shall be provided by the Contractor. The necessary spares shall be brought by the Contractor prior to the pre-commissioning test so as to avoid the downtime of equipment due to non-availability of them. All these spares have to be provided as required, by Contractor free of cost.

6.3. All spare parts shall be new, unused and strictly interchangeable with the parts for which they are

intended to be replacements and shall be treated and packed for long storage under the climatic conditions prevailing at the Site. Each spare part shall be clearly marked or labeled on the outside of its packing with its description, number and purpose. When more than one spare is packed in a single case or other container, a general description of its contents shall be shown on the outside of such case or container and a detailed list enclosed. All cases, containers and other packages shall be marked and numbered in an approved manner for the purpose of identification. Spares shall be delivered to Site after the completion of erection but before start of commissioning of Plant along with technical leaflets and details. Spare parts shall be indicated in the assembly drawing showing clearly the part numbers.

6.4. All cases, containers or other packages are liable to be opened for such examination as the Engineer's Representative may require and packing shall be designed to facilitate opening and thereafter re-packing. In the event of the some specific spares offered in the Contract being withdrawn from manufacture owing to changes in design of equipment or similar reasons viz., model being obsolete etc., the Contractor shall inform the Employer before such withdrawal so that the Employer can take timely alternative steps.

7. Tools:

7.1. Tools shall be delivered to site just prior to Tests on Completion.

7.2. The specified tools shall not be used for the erection of the Plant being supplied and except that the Engineer may call upon the Contractor to demonstrate their use or effectiveness, they must be handed over to the Employer in a completely new and unused condition. Should the Contractor require any such tools at site for erection, he shall provide his own.

The test equipment shall include special purpose items essential to the testing or re-calibration of related items of Facilities.

CRITERIA FOR PREPARATION OF DESIGNS OF RCC HGLR & PUMP HOUSE BY PRIVATE AGENCY

The payment for preparation of design shall be borned by the contractor will not be reimbursed by GWSSB. Approved Vendor List for Proof Checking/ Preparation of Structural Design of RCC HGLR by G.W.S.S.B.

LIST OF QUALIFIED STRUCTURAL CONSULTANTS

| | | | |
|---|---|---|---|
| 1 | To, The Consultant Sthapati Designers & consultant Pvt Ltd "Ohm"Chamber" Station Road Navsari-396445 Ph No. (02637) 250330,280330 | 5 | To, The Consultant Stup Consultant Pvt Ltd. 2 nd Floor, Shoopers Plaza-2 Opp. Telephone Bhavan C.G. Road, Navrangpura Ahmedabad-380009 Ph No. (079) 26468495,26468496 |
| 2 | To, The Consultant Ashirwad Engineering Consultant 2 nd Floor, Induchacha House, above Prakash Group Opp. Chhani Jakat naka Baroda-390002 Ph No. (0265) 2761977,2781753 | 6 | To, The Consultant Deesh Civil Engineering Design 17,Sarohi-III, Naroda Nikol-Road, Nikol, Ahmedabad. Ph No. (079) 22893839, (M) 9426067039 |
| 3 | To, The Consultant Saurachna Strucon Pvt Ltd 330,Akshar Arcade Opp: Memnagar Fire Station, Vijay Cross Road,Navrangpura Ahmedabad-380014 Ph No. (079) 26562119,26562120 | 7 | To, The Consultant Shri Manish V.Doshi, 507, Hem Arcade, Dr. Yagnik road, Opp. Swami Vivekanand Statue, Rajkot-360001 Ph No. (0281) 2466303 |
| 4 | To, The Consultant | 8 | To, The Consultant |

| | |
|--|---|
| Dr. H.J.Shah B-9,Sai Krupa Society Vibhag-2, Besides Sai Temple,Water tank Road, Harni Road, Baroda-390006 Ph No.(0265) 2483407 | Mars Planning & Engineering Service Pvt Ltd., 601, Sun Mount Building, Opp. Iscon Mega Mall, S.G. Highway, Ahmedabad-15 Ph No.(079) 40026333 |
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1.0 GENERAL:

1.1.0 Capacity of the container of the tank shall be the volume of the water it can store between the designed full supply level (F.S.L) and lowest supply level (L.S.L) i.e. the level of the lip of the outlet pipe. Due allowance shall be made for 20 mm. thick plastering the tank from inside, while calculating the capacity of the tank.

1.2.0 Freeboard is the vertical distance between F.S.L. and Soffit of covering slab or dome or beam supporting the cover. In any case the free board shall not be less than 300 mm from bottom of beam.

1.3.0 Height of the staging or height of the tower shall be the vertical difference between L.S.L. of the tank and the average ground level at the site of tank.

1.4.0 Dead storage shall be the storage capacity of water below L.S.L. depth of dead storage shall be the vertical distance between the top outlet level and wash out level. The washout pipe level shall be at the lowest portion of the container.

1.4.1 Minimum depth of water for dead storage shall be 100 mm even for flat bottom slab and not more than 300 mm for inlet i.e. bottom dome slab type tank.

1.5.0 Water depth in the tank shall be the vertical distance between L.S.L. and F.S.L. of tank.

1.6.0 The agency has to carry out the safe bearing capacity test from Government approved laboratory.

1.7 As per IS:11682-1985 Page-25 typical reinforcement details "The" Ties or "Links" jointing to vertical bars of shaft is highly needed.

1.8 The Min. concrete grade for RCC shall be M: 30. Proportion of concrete ingredients shall be as per Mix design using weigh batching.

1.9 TMT (Fe 415)or higher grade reinforcing bars confirming to IS 1786-1139/1139-1986 TMT bars shall be used as per detailed specification.

1.10 Maximum spacing between horizontal bracings shall be 5 m (storey height).

1.11 Water level indicator shall be provided and fixed float type /electronic (as specified).

1.12 The rate shall include providing and fixing pipes, specials, and valves required for inlet, outlet, wash out, over flow and bye pass arrangement. The scope of work includes constructing supporting RCC pillars, erecting, laying, fixing and joining pipes and specials etc up to 5m length from face of staging (outer most columns).

1.13 CI pipes & specials shall only be used.

1.14 The rate shall include cost of dewatering during execution making all arrangement and any dewatering technique.

1.15 The structure shall be designed properly for uplift due to Groundwater table specified in data or GWT met with during execution. No extra shall be paid.

1.16 Effective curing shall be carried out as per specifications.

1.17 Agency shall engage qualified (at least graduate) consulting engineer for designing the structure and he/she shall visit the site for guidance of work at least 3 times.

1.18 TMT Fe 415 grade reinforcing bars confirming to I.S. 1786 -1985 1139-1986 shall be considered in design. TMT bars shall be provided. Any other steel can be used with approval of C.E. / in situation of non availability in market without extra cost.

General Specifications FOR RCC H.G.L.R.:-

(1) Water depth in container shall be adopted as per data of tender. If water depth is not specified the suitable water depth / acceptable to field engineer in accordance with hydraulic requirement shall be adopted for capacity.

(2) Shape of container (in plan) specified by in data shall be adopted in absence circular shape shall be adopted.

- (3) Size shall be fixed as per availability of space (land area) at site / acceptable engineer in charge.
- (4) Effect of overlapping of pressure bulbs on soil due nearby structure and proposed HGLR should be considered.
- (5) Care shall be taken that no damage should occur to nearby existing structure. Compensation shall be paid for the same by agency.
- (6) The minimum concrete grade for RCC shall be M-300.
- (7) HYSD Fe 415/500 grade reinforcing bars confirming to IS 1786/1139 shall be considered in design. Any other steel can be used with approval of C.E./in situation of non availability in market without extra cost.
- (8) Minimum size (or thickness) of various components shall be provided as per tender criteria / specifications in absence as per I.S./ Std. practice of G.W.S.S.B. Minimum dimensions specified for various components in tender data / specifications shall be provided without fail.
- (9) The safe bearing capacity shall be referred from the SBC test. The SBS test shall be carried out by the contractor from government approved laboratory and to submit the report. No any extra shall be paid for this purpose.
- (10) CI pipes and special shall only be used if type is not specified in tender.
- (11) The rate shall include cost of dewatering during excavation making all arrangement when water table meets within depth.
- (12) The structure shall be designed properly to resist uplift due to ground water table specified in data or actual ground water table meets with during excavation. No extra shall be paid.
- (14) Appearance of structure should be aesthetically good looking acceptable to authority.
- (15) Any charge in size, shape, depth below GL, height above GL, water depth, F.B., size of member etc can be permitted in exceptional case due to site condition or hydraulic design requirement by C.E. No extra shall be paid for change.
- (16) Any charge in data, dimensions, shape, water depth, reduction in size if permitted by competent authority and if it reduces quantity then payment shall be reduced prorate.
- (17) When capacity of GSR is > 20 lakh liters two or suitable compartments acceptable to executive engineer shall be designed and provided.
- (18) Agency shall engage qualified (at least graduate) consulting engineer for designing the structure and he / she shall visit the site for guidance of work.

List of Indian Standards for Design of GSR:-

The structural design of GSR shall be in accordance with provisions relevant I.Ss.

List of I.S.Code :-

- (1) I.S. 3370 part I to IV 1965 or latest revised
- (2) IS 456-2000 or latest revised
- (3) IS 11682- 1985 or latest revised
- (4) IS 1893-2002 part I to V or latest revised
- (5) IS 13920 -1993, or latest revised
- (6) IS 875part I to III, 1987 or latest revised
- (7) IS 11089- 1987 or latest revised
- (8) IS 1080- 1985 or latest revised
- (9) IS 2911- 1988 or latest revised
- (19) The design of RCC HGLR shall be in accordance with IS-1893-(Part-I) " Criteria for Earthquake Resistant Design of Structures" Part-I General provisions and Buildings and IS - 1893-(Part-II (2002) " Liquid Retaining Tanks (Elevated and Ground supported " and IS 875 Part-III, IS 13920, IS 4326.
- (20) As per IS : 11682 - 1985 page 25 Typical reinforcement details " The " Ties or "Links" jointing to vertical bars of shaft is highly needed.

2.0 GENERAL REQUIREMENTS:

2.1.0 Cement concrete shall be in accordance with IS 456-2000 fine and coarse aggregates shall be confirming to IS 383-1963 or its latest revision. The selection of the type of fine and coarse aggregate to be actually used shall be as directed by the Engineer-in-charge.

2.2.0 For parts of the tank in contact with stored water and closing vapors above FSL shall be in concrete grade M300 or in richer grade.

2.3.0 Inlet, Outlet, Overflow, and Washout pipe:

2.3.1 Inlet Pipe: As per Data Sheet

2.3.2 Outlet Pipe: As per Data Sheet

2.3.3 Overflow pipe: As per Data Sheet

2.3.4 Washout Pipes: As per Data Sheet

Outlet cum washout arrangement shall be provided with sluice valves at GL. Detailed drawing showing all the pipes, duck foot bends, chamber, sluice valves and other necessary connection shall be furnished in the plan. Plain concrete block in M-150 for duck foot bands shall be of minimum depth of 600 mm. The width of the block shall have an offset minimum of 150 mm.

2.4.0 Water Level Indicator:

A water level indicator shall be provided for the tank reading depth of water in meters with least count of 10 cm. The system shall consist of uncorrodible material and shall be simple and easy to maintain. The water level indicator shall be provided and fixed as approved and directed by the Engineer-in-charge.

2.4.1 Access to roof for an entry to the inside of the tanks shall be provided. At roof level of the tank the access to roof manhole from the ladder or stair shall be properly provided with parapet or railing. At ground level or at walkway level the access forgoing up shall be provided with a door and locking arrangement. Railing at roof level and at gallery level shall be provided.

2.4.2 At least two manholes with frame and cover of CI medium type shall be provided with ladder for entering into the container for maintenance purpose. The size of manhole frame shall be of 0.6 x 0.6 meter 54 kg for each manhole frame.

2.5.0 Lightning Arrestor:

Lightning arrestors shall be provided on the roof of the tank as per IS 2309-1969. Position and height of lightning arrestors shall be such that the whole structure shall be enclosed within dome having its apex at top and of the arrestors and generated by a line inclines at 60° to the vertical. The arrestors shall be suitably earthed. Copper strip shall be covered with GI pipe 25-mm dia up to 4-meter height from GL.

2.6.0 The roof of the tank shall be ventilated by providing cowls or ventilators with mosquito proof net for ventilators. They shall be fixed with proper framing. Ventilation area shall not be less than of (A) 0.04% of the free water surface when cowl type ventilators are provided. (B) Cross sectional area of the inlet pipe. (C) Cross sectional area of the outlet pipe.

2.7.1 All tanks shall be checked for seismic forces confirming to IS 1893-1975 or its latest revision and wind forces also.

2.7.2 Water tank in vicinity of mines, galleries and blasting sites or in areas which may be subjected to blasting sites or in areas which may be subjected to blast or shock, shall be designed for the dynamic forces developed due to blast equipment.

2.7.3 Members of towers, which are primarily subjected to dynamic stresses, shall be checked for ductility of the members at the joint.

2.7.4 Staircase and all columns shall be tied together just above foundation level by structural members such as a braced or a tie ring beam.

2.8 Following shall be the minimum thickness of various members of the tank container.

| | |
|------------------------------------|--------|
| Roof slab | 100 mm |
| Bottom slab | 200 mm |
| Container Dome | 100 mm |
| Vertical wall including shaft wall | 150 mm |

2.9.0 Error up to 2 % in weights, forces, moments etc. in the design calculations may be neglected.

3.0 LOADS:

3.1.0 For all RCC and PCC component unit weight shall be taken as 25000 N/m^3 , 24000 n/m^3 respectively, allowance of platter up to 20 mm. Inside surface of container shall be taken in to consideration of in normal circumstances.

3.2.0 Water load shall be taken as 10000 n/m^3 .

3.3.0 Live load and snow load shall be taken as per IS: 875-1964 or its latest revision.

3.3.1 No live load may be assumed while designing the staging (or tower) and foundation for seismic loads.

3.3.2 Live load on gallery all round the elevated tank shall be considered as 1500 n/m^3 .

3.4.0 Wind load as per Fig. i.e. basis maximum wind pressure or Indian including winds of short duration as per IS 875/1964 shall be considered.

3.5.0 Seismic forces on the tower shall be as per IS 1893-1975 or its latest revision. Wind and seismic forces shall not be assumed to act simultaneously.

INCREASES IN PERMISSIBLE STRESSES:

Where stresses due to wind or earth quack temperature & shrinkage effects are combined with those due to dead, live and impact loads the stresses specified in table 13, 16 & 17 of 456-1978 may be increased up to a limit of 33.50%.

4.0 DESIGN:

4.1.0 General:

4.1.1 Shape of the structure shall be circular or as directed by Engineer-in-charge and shall be selected depending upon site condition from the standard shape

4.1.2 General description and salient feature as mentioned below of the design shall be not approved by the Engineer-in-charge and shall be mentioned in the design before detail design calculations starts.

4.2 Sketch showing dimensional section, elevation with plan shall be given.

4.3.1 The safety against overturning of structure shall be computed quite accurately.

4.3.2 Design shall be based on the worst possible combination of various loads, moments, shears and resultant stress in the tank for the following two cases.

(i) Tank Full 'A' (ii) Tank Empty

Tank full means depth of water inside the container up to full height of the container without consideration of free board Or safe bearing capacity of soil based on actual soil investigation report of the laboratory.

Position of sub soil water level. Chemical analysis if sub soil water and soil where possibility of brakish/saline water is ascertained.

Location of site on index plan.

4.3.3 Design shall be based on accepted basis and methods of design as well as the provision of IS 3370-1965, IS 456-1978, IS 1343-1960, IS 2210-1962, IS 2204-1962 etc. and their latest revision. However methods based on experimental investigation as mentioned in para 18.2 % "C" in IS 456-1978 shall not be entertained.

4.4.0 The parts of the structure neither in contact with the liquid on any face more enclosing the space above the liquid as in the case of stages of a tower shall be designed on working stress method on accordance with the requirement of IS 456-1978. Staging may be designed on limit method as per IS 456-1978.

4.5.0 Design of members other than these excluded by above (i.e. roof, walls, floor etc. of the container) shall be based on consolidation of adequate resistance of cracking as well as adequate strength calculation of stresses shall be para s per 3.2.2 of IS 3370 (part-II) 1965 or its latest revision.

4.5.1 PERMISSIBLE STRESS IN CONCRETE FOR RESISTANCE TO CRACKING:

For calculations relating to the resistance of members to cracking the permissible stresses in tension (direct and due to bending) and shear shall confirm the values specified in Table-I of IS 3370 (part-II 1965)

The permissible tensile stresses due to bending apply to the fact of the member in contact with the liquid. In members less than 225 mm thick and in contact with the liquid on one side, this permissible stress in bending apply to the face remote from liquid.

4.5.2 FOR STRENGTH CALCULATION:

In strength calculation, the permissible concrete stresses shall be in accordance with para-44 of IS 456-1978. Where the calculated shear stress in concrete alone exceeds the permissible value reinforcement

acting in conjunction with diagonal compression in the concrete shall be provided to take the whole of the shear.

4.5.3 Permissible compressive stress (Directly only) insheels (i.e. Top Dome, Wall and shall be reduced by 43% for 10 cm thick walls. For thickness more than 30 cm, the compressive stress shall be reduced by 50% and for inter media thickness 10 cm. to 30 cm. linear interpolation shall be done.

4.6 PERMISSIBLE STRESSES IN STEEL:

4.6.1 For resistance to cracking the steel and the concrete are assumed to act together. For checking the tensile stresses in un cracked concrete for avoidance of cracks, the tensile stress in the steel shall be the product of the modular ratio and the corresponding allowable tensile stress in concrete as per IS 3370(part-II) 1965 or its latest revision. Modular ratio "M" for different concrete mix shall be taken as under:

| Grade of Concrete | Modular Ratio "M" |
|-------------------|-------------------|
| M-150 | 19 |
| M-200 | 13 |
| M-250 | 11 |
| M - 300 | 9.33 |

4.6.2 For strength calculation (concrete assumed to be cracked), the permissible stresses in reinforcement shall be as per Table -2 of IS 3370(part-II) 1965 or its latest revision. For steel, the stresses shall be as per IS 1966 or its latest revision.

4.7.1 The analysis of staging of the tank shall be done by using any established method such as portal method etc. The staging shall be analyzed from combination of dead, dead live loads and wind seismic loads. The effect of continuity of beams of the junction shall be properly accounted and column reaction worked out, for different condition of loading, axial force, shear force, bending moments.

4.8.1 Modules of elasticity of concrete MEC shall be taken as 5700/FC where equal to characteristic cube strength of concrete in N/m² as per IS 456-1976.

4.8.2 Columns shall be checked for tensile stress for both the conditions as mentioned in para 4.3.2 in combination with axial tension and bending due to wind or seismic loads, and shall be checked for bond for maximum tensile stress arrived.

4.8.3 Columns may be assumed to fix at the top of footing.

4.8.4 Water Tower in seismic zone (V) of IS 1393-1975 twin diagonal (crossed) backing of steel in vertical plane in addition to the horizontal bracing may be provided.

4.9 COLUMNS:

4.9.2 Reinforcement shall be provided on both faces of the load-bearing shaft. Minimum vertical reinforcement in the shaft shall be of 0.4% of the gross concrete area required. Minimum horizontal reinforcement shall be 0.3% of the gross concrete area. Required in ease, for tower in high seismic zone (V) minimum horizontal reinforced shall be 0.4% of the gross concrete area; for before bars of medium tensile or height tensile steel the above steel requirements may be reduced by 20 %.

4.9.3 Shaft shall be checked for combined axial load and bending to the wind or seismic loads and shall satisfy the provision of IS 456-1978 in tank full and tank empty condition.

4.9.4 Horizontal construction joints in shaft shall be as minimum as possible. On account of minor in accordance in construction shaft the allowable direct compressive stress shall be reduced by multiplying with 0.8% factor. On account of buckling reduction factor, if any, shall be multiplied to the value 0.85. For the calculation of direct compressive stress the contribution of steel shall be neglected.

4.9.5 Age factor for increasing strength shall not be considered.

4.9.6 Shaft shall be checked for tensile stress for worst condition in combination with axial tension on bending due to wind or seismic load.

5.0 FOUNDATION:

5.1 The permissible increase in bearing pressure for different types of foundation shall be as per table -I of IS 1893-1965 or its latest revision. When seismic forces are considered and for wind forces it shall be as per IS 1904-1966 or its latest revision.

5.2 For the purpose of the design of foundation the loading data shall be given the magnitude of vertical load, lateral load and moments at top of footing (Foundation) level. The data shall be made available, for both the cases as per para 4.3.2.

5.4.1 The foundation area, door, individual column footings, combined footings, angular rafts and solid rafts shall be worked out on the basis of lower most value of the safe bearing capacity or allowable bearing pressure values as derived from IS 1904-1978, IS 9403-1971, IS 8009-1976 or their latest revision.

5.4.2 In case of purely cohesive and CI pipe of soil particulars attention should be given to IS 1903-1978 clause 6 & 7. Settlement shall be calculated as per IS 8009 (part I) 1976 for foundation.

5.4.3 In case of purely cohesion less soil, foundation shall be design for safe bearing capacity and shall be checked for permissible total as well as differential settlement values as given in relevant IS.

5.4.4 If the foundation consists of individual columns footing, minimum clear distance between centers of column shall be equal to twice the width of footing and clear distance between the edges of footing shall be not less than width of footings.

5.4.5 In case of soil beneath the footings are not of the same characteristics the footing shall be designed for the soil having lowest SNC or ANP as the case may be. In such conditions the permissible limits of total as well as differential settlement shall be limited to 75% of the permissible limit given in ISS.

5.4.6 For special type of foundations like well foundation under beam pipe foundation etc., decision of Superintending Engineer, Public health Design Circle shall be final and binding to the designer.

5.4.7 Classification of soil and all characteristics of soil relevance to BSBC and APB shall be as per the soil in irrigation reports of Government stipulation. Government approved investigators.

5.5 For the design of foundation angular or solid raft type, the "PLACE THEORY" shall be adopted.

5.6 In normal circumstances minimum 100-mm thick plain cement concrete with 100 mm projection around in Grade M 100 with coarse aggregate as metal shall be provided as leveling course. Where injurious soil progressive water is expected the leveling course shall be grade not weaker than M 15 and if necessary sulfate resisting or the special cement shall be used. The ground level within the foundation area of the structure shall be consolidated properly with a suitable slope to drain out rainwater outside the foundation

6.0 DETAILING:

6.1 MINIMUM REINFORCEMENT FOR WATER RETAINING MEMBER:

6.1.1 The minimum reinforcement in walls, floors, roofs, in each of two directions at right angle shall have an area of 0.3% of the concrete section in that direction for sections up to 100.00 mm thick. For section for thickness greater than 100 mm and less than 450 mm thick, minimum reinforcement each of two directions shall be nearly deducted from at 0.3% for 100 mm thick sections or greater two layers of reinforcing steel shall be place one near each face of the section to make up to minimum reinforcement specified in this clause.

6.1.1 The minimum reinforcement specified in this 6.1 above may be decrease by 20 % in case of high yield strength bars confirming to IS 1786-1976 or IS 139-1966.

6.2.1 Minimum clear cover to reinforcement under normal conditions shall be as per para 25.4 of IS 456-1978.

6.2.2 For liquid faces of parts of members either in contact with the liquid or enclosing the space above the liquid shall be as per para 7.2 IS 3370 (part-I 1965).

6.2.3 In case of Raft Foundation, the cover to reinforcement shall be as per 4.6.2 of IS 295 (part-I) 1973.

6.2.4 In case of "shaft" the cover to reinforcement shall be as under; Vertical 25 mm, Horizontal 15 mm

6.3 For members of structure in contact with water, effective cover shall not be more than 60 mm. Even bars subjected to bending stress, or bars subjected to tension due pure tension in the member the effective cover shall not more than 75 mm.

6.4.1 Spacing of reinforcement shall be as per para 25.3 IS 456-1978.

6.4.2 Spacing of lateral ties for column shall satisfying provision of para 25.3.2 'C' of IS 456-1978.

6.4.3 The additional suggested criteria for reinforcing steel which accounts for existing moments, tension etc. i.e. other than temperature or binding steel shall comprise of minimum 8 mm for deformed or 10 mm mild steel bars.

6.4.4 The spacing between two para in main reinforcement shall distribution steel, stirrups, links etc. shall not exceed 30 cm.

6.5 For members of the container, the maximum diameter of reinforcement in tension shall not exceed as given below depending upon the geometrical percentage of reinforcement. (Ratio of tensile steel to gross is concrete.)

| | |
|------------|-----------|
| Up to 1.0% | 16 mm dia |
| Up to 1.5% | 22 mm dia |
| Up to 2.0% | 25 mm dia |

Note:

1.0 In case of dispute regarding interpretation any above clause, the decision of the Superintending Engineer, Public Health Circle, Concerned will be binding to the Designer.

2.0 In case of any clauses not included in the above criteria the decision of the Superintending Engineer, Public Health Design Circle will be final and binding to the Designer.

**INSTRUCTION FOR PREPARATION OF DESIGN OF RCC ESR/HGLRS
(ONLY FOR SELF DESIGN BY CONTRACTOR)**

1.0 The design of RCC ESR supplied by the contractor in his own design shall be in accordance with the design criteria prepared by the Public Health Design Circle, Gandhinagar. The design and drawing supplied by contractor should be accepted after the approval by the competent authority from the Department.

2.0 The contractor should mention the name, qualification, experience etc. of the design engineer who will be the necessary design scrutiny work etc. The design Engineer should attend the office of the Department if required at any stage prior to the acceptance of design or drawing construction with reference books etc. It will be the duty of designer to submit the design drawings and compliance of remarks by the Department.

3.0 PAYMENT AS PER PAYMENT SCHEDULE

4.0 COMMON CONDITIONS:

4.1 All petty items occurring if the work shall be carried out in workman like manner as per specification published by G.W.S. & S. Board and as per general specification current in the Division and as per instruction of the Engineer-in-charge from time to time.

4.2 Extra charge of claims in respect of extra work shall not be allowed unless such works are ordered in written by the Engineer-in-charge and are claimed for in specified manner before the work is taken in Hand.

4.3 The contractor shall engage on in experience and qualified supervisor as his authorized agent for the work. He shall be responsible to take from time to time such orders as may be given by the Engineer-in-charge to carry them.

4.4 As order book shall be maintained on the work site and the contractor shall sign the orders given by the Engineer-in-charge and he shall carry out them promptly. The order books shall be surrendered to the Department on completion of Work.

4.5 The contractor shall have to clear the site of work before it commences and after the work is completed for which separate claim shall not be entertained.

4.6 In addition in the required stores the contractor shall provide at his own cost the suitable temporary office shed with a covered area of about 20 sq mt. with necessary furniture for the use of Government staff while in works. The shed and furniture on completion of the work shall be removed by the contractor at his own cost.

4.7 The contractor shall provide at his own cost all labour charges setting out the as may be required for lining and setting out the as may be required for lining and setting up the works satisfactory and adequate facilities site scaffolding etc. for facility of checking his work or taking measurements etc.

4.8 Department shall give reasonable facilities to the contractor to enable him to obtain controlled materials at controlled rates as may be fixed from time to time. The contractor shall however not be entitled to claim any compensation extra time limit to account of non-supply at controlled rates. The materials obtained shall be only used for the work in question. Any materials remaining surplus shall be neither disposed nor removed by the contractor without obtaining written permission of Department to that effect. Government shall have the right to take delivery of the surplus materials at the original purchase price of the receipt

contractor shall be sue of such materials to the satisfaction of Engineer-in-charge and submit in monthly statement thereof.

4.9.1 The contractor at his own cost expense shall provide necessary housing accommodation and the sanitary.

4.9.2 Arrangement for his staff and labour and shall pay direct of the authorities concerned all rates. Taxes royalties and other charges.

The contractor shall also comply with the requirement of the Health Department as regards anti malarial measures etc.

4.10 Water require for the execution of work and for the water tightness test of the reservoir shall be supplied by the contractor at his own cost in manner satisfactory to the Engineer-in-charge of work.

4.11 The contractor shall not be entitled to claim compensation from the Government. For works suffered on account of delay where such delay is caused either by (i) Difficulties relating to the supply of Railway Wagons, (ii) Force majeure, (iii) Acts of the God, (iv) Any other reasonable caused beyond the control of the Department. In case of delay Govt. shall however grant such extension of time limit for the completion as may appear reasonable to the Engineer-in-charge and his decision shall be final.

4.12 The contractor shall be responsible to pay complete compensation to his staff and to his labours according to the labour compensation rules, on account of accidents and less of life or less of the life due to accident.

5.0 DECLARATION:

The contractor shall made declaration as under:-

"I have made myself thoroughly conversant conditions as regards the availabilities or otherwise of all construction materials skilled and unskilled labour on which. I have quoted my rates for this work. The specifications, drawing and design of this work have been careful studies and are understood by me before the submission of this tender.

DETAILED SPECIFICATION

Detailed specification given here shall be treated as extension or partial modifications to the specifications of respective items given in the volume of specification published by Gujarat Water Supply and Sewerage Board.

1.0 EXCAVATION FOR FOUNDATION:

1.0 When the rates are to be quoted for a work based on " contractors own design" the word excavation for foundation shall mean excavation for foundation in all types strata such as soil soft murrum as well as hard rock up to the designed depth at which foundation is to rest. No extra payment will be given for any change in strata at the same place. The rate shall also include dewatering and shoring strengthens if and where found necessary.

1.1 Excavation shall be carried out as per approved drawing. The excavation made deeper or wider than that required as per drawing shall not paid, but such deeper excavation if carried out shall have to be filled up using C.C. 1:4:8 by the contractor without extra cost. If the type of strata require wider excavation at top (GL) Then contractor shall excavate the trench accordingly but no extra payment for such wider excavation shall be made.

1.2 The rate shall include providing cured warnings lights during night time providing barricading consisting of metal ropes and bamboo for which no extra payment will be made.

1.3 The contractor shall make his own arrangements to obtain prior permission directly from relevant authorities for staking of excavated stuff near work side. If he fails to obtain such permission, then he will have to make his own arrangement with out claiming extra cost to transport and stack the excavated stuff at a suitable place approved by the Engineer-in-charge of work.

1.4 The excavated stuff shall be stacked at least 3.0 meter away from the edge of excavated trench, If enough space is not available at work site then the excavated stuff shall be stacked at suitable place situated away from site. Similarly the surplus stuff shall have to be disposed off at a suitable place for which contractor shall have to obtain permission directly from relevant authorities. No extra payment for transportation of excavated stuff or surplus stuff shall be made.

1.5 No excavated stuff shall be disposed off or used for any purpose other than refilling without prior permission of Engineer-in-charge of work.

1.6 Details shown in the data sheet regarding water table are approximate. The contractor should make his own arrangements for taking trial pots at his own cost more quoting his rates for as certain type of strata water table, quantity of seepage water etc.

1.7 Work at nighttime shall be carried out only with written permission of Engineer-in-charge.

1.8 Bottom of the excavated foundation trench shall be sprinkles with water (If water table is not above foundation level) and wall rammed to obtain a reasonably firm and level bedding.

1.9 The rates shall include continuous dewatering of seepage water or rainwater from, trenches to keep the trench dry particularly during casting of base concrete. Concrete for footing and columns of shaft etc. till concrete fully cures etc.

1.10 Whenever collapsible types of strata are encountered pucca shoring and strutting shall be invariably claim shall be entertained.

2.0 C.C.M. 100 BASE CONCRETE FOR LEVELLING COARSE:

2.1 For all practical purpose and in absence of proportioning of concrete on base of preliminarily tests, C.C. 1:3:6 may be provided as a leveling course i.e. one part of cement three parts of sand and six parts of black trap kapachi. Specification for various ingredients of concrete such as sand, cement, kapachi, water shall be as these given in specification for C.C.M. 15.

2.2 While laying base-concrete for leveling course the concrete shall not be dumped from above but shall be carried out to the bottom and gently placed from a height not exceeding 1.5 meter. If concrete is transported by chutes, then the same shall be remixed at bottom of chutes to overcome any segregation that might have occurred.

3.0 C.C.M. 150:

3.1 As far as possible the preparation of various ingredients of concrete shall be determined on the bases of preliminary tests as per ISS using the actual materials to be used on site. However in absence of such preliminary tests the volumetric proportion of 1:2:4 may be adopted i.e. one part of cement, two parts of sand and four parts of kapachi, water just sufficient to attain desired workability may be added. However the aim while proportioning should be to fix the proportion of aggregation and water cement ratio shall be always sufficiently low enough to get desired strength.

3.2 Materials:

3.2.1 Coarse aggregate shall consist of tough angular black trap kapachi. The kapachi shall be obtained from approved source only. Normally at least two stock piles of different size of 12 to 20 mm and 25 mm to 40 mm shall be maintained. It will however, be preferably to maintain third stock pile of 6 mm to 12 mm also for better control on mix of concrete.

3.2.2 The maximum size of coarse aggregate to be used shall be as large as possible within the limits of requirements, based on size of member and spacing of reinforcement. But aggregate exceeding 40 mm shall not be used in concrete for ESR and HGLRs.

3.2.3 Depending up on the size of member, spacing of reinforcement and degree of workability desired, the coarse aggregates from different stockpiles may be mixed in a suitable proportion to get a uniform mix that does not segregate.

3.2.4 The coarse aggregate shall not contain dust, clay or other such harmful material. If directed by the Engineer the same shall be washed with water and dried before being used.

3.3.0 Fine Aggregates:

Fine aggregates shall consist of coarse, angular river sand free dirt and other harmful organic materials. If directed the same shall be screened and washed before being used. Sand brought from approved source shall only be used.

3.4.0 Cement:

Contractor shall provide a temporary store with double lock arrangement for storage of this cement on work site without extra cost. Cement shall be stored in such a way that it is not affected by moisture.

3.5.0 Water:

Water to be used in concrete work shall be potable, free from injurious elements such as chloride or sulphate etc. and shall be obtained from approved source only. Contractor shall make his own arrangements to obtain and store sufficient quantity of water at all times.

3.6.0 Reinforcement Steel:

The reinforcing bars to be provided with TMT Steel & shall confirm to its relevant IS specifications. The steel shall be supplied by the contractor at his own cost. The contractor shall cart the materials on site at his own cost. The steel bars should be cleaned should be free from rust. The binding material shall be provided by the contractor at his cost. The dimension of spacing and binding bars will be as per design. The reinforcement shall have to be got approved by the Executive Engineer or his Deputy Executive Engineer before starting concreting. Necessary certificate for testing of the reinforcement bar shall have to be provided by the contractor at his own cost. All main reinforcement shall be necessarily be tied to the cross reinforcement to prevent any displacement during laying of concrete.

3.7.0 HANDLING:

3.7.1 The bars shall be carefully handled in technical manners.

4.0 FORM WORK:

Form work shall consist of steel plates or smooth timber planks to be joined by nuts, bolts, nails or pegs so as to have a reasonably water tight joints. Sufficient number of vertical and horizontal supports shall be providing when completed. Formwork shall be sufficiently sturdy & strong to absorb all stresses and movements. Before concrete is placed in position the formwork and steel shall be got checked through Engineer-in-charge of work. Advance intimation shall be given to the Engineer-in-charge for this purpose. The ultimate responsibility for safety and of lives of workmen and that of forms etc. from beginning of work till its completions shall always rest with the contractor proper ladders and plant forms for easy access shall be provided by the contractor without extra cost.

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 Engineer In charge. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

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

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

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

- (a) Development of adequate concrete strength;
- (b) Permissible deflection at time of striking form work;
- (c) Curing procedure employed - its efficiency and effectiveness;
- (d) Subsequent surface treatment to be done;
- (e) Prevention of thermal cracking at re-entrant angles;
- (f) Ambient temperatures; and
- (g) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

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

5.0 MIXING, TRANSPORTATION AND LAYING:

5.1 For important works like ESR and HGLRs mixing of concrete shall be invariably done in approved machine mixer only. The mix obtained from the mixer shall be a uniform mass consisting of all aggregates coated with cement paste.

5.2 Fresh concrete shall be transported horizontally in ghamellas or wheelbarrows. Vertical transportation shall be done either by manual labour or using mechanical vertical lifts. When chutes are used for transportation, care should be exercised to avoid segregation and concrete may be remixed at bottom of chutes to get uniform mix. Before any concrete is placed in position all loose materials such as dirt, chips of stones, wood, steel etc. should be removed. Inner side of forms should be coated with thin layer of oil to get a good finished surface.

Concrete should not be dumped from above in which case aggregate will segregates, but placed gently from a height not exceeding 1.5 meter. Compaction of concrete shall be done by vibrators till cream appears at top. Over vibration shall be avoided to avoid segregation.

6.0 CURING:

After concrete is set in position it shall be kept continuously wet with water for 7 days either by using gunny bags (column and walls) by ponding (slab) or as directed by spraying of water.

Unless otherwise specified the rate shall include finishing the exposed surface to get good finished surface.

The forms shall be kept in position for period given below:-

| | | | |
|----|---|----|------|
| 1) | Vertical sides of walls, beams, columns | 2 | Days |
| 2) | Slabs (props left under.) | 7 | " |
| 3) | Bottom of beam (props left under) | 7 | " |
| 4) | Removal of prop to slab spanning up to 4.5 superious over 4.5 m. | 7 | " |
| 5) | Removal of props to fearus spanning up to 6.0 m. | 14 | " |
| 6) | Spanning over 6.0 m. | 21 | " |

C.C. M-300:

Specification for various ingredients of concrete such as sand, cement, kapachi, water shall be as per given in specification for C.C.M. 15. The proportion of mix for Cement Concrete M-300 shall be of as per Mix Design. Since M300 mix is normally used in water retaining parts of container where the aim is not to get dense, strong and watertight concrete, special care shall be exercised in controlling proportion of aggregate, water cement ratio, compaction, and curing.

7.0 PROVIDING AND PLACING IN POSITION STEEL REINFORCEMENT:

7.1 Reinforcement bars to be used in RCC work shall have to be supplied by the contractor. The rates include providing, cutting, bending, binding, hooking and placing in position including cost of binding wire. The bars shall be fusion bonded and epoxy coated.

7.2 Depending upon the type of reinforcement steel proposed in design (i.e. M.S. or deformed etc.) the steel shall confirm to relevant ISS codes in practice. Contractor shall produce necessary test certificate in absence of which the steel bars shall be get tested by the Department at the contractor's cost.

7.3 Steel bars shall be cut, bent up, hooked bound with wires and then placed in position as per approved drawing. The steel shall be got checked through Engineer-in-charge. Before any concrete is placed in formwork advance intimation shall be given to the Engineer-in-charge for this purpose. The steel shall be cleared of any dust or rust that might have been deposited on bars.

7.4 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 SPECIAL OFFICER & CHIEF 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 scaling of the concrete cover.

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

Substitution of reinforcement, laps/splices not shown on drawing shall be subject to SPECIAL OFFICER & CHIEF Engineer's approval.

8.0 M.S. LEDDER FROM GL. TO TOP OF CONTAINER:

The materials shall be best quality & approved by the Executive Engineer or his Deputy Executive Engineer. The M.S. flat 10mm x 60mm size shall be kept 50 cms part and 20mm dia steps shall be welded or riveted to the iron at 30 cms interval or as directed by the Engineer-in-Charge.

The ladder shall be anchored properly & adequate stays of 10mm x 50mm flat iron fixed at 3 meter centre shall be provided. The ladder shall be fixed in 1:2:4 C.C. at the bottom as directed.

The stays of 10mm x 50mm flat iron shall be fixed at 3.00 mtr centre to centre. The whole work shall be carried out in a best work manlike & to entire satisfaction of the Executive Engineer two coats of anticorrosive paint shall be applied to the ladder after thoroughly cleaning the steel work.

9.0 WOODEN WATER LEVEL INDICATOR:

9.1 A wooden water level indicator of approved size and type shall be provided and fixed by the contractor. It shall consist of wooden plank of 250 mm x 40 mm.

9.2 The divisions on water level indicators shall show distance of 10 cm. clearly. A copper or PVC float of 500-mm dia and 50 mm height shall be provided along with steel wires pulleys etc. The entire arrangement shall be first got approved by the Engineer-in-charge of work. Letter and marking shall be painted with approved enamel paint.

10.0 COPPER LIGHTENING CONDUCTOR:

Copper lightning conductor with size of strip 20 mm x 3 mm with clamps and screw and copper plate of 600 mm x 600 mm x 6 mm and copper red as per specification no. 120 of PWD Hand book Vol I (ISS - 2309) shall be provided and fixed by the contractor. It shall consist of copper arrestor at top, copper conductor from top up to GL and copper Earthing plate shall be 1 m. deep below GL and filled with salt and charcoal to transmit the current to earth, minimum dimension of these part shall confirmed to relevant ISS. Heights of the arrestor shall be such as to enclose the entire structure with imaginary cone generated by a inclined at 60° degrees with vertical at top.

11.0 Providing and fixing CI flanged pipes and special such as duck foot bends, crippling flanges bell mouthpiece etc. for inlet outlet overflow and wash out.

11.1 Diameter and length of above pipes shall be as given in Appendix - A. DI flanged pipes shall be vertically cast double flanges and shall be confirm to relevant ISS. They shall be first get approved by the Engineer-in-charge of work.

11.2 Item shall include providing all specials such as crippling flanges, and duck feet bends etc. as may be required on site.

11.3 The Item shall also include cost of all jointing materials such as nuts, bolts, rubber packing, white zinc or pig lead or lead wool if required.

11.4 Pipes shall be fixed perfectly vertical and straight.

11.5 Before fixing in position pipes shall be coated with two coats of anticorrosive paint.

11.6 The pipes and specials shall be tested hydraulically. Leakage if found shall be repaired without extra cost.

12.0 PROVIDING AND FIXING CI SLUICE VALVE:

12.1 Diameter of CI sluice valve shall be as shown in Appendix - A. CI sluice valve shall be of class - I confirming to IS - 780-1980.

12.2 The rate includes providing and fixing CI sluice valves with tailpieces including jointing materials such as nuts, bolts, rubber packing zinc etc.

12.3 The rate includes giving hydraulic test to the satisfaction of Engineer-in-charge of work.

12.4 Sluice valve shall be supplied with necessary spindle or wheel for operating the same.

13.0 PROVIDING AND FIXING C I M H FRAME AND COVER:

Two number of C I M H frame and cover shall be provide and fixed in top slab of container. The dimensions and weight shall be as shown in Appendix - A. The C I M H frame and cover shall be first got approved by the Engineer-in-charge. Two coats of anticorrosive paints shall be applied before fixing them in position.

14.0 C I COWL TYPE VENTILATORS:

The C I Cowl type ventilator should be of 100 mm dia shape with flanged and roughing screen shall be as per Appendix - A. The rate includes providing and fixing C I Cowl type ventilator as per Appendix - A including cost of all jointing materials such as nuts, bolts, white zinc rubber packing etc. Two coats of

anticorrosive paints shall be applied to the surface before they are fixed in position. They shall be first for approved by the Engineer-in-charge.

15.0 PROVIDING AND FIXING M.S. LADDER INSIDE CONTAINER:

Contractor shall have to fabricate and fixed M.S. ladder. The ladder to be fixed shall be fabricated from M.S. flat of 10 mm x 65 mm or M.S. angle having equivalent modular of selection 20 mm dia. Bars shall be fixed at 30 mm c/c. to act as steps. The ladder shall be 45 cm. wide if length of ladder is more than 8.0 m. Three coats of approved anticorrosive paint shall be applied to the ladder. The design of M.S. ladder shall be got approved by the Engineer-in-charge before it is fabricated and fixed in position. Rate includes providing and fabricating, painting and fixing in position of M.S. ladder as above.

16.0 CONSTRUCTION OF VALVE CHAMBER:

The chamber shall be such height so as to have the C.I.M.H. cover fixed flush with G.L. or a little above the G.L. as directed. The depth of chamber will be so depending upon the invert of pipe and G.L. at site. The M.H. frame and cover shall be fixed on the chamber if required and as directed by the Engineer-in-Charge. Masonry walls of the chamber shall be of 25 cms. Thick & burnt bricks in cement mortar 1:6 shall be used. The floor shall be of cement concrete 1:3:6 with trap metal 25mm to 40 mm size & 150 mm thick.

The interior walls of the chamber shall be plastered with C.M. 1:6 12mm thick in case of brick masonry and 20mm thick in case of masonry chambers and properly cured.

Exposed faces of the masonry are to be pointed with cement pointing 1:3 for the covered portions. The joints shall be struck in cement mortar along with the progress of the masonry work. The off-set for the concrete foundation shall be 150 ms. On all sides beyond the walls of chamber.

Whenever, a tail pieces or a special enters or leaves the mason chamber, brick on edge must be so laid around the upper half of the pipes so as to form as such to prevent the weight of the masonry chamber over it.

On the top of the masonry walls, 10cms thick R.C.C. (1:2:4) slab with reinforcement as directed by the Executive Engineer or his representative shall be provided.

Cement concrete for slab shall be of proportion of 1:2:4 with black trap metal 12mm to 20mm size on part of cement 2 parts of sand 4 parts of aggregate by volume necessary from work and centering shall have to be provided by the contractor at his cost.

The R.C.C.work shall have to be cured for 14 days. The R.C.C. slab shall have full bearing on all the surrounding walls.

Under the special circumstance precast RCC slab. If required, in pieces shall be provided. If directed by the Executive Engineer or his representative any extra cost.

This item includes each completed chambers with materials, labour, curing, finishing etc. complete in all respect.

17.0 PAINTING LETTER:

The words for indication for capacity & programme name of ESR shall be painted on the container. The letters shall be 45 cm high and the black ground of suitable color shall be provided. Approved enameled paint shall only be used for painting letters and background. Entire work shall be carried out as per instruction of Engineer-in-charge.

18.0 PROVIDING AND FIXING GI PIPE RAILING AROUND TOP SLAB:

Railing shall consist of 3 raw of 25 mm dia GI pipes fixed in M.S. angles of 60 mm x 60 mm x 6 mm 0.9 m. height fixed at 2 m c/c. The materials shall be got approved by Engineer-in-charge before fabrication. Three coats of approved anticorrosive paint shall be applied to M.S. angle before they are fixed in position.

19.0

20.0 WEATHER COAT PAINT:

The paint shall be of best quality and approved make. The work shall be carried out as per manufacturer's specification. The paint shall be of required shade approved by Engineer-in-charged. The paint shall be got approved before use.

The painting works shall be carried out as per technical manner. The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fiber brush or and suitable means and washing the surface. All loose pieces shall be scrapped out and hole shall be stopped with mortar.

After cleaning the surface the watering hole surface and applied snowcem paint in three coats. Necessary curing, scaffolding, materials, labours are including in this item.

21.0 WATERPROOF CEMENT PLASTER:

The cement mortar shall consist of two parts of fine river sand free from any dust and other organic matter and one part of approved quality of cement. The mortar shall be properly mixed on watertight platform. The mortar shall be used within half an hour after mixing. The water proofing materials weighting 1.5 kg of powder in one bag of cement shall be added.

The plaster shall be applied in uniform thickness of 20 mm and shall be properly smoothened with wooden & finished with cement finishing of required. The curing shall be done at least for week by sprinkling the water over the wall. The wall shall be tested for waterproofness. The rate includes the cost of waterproofing materials. The test for waterproof ness shall be carried out by the contractor at his own cost by filling the contractor with water and it shall be checked out that there is no percolation of water from the wall. Payment shall be made per sq. m. of plaster done.

22.0 BRICK PITCHING/CC FLOORING:

Brick Pitching:

The brick shall be of proper quality, standard size, uniform in color, well-burnt and free from cracks. The work of brick pitching shall be carried out in C.M. 1:6. It shall be laid as per the drawing and directed by the Engineer-in-charge. The bricks shall properly soak before being using in work. No brickbats shall be use except the bricks. The joint shall be racked out 20mm depth. Every day at the end of the day's work the cement pointing in C.M. 1:2 shall be carried out by line as directed by the Engineer-in-charge. The excavation required for brick pitching shall have to be carried out by the contractor as directed including necessary temping consolidation etc. complete.

After completion & testing of work the contractor shall have provide & fix the Marble 'Takti' of required size with necessary writings, as directed by the Engineer-in-charge.

CC Flooring:

The concrete shall be consists of one part of approved quality cement with two parts of clean and angular sand without parts of coarse aggregates of 12mm to 20mm size.

Portable water shall be added as per required quantity and shall be mixed in best work manlike manner.

Necessary form work shall be done by the contractor. Lining work shall be carried out as per instruction of Engineer-in-Charge.

The entire work shall be cured atleast for 14 days the total thickness of the flooring shall be kept 50mm.

The rate include all materials labour for mixing finishing, lining curing form work etc.complete

23.0 RCC work of shaft, container and staircase should be of well finished condition if the same is not satisfactory than contractor since have to finish the surface with 12 mm thick plaster C.M. without any extra cost.

24.0 The contractor shall have to make arrangement for testing of steel bars brought on site and concrete cubes, for different mix at different stage like foundation, shaft, column, and cube should be cast on site and send Govt. approved laboratory for compressive strength at 28 days. Results must be produced in office before taking payment of work done. Testing charge must bear by contractor.

25.0

1) Conditions: The paint is supplied in two packs, fine zinc dust mixed with epoxy resin as base and liquid hardener. They are to be mixed in following ratio.

| | By Volume | By Weight |
|-----------------------|-----------|-----------|
| Base | 1.5 | 4.0 |
| <i>Harde Hardener</i> | 1.0 | 1.0 |

2) Mixed Paint Properties

| | | |
|----|-----------|-----------------------|
| I) | Viscosity | 20+3% seconds by flow |
| | | Cup No.4 @ 30 °C |

| | | |
|-------|--------------------------------|---|
| ii) | Specific Gravity | 1.70+3% |
| iii) | Post life of mixture | 6-8 hrs. |
| iv) | Zinc dust content on DFT basis | 92+/-3% |
| v) | Finish | Smooth and Matt. |
| vi) | Drying time | |
| | Surface dry | 5 minutes |
| | Hard Dry | Less than 1 hr. |
| vii) | Over coating after | Minimum 24 hrs. |
| | | Maximum No limit |
| viii) | Flash point | Above 23 o C |
| ix) | D.F.T. | 20-25 microns depending on blasting profile |
| x) | Compatibility | Compatible with all systems of paints like Bituminous, conventional, chlorubber vinyl and epoxy paints. |
| xi) | Toxicity | Non toxic |

5) Application: By Brush/Spray (Air and Airless)

6) Thinner: Epoxy thinner shall be used if required.

7) Coverage: 10 Sq. m./liter at 25 microns.

8) High build black paint.

| | | |
|----|-------------------|--|
| 1) | Dry time | Surface dry not more than 4 hours Hard dry not more than 18 hours Film thickness per coat 75 micron. |
| 2) | Consistency | Thixotropic liquid |
| 3) | Covering Capacity | 5 Sq.m./liter |
| 4) | Color | Black/Brown/Black in alternative layer |

9) Characteristics:

The coating shall be non-phenolic, non-toxic. It shall afford a highly durable protective air tight coating to prevent corrosion or rusting of iron and steel against air moisture/water and shall be of sufficient elasticity to prevent racing, blistering or peeling. It shall retain its consistency at the ordinary atmospheric temperatures when packed in suitable containers. After application of drying, the coating shall not show any surface cracks due to drying, weathering action or expansion and contraction. Its resistance to water must be perfect. It shall also be resistant to weak acid and alkalis, natural salts and to dry heat up to 150 centigrade. It should have good brush ability.

The primer as well as paint shall have to be applied as per the manufacturer's specification. The paints shall be tested in the laboratory by the owner at the cost of the contractor if found necessary. The manufacturer shall accompany each lot of primer and paint supplied. The entire procedure of applying the coating as specified shall be rigidly inspected right from cleaning stage to application of final coat.

10) Stacking of bars:

On receipt the pipes shall be stacked on wooden/concrete sleeper to ensure that they do not come in contact with earth. The contractor shall take necessary precaution for safety of bars so that no damage occurs during stacking.

26.0 Mode of measurement and payments: **Payment will be as per payment schedule.**

MATERIALS AND WORKMANSHIP

1. Introduction

1.1. This part of the Specification sets out the general standards of materials to be supplied and the workmanship required to be ensured by the Contractor. All component parts of the Works shall, unless otherwise specified, comply with the provisions of employer's requirement or be subject to the approval of the Employer. Particular attention shall be paid to a neat, orderly and well-arranged installation carried out in a methodical competent manner.

2. Reference Specifications and Standards

2.1. Where reference is made in the Specification to a British Standard Specification (hereinafter abbreviated to 'B.S') issued by the British Standards Institution of 2, Park street, London W.I., or to an Indian Standard Specification (I.S.) issued by the Bureau of Indian Standards, (earlier known as Indian Standard Institution), Manak Bhavan, 9 Bahadur shah Zafar Marg, New Delhi 110 002, or American Society for Testing and materials (ASTM) issued by ASTM 1916 Race Street, Philadelphia, P.A., 19103, U.S.A. or American national Standards Institute (ANSI) issued by ANSI 1430, Broadway, New York, N.Y., 10018, U.S.A. or Japanese Industrial Standards (JIS) issued by Japanese Standards Association, 4-1-24, Akasaka, Minato-Ku, Tokyo 107, Japan or to any other equivalent Standard it shall be to the latest revision of that Standard at the Tender opening date.

2.2. The Contractor may propose at no extra cost to the Employer, the use of any relevant authoritative Internationally recognized Reference Standard.

2.3. All details, materials and equipment supplied and workmanship performed shall comply with the specified Standards. If tenderer offers equipment to other Standards, the equipment/material should be equal or superior to those specified and full details of the difference shall be supplied.

2.4. In the event of conflict between this Specification and the Codes for equipment, provisions of this Specification shall govern. Certain specifications issued by national or other widely recognized bodies are referred to in this Specification. In referring to the Standard Specifications the following abbreviations are used:

| | | |
|------|---|--|
| IS | : | Indian Standard |
| ANSI | : | American National Standards Institute |
| API | : | American Petroleum Institute |
| ASME | : | American Society of Mechanical Engineers |
| ASTM | : | American Society of Testing and Materials |
| AWS | : | American Welding Society |
| AWWA | : | American Water Works Association |
| ISO | : | International Organization for Standardization |
| DIN | : | Deutsches Institute fur Normung |
| BS | : | British Standard |
| IEC | : | International Electrotechnical Commission |
| IEE | : | Institution of Electrical Engineers |
| IEEE | : | Institute of Electrical and Electronic Engineers |
| NEMA | : | National Electrical Manufacturers Association |
| AGMA | : | American Gear Manufacturer's Association |

3. Materials - General

3.1. All materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of reputed make/approved quality, free from imperfections and selected for long life and minimum maintenance. Non-destructive tests, if called for in the Specification, shall be carried out. All submerged moving parts of the Plant, or shafts and spindles or faces etc. in contact with them shall be of corrosion resistant materials. All parts in direct contact with various chemicals, shall be completely resistant to corrosion, or abrasion by these chemicals, and shall maintain their properties without aging due to the passages of time, exposure to light or any other cause.

4. Workmanship – General

4.1. Workmanship and general finish shall be of first class quality and in accordance with best workshop practice.

4.2. All similar items of the Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items.

4.3. All parts, which can be worn or damaged by dust, shall be totally enclosed in dust proof housings. All materials incorporated in the Works shall be the most suitable for the duty concerned, free from imperfections and selected for long life and minimum maintenance. All necessary accessories required for satisfactory and safe operation of the Plant shall be supplied by the Contractor unless it is specifically excluded from his scope. Suitable provision by means of eyebolts or other means are to be provided to facilitate handling of all items that are too heavy or bulky for lifting and carrying by two men.

5. Welding

5.1. Welding shall comply with the latest revision of the BS 5135 Code.

5.2. Welders shall be qualified in accordance with the requirement of the appropriate section of BS 4871. The Engineer shall have the right to call for further qualification from time to time from any welder who in the opinion of the Engineer does not produce weld in accordance with the qualification. Each welder shall be assigned a number and letter. Each weldments shall clearly be identified as to its welder marking the welder's Code adjacent to the welds. A record chart shall be maintained for each welder showing the procedures for which he has qualified, the date of such qualification, the type of defects produced and their frequency. The Engineer shall disqualify the welder whose Work requires a disproportionate amount of repairs. All procedures where required shall be qualified as per BS EN 283-3.

5.3. Inspection and quality of surveillance shall not be limited to the examination of finished welds. The techniques employed shall be based on methods which are known to produce good results and which have been verified at Site by actual demonstration.

5.4. Haphazard striking of the electrodes for establishing an arc shall not be permitted. The arc shall be struck either on the joint or on a starting tag. The starting tag shall be of the same material or a material compatible with the base metal being welded. In case of any inadvertent strike on place other than the welding, the area affected shall be ground flushed and examined by liquid penetration method.

5.5. Generally, a stringer bead technique shall be used with a slight oscillation of necessary to avoid slag and to minimize the number of beads needed to fill exceed 3 times the wire diameter. Vertical welds shall be made in upward direction. For all pipes above 300 mm dia., welding shall be done whenever possible, by 2 welders working simultaneously along both sides of the pipe.

5.6. The root pass shall have less than 1.5 mm internal reinforcement. Defects like icicles, burn through and excessive "such back", etc. shall be cause for rejection of welds.

5.7. Final welds shall be suitable for appropriate fabrication of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without gouging or thinning of the parent metal in any way. Uneven and excessive grinding may be a cause for rejection. Fillet weld shall preferably be convex and free from undercutting and overlap at the toe of weld. Convexity and concavity shall not exceed 1.5 mm. The leg lengths shall not exceed the specified size by more than 1.5 mm.

5.8. All attachments such as lugs, brackets and other non-pressure parts shall also be done by qualified welders in accordance with the design details and materials specifications. Temporary attachments shall be removed in a manner that will not damage the parent metal. Areas of temporary attachments shall be dressed smooth and examined by ultrasonic or liquid penetration methods.

5.9. All tack welds shall be made using qualified procedure and welders, the number of size of tack welds shall be kept as small as to consist of adequate strength and joint alignments. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their starting ends so that they may be satisfactorily incorporated in the welds. Unacceptable defects shall be removed by grinding machine or chipping or gouging. Flame gouging may be permitted provided gouged surfaces are ground at least by 1.0 mm below the deepest indentation.

5.10. All weld repairs shall be carried out using the approved welding procedures and welders. Re-welded areas shall be re-examined by the methods specified for the original welds and the Engineer's Representative shall duly qualify repair procedures.

6. Pre-heating and Post-heating Treatment

6.1. Pre-heating and post heating treatment shall conform to the relevant application Codes. Pre-heating not exceeding 121 deg. C for all carbon steel construction above 25 mm thickness would be mandatory. Such pre-heating would be maintained during flame cutting, flame or arc gouging, welding and repairs and may be done by gas heating by gas torches/gas rings with neutral flame. The temperature shall be checked by temperature indicating crayons. However, such pre-heating will not be necessary for welds less than 6 mm size. In large diameter pipe fabricated out of plate materials, production control test plates in accordance with the BS 4870 part 1 Table 6 to represent 30% of the long seams and each welder's performance would be mandatory.

7. Electrodes

7.1. All electrodes shall be stored in their original sealed containers under dry conditions. Electrodes shall remain identified until consumed. All electrodes shall be dried before use. Drying ovens shall be provided in Work areas for drying purposes. Electrodes withdrawn from oven shall be promptly used and excess unused electrodes shall be promptly returned to oven.

8. Examination/NDT/Radiography

8.1. The various stages of examination and types shall be as stipulated in the respective fabrication Codes. Radiographic examination shall be carried out as per provisions of BS 2600 or BS 2910; Ultrasonic tests where called for shall be carried out as per provisions of BS 3926; magnetic particle tests shall be carried out as per BS 6072. Liquid penetration tests shall be carried out as per BS 6443.

9. Stainless Steel Welding

9.1. All welding consumable such as electrodes, filler weirs, argon gas for shielding and purging shall be of high quality and the proposed brand shall be furnished for approval of the Engineer. Weld deposits shall have similar or higher physical properties and similar chemical composition to the members joined.

9.2. All electrodes shall be purchased in sealed containers only and stored in their packing intact. The packets opened shall be consumed as early as possible. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by electrode manufacturer. Special care shall be taken in avoiding mixing of electrodes in the oven. The electrodes and filling wires shall be free from rust, oil, grease, earth and other foreign matter.

9.3. Argon gas with purity 99.5% shall be used for shielding and purging. The purity of gas shall be certified by the gas manufacturers.

9.4. Non-destructive examination of the welds shall be carried out to ensure quality of weld.

9.5. The electric current for welding shall be direct current, straight polarity (electrode negative). The welding current shall be kept minimum possible to ensure minimum heat affected zone in the parent material. Other side of the weld joint shall be periodically flushed with argon gas.

10. Castings

10.1. Cast iron shall be of standard grey close-grained quality. The structure of the castings shall be homogeneous and free from non-metallic inclusions and other injurious defects. All surfaces of castings, which are not machined, shall be smooth and shall be carefully fettled to remove all foundry irregularities.

10.2. Minor defects in depth not exceeding 12.5 percent of total metal thickness and which will not ultimately affect the strength and serviceability of the casting may be repaired by approved welding techniques. The Engineer shall be notified of large defects and no repair welding of such defects shall be carried out without prior approval of the Engineer. If the removal of metal for repair should reduce the stress resisting cross section of the casting by more than 25 percent, or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then casting shall be rejected. Test coupons cast simultaneously with the main castings shall be identified to check physical, chemical analysis of casting. Major defects on casting are not acceptable. Castings repaired by welding for minor defects shall be stress-relieved after such welding. Non-destructive tests as directed by the Engineer will be required for any casting containing defects whose extent cannot otherwise be judged, or to determine where repair welds have been properly made.

11. Forging

11.1. All major stress-bearing forging shall be made to a Standard Specification. Forging shall be subjected to magnetic particle testing or dye penetration test at the areas of fillets and change in section. The testing shall be conducted after rough machining (10 microns). Any defect, which will not machine out during the

final machining, will be gouged out fully, inspected by dye penetration or magnetic particle inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indication, which proves to penetrate deeper than 2.5% of the finished thickness of the component, shall be reported to the Engineer giving the details like location, length, width and depth. For the magnetic particle inspection the choice of wet or dry particles shall be at the Contractor's discretion.

11.2. All forging shall be demagnetized after test and shall be heat-treated for the relief of residual stresses.

12. Design Life

12.1. The Works as a whole shall be new, of sound workmanship, robustly designed for a long reliable operating life and shall be capable of 24 hours per day continuous operation for prolonged period in the climatic and working conditions prevailing at the Site, and with the minimum of maintenance. Particular attention shall be given to temperature changes, the stability of paint finish for high temperatures, the rating of engines, electrical machinery, thermal overload services, cooling systems and the choice of lubricants for possible high and prolonged operating temperatures. The Contractor shall be called upon to demonstrate this for any component part either by service records, or evidence of similar equipment already installed elsewhere or relevant type tests. Routine maintenance and repair shall as far as possible not require the services of highly skilled personnel.

12.2. The Plant shall be designed to provide easy access to and replacement of component parts, which are subject to wear, without the need to replace whole units. No parts in contact with water shall have a life from new to replacement or repair of less than five years.

12.3. Design features shall include the protection of Plant against damage caused by vermin, dirt, dust and dampness and to reduce risk of fire. Plant shall operate without undue vibration, and parts shall be designed to withstand the maximum stresses under the most severe condition of normal service. Materials shall have a high resistance to change in their properties due to the passage of time, exposure to light, temperature and any other cause, which may have a detrimental effect upon the performance or life of the Works.

12.4. Plant located outside lockable areas/building shall have additional features to prevent un-authorized operation.

13. Name Plate

13.1. Each item of the Plant shall have permanently attached to it in a conspicuous position, a nameplate and rating plate. Upon these shall be engraved or stamped, the manufacturer's name, type and serial number of Plant, details of the loading and duty at which the item of Plant has been designed to operate, and such diagrams as may be required by the Engineer. All indicating and operating devices shall have securely attached to them or marked upon them designations as to their function and proper manner of use.

13.2. Nameplates, rating plates and labels shall be of a non-flame propagating materials, either non-hygroscopic or transparent plastic with engraved lettering of a contrasting colour. Fixing shall be by means of non-corrosive screws; drive rivets or adhesives shall not be used.

13.3. Warning labels shall be provided where necessary to warn of dangerous circumstances or substances. Inscriptions or graphic symbols shall be black on a yellow background.

13.4. Instruction labels shall be provided where safety procedures such as wearing of protective clothing are essential to protect personnel from hazardous or potentially hazardous conditions. These labels shall have inscriptions or graphic symbols in white on a blue background.

14. Nuts, Bolts, Studs and Washers

14.1. Nuts, bolts, studs and washers for incorporation in the Plant shall conform to the requirements of the appropriate standard. Nuts and bolts shall be of the best quality of specified grade, machined on the shank and under the head and nut

14.2. Fitted bolts shall be a light driving fit in the reamed holes they occupy, shall have the screwed portion of such a diameter that it will not be damaged in driving and shall be marked in a conspicuous position to ensure correct assembly at Site.

14.3. Washers, locking devices and anti-vibration arrangements shall be provided where necessary. Jointing hardware for the entire Plant shall be provided with sufficient spares to cater for site losses.

14.4. Where bolts pass through structural members taper washers shall be fitted, where necessary, to ensure that no bending stress is caused in the bolt. Where there is a risk of corrosion, bolts, nuts and studs shall be designed so that the maximum stress does not exceed half the yield stress of the material under any

conditions. All bolts, nuts and washers that are subject to frequent adjustment or removal in the course of maintenance and repair shall be made of nickel-bearing stainless steel.

14.5. The Contractor shall supply all holding down, alignment and leveling bolts complete with anchorages, nuts, washers and packing required to attach the Plant to its foundations, and all bed plates, frames and other structural parts necessary to spread the loads transmitted by the Plant to concrete foundations without exceeding the design stresses.

15. Allowances for Wastage

15.1. The Contractor shall supply reasonable excess quantities to cover wastage of those consumable, which will be normally subject to waste during erection, commissioning and setting to Work.

16. Painting – General

16.1. The Contractor shall be responsible for the cleaning, preparation for painting, and priming or otherwise protecting, as specified, all parts of the Plant at the place of manufacture prior to packing.

16.2. Parts may be cleaned but surface defects may not be filled in before testing at the manufacturer's works. Parts subject to hydraulic test shall be tested before any surface treatment. After test, all surfaces shall be thoroughly cleaned and dried out, if necessary by washing with an approved de-watering fluid prior to surface treatment. Except where the specification provides to the contrary all painting materials shall be applied in strict accordance with the paint manufacturer's instructions.

16.3. All protective coatings shall be suitable for use in warm humid climates. All primers, under coats and finishes shall be applied by brush or airless spray, except where otherwise specified. Consecutive coats shall be in distinct but appropriate shades. All paints shall be supplied from the store to the painters, ready for application, and addition of thinners or any other material shall be prohibited.

17. Painting at Place of Manufacture

17.1. Steel and cast iron parts shall be sand blasted to near white cleaning before painting. Edges, sharp covers etc. shall be ground to a curve before sand blasting. A primer coat of a zinc rich epoxy resin based coating with at least 75 microns dry film thickness is to be provided. In addition the parts are to be provided with adequate number of coats of coal tar epoxy polyamine coating to a dry film thickness of 175 microns including primer coating.

18. Painting at Site

18.1. Immediately on arrival at the site, all items of Plant shall be examined for damage to the paint coat applied at the manufacturer's works, and any damaged portions shall be cleaned down to the bare metal, all rust removed, and the paint coat made good with similar paint.

18.2. After erection, such items, which are not finish painted, shall be done so and, items that have been finish painted at the manufacturer's works shall be touched up for any damaged paintwork. For finish painting, two coats of synthetic enamel conforming to IS: 2932 shall be applied. Dry film thickness of each coat shall be at least 25 microns.

18.3. The dry paint film thickness shall be measured by Electrometer or other instruments approved by the Employer. In order to obtain the dry film thickness specified the Contractor should ensure that the coverage rate given by the paint manufacturer would enable this thickness to be obtained. Strength of adhesion shall be measured with an adhesion tester and this value shall not be less than 10 kg/cm². Painted fabricated steel work which is to be stored prior to erection shall be kept clear of the ground and shall be laid out or stacked in an orderly manner that will ensure that no water or dirt can accumulate on the surface. Suitable packing shall be laid between the stacked materials. Where cover is provided, it shall be ventilated.

19. Galvanizing

19.1. Wherever galvanizing has been specified the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of zinc coatings for various applications shall not be less than those indicated below:

a) Fabricated steel

Thickness less than 2 mm but not less than 1.2 mm 340 gms/sq.m

Thickness 2 mm and above 460 gms/sq.m

b) Fasteners

Up to nominal size M10 270 gms/sq.m

Over M10 300 gms/sq.m

19.2 Galvanizing shall be carried out after all drilling; punching, cutting, bending and welding operations have been carried out. Burrs shall be removed before galvanizing. Any Site modification of galvanized parts should be covered well by zinc rich primer and aluminum paint.

20. Support for Pipe work & Valves

All necessary supports, saddles, sling, fixing bolts & foundation bolts shall be supplied to support the pipe work. Valve and other facilities mounted in the pipe work shall be supported independent of the pipes to which they connect.

INSPECTION AND TESTING AT MANUFACTURER'S PREMISES

1. Inspection and Tests

1.1. Valve

1.1.1. During testing there shall be no visible evidence of structural damage to any of the valve component.

1.1.2. Motorized valves shall be tested with their actuators, with a differential head equivalent to their maximum working pressure, to prove that the actuators are capable of opening and closing the valves under maximum unbalanced head condition within the specified opening or closing period.

1.1.3. The following test shall be carried out for butterfly valves:

- a) Seat leakage test at rated pressure
- b) Body hydrostatic test at 1.5 times the rated pressure
- c) Disc strength test at body test pressure
- d) Valve operation with and without actuator
- e) Crack opening test under tension

1.1.4. The following test shall be carried out for sluice valves:

- a) Seat leakage test at rated pressure
- b) hydrostatic test at 1.5 times the rated pressure
- c) Valve operation

1.1.5. The following test shall be carried out for non-return valves:

- a) Seat leakage test at rated pressure
- b) Body hydrostatic test at 1.5 times rated pressure
- c) Operation

1.2. Pipe work

1.2.1. Testing of pipes and fitting shall be carried out in accordance with relevant Indian Standard and internationally approved standard. Pipes, fittings and expansion bellows shall be hydrostatically tested for 1.5 times the rated pressure.

1.3. E.O.T. Crane

1.3.1. The cranes shall be completely assembled in the Contractor's or subcontractor's Works and shall be subjected to the tests as specified in IS 807/IS 3177 or relevant internationally approved standard. The Contractor shall provide the test weights.

CONCRETE

Applicable Codes

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. 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.

Material Storage

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

Concrete Mix Design

- 1) IS: 10262 Recommended guidelines for concrete mix design.
- 2) SP: 23 (S&T) Handbook on Concrete Mixes

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.

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 weighs batchers for concrete (single and double bucket type).
- 14) IS: 2750 Specification for steel scaffoldings.

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 inset cement concrete flooring.
- 16) IS: 7861 Code of practice for extreme weather concreting: Part 1 Recommended practice for hot weather concreting.

Construction Safety

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

General

The ENGINEER INCHARGE shall have the right at all times to inspect all operations including the sources

of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment and the quality control system. Such an inspection shall be arranged and the ENGINEER INCHARGE'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 ENGINEER INCHARGE and after establishing their performance suitability based on previous data, experience or tests.

Materials

Cement:

Unless otherwise called for by the ENGINEER INCHARGE, 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 ENGINEER INCHARGE.

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

Aggregates (General):

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

Aggregates shall be washed and screened before use where necessary or if directed by the ENGINEER INCHARGE.

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.

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.

Reinforcement

All reinforcement steel shall be HYSD steel grade – Fe415 conforming to relevant I.S. 1786 for water retaining structure

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.

Admixtures

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

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the ENGINEER INCHARGE. 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.

Wastage

Wastage allowance for cement and steel shall be considered in the item rate and no extra payment shall become payable to the Contractor on any account.

Samples and Tests

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

Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the ENGINEER INCHARGE samples shall also be got tested by the Contractor in a Government approved laboratory or approved by the ENGINEER INCHARGE at no extra cost to Employer. ENGINEER INCHARGE may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests. Sampling and testing shall be as per IS: 2386 under the supervision of the ENGINEER INCHARGE.

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.

Storing of Materials

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

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

Concrete

General

Concrete grade shall be as designated on drawings. In concrete grade M15, M20 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.

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 watertight 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 |
|-------------------|--|
| M 15 | 240 |
| M 20 | 250 |
| M 25 | 300 |
| M 30 | 320 |

The minimum cement content stipulated above should 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 CONTRACTOR.

It shall be the Contractor's sole responsibility to carry out the mix designs at his own cost. He shall furnish to the ENGINEER INCHARGE 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 Compressive Strength N/sq.mm at 28 days |
|-------------------|--|---|
| M 15 | 10.0 | 15.0 |
| M 20 | 13.5 | 20.0 |
| M 25 | 17.0 | 25.0 |
| M 30 | 20.0 | 30.0 |
| M 35 | 23.5 | 35.0 |
| M 40 | 27.0 | 40.0 |

A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the ENGINEER INCHARGE is given below:

| Structure/Member | Slump in millimeters | |
|---|----------------------|---------|
| | Maximum | Minimum |
| Reinforced foundation walls and footings | 75 | 25 |
| Plain footings, caissons and substructure walls | | |
| Slabs, Beams and reinforced walls | | |
| Pump & miscellaneous Equipment Foundations | 100 | 25 |
| Building columns | 75 | 25 |
| | 100 | 25 |
| Pavements | | |
| Heavy mass construction | 50 | 25 |
| | 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 ENGINEER INCHARGE 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 Government approved laboratory or in field with prior consent of the ENGINEER INCHARGE. Sampling and testing of strength and workability of concrete shall be as per IS: 1199, IS: 516 and IS: 456, IS 3370.

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.

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, false work, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the ENGINEER INCHARGE, the drawings and calculations for the design of the formwork shall be submitted to the ENGINEER INCHARGE 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 finishes within the specified tolerance limits.**
- (d) Capable of withstanding without deflection the worst combination of self weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.**
- (e) Capable of easy striking out without shock, disturbance or damage to the concrete.**
- (f) Soffit forms capable of imparting a camber if required.**
- (g) Soffit forms and supports capable of being left in position if required.**
- (h) Capable of being cleaned and/or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.**

The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of the ENGINEER INCHARGE. 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 ENGINEER INCHARGE. 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 ENGINEER INCHARGE, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the ENGINEER INCHARGE, than that required as per drawing to compensate for irregularities in excavation.

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

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

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

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

- (h) Development of adequate concrete strength;
- (i) Permissible deflection at time of striking form work;
- (j) Curing procedure employed - its efficiency and effectiveness;
- (k) Subsequent surface treatment to be done;
- (l) Prevention of thermal cracking at re-entrant angles;
- (m) Ambient temperatures; and
- (n) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Under normal circumstances (generally where temperatures are above 20°C) forms may be struck after expiry of the time period given in IS: 456 unless approved otherwise by the ENGINEER INCHARGE. For Portland Pozzolana/slag cement the stripping time shall be suitably modified as approved by the ENGINEER INCHARGE. 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.

Reinforcement Workmanship

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

All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/schedules or as directed by ENGINEER INCHARGE.

Re-bending or straightening incorrectly bent bars shall not be done without the approval of the ENGINEER INCHARGE.

Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by the ENGINEER INCHARGE 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 ENGINEER INCHARGE's approval.

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 |

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 ENGINEER INCHARGE. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

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 ENGINEER INCHARGE. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

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

Mass Concrete Works

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

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

- (a) **Premature drying out, particularly by solar radiation and wind;**
- (b) **Leaching out by rain and flowing water;**
- (c) **Rapid cooling during the first few days after placing;**
- (d) **High internal thermal gradients;**
- (e) **Low temperature or frost;**
- (f) **Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.**

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

Where a curing membrane is approved to be used by the ENGINEER INCHARGE, 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 ENGINEER INCHARGE 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.

Construction Joints and Keys

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

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

Foundation Bedding

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

Finishes

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.

Surface Finish Type F1

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

Surface Finish Type F2

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

Surface Finish Type F3

This finish shall give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no 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.

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 ENGINEER INCHARGE shall be supplied and used as recommended by the manufacturer.

Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be inspected by the ENGINEER INCHARGE who may permit

patching of the defective areas or reject the concrete work.

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

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

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the ENGINEER INCHARGE.

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

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 ENGINEER INCHARGE's approval.

Hot Weather Requirements

Concreting during hot weather shall be carried out as per IS: 7861 (Part I). Adequate provisions shall be made to lower concrete temperatures, which shall not exceed 40° C at the time of placement of fresh concrete.

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

Cold Weather Requirements

Concreting during cold weather shall be carried out as per is: 7861 (Part II). The ambient temperature during placement and up to final set shall not fall below 5 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.

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 ENGINEER INCHARGE. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the ENGINEER INCHARGE at no extra cost to the EMPLOYER.

Testing Concrete Structures for Leakage

Hydrostatic test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the ENGINEER INCHARGE, 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 water tightness of the structure. The ENGINEER INCHARGE 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.

Optional Tests

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

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

Grouting

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 ENGINEER INCHARGE. 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 |
| Use | Grout Thickness | Mix Proportions | W/C Ratio (max) |
| b) General mix | 25mm and over but less than 50mm | One part Portland Cement to 2 parts of sand | 0.53 |
| c) Stiff mix | 50mm and over | One part Portland Cement to 3 parts of sand | 0.53 |

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 ENGINEER INCHARGE. Materials rejected by ENGINEER INCHARGE shall be expressly removed from site and shall be replaced by Contractor immediately.

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

left clean.

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

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

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

For work not accepted, the ENGINEER INCHARGE may review and decide whether remedial measures are feasible so as to render the work acceptable. The ENGINEER INCHARGE 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.

Water stops

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/mm² minimum
- b) Ultimate elongation : 300% minimum
- c) Tear resistance : 4.9 N/mm² minimum
- d) Stiffness in flexure : 2.46 N/mm² minimum
- e) Accelerated extraction
- i) Tensile strength : 10.50 N/mm² 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 ENGINEER INCHARGE before procurement for incorporation in the works. Alternatively G.I. sheet of 18 gage (1.3mm) thick and 200mm wide can be used by the contractor as construction joints.

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

Workmanship

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

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

Water stops shall be placed at the correct location/level and suitably supported at intervals with the reinforcement to ensure that it does not deviate from its intended position during concreting and vibrating. Care shall also be taken to ensure that no honey-combing occurs because of the serrations/end grips, by placing concrete with smaller size aggregates in this region. Projecting portions of the 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.

Preformed Fillers and Joint Sealing Compound

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.

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.

15 SAMPLING AND STRENGTH OF DESIGNED CONCRETE MIX

15.1 General

Samples from fresh concrete shall be taken as per IS 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS 516.

15.1.1 In order to get a relatively quicker idea of the quality of concrete, optional tests on beams for modulus of rupture at 72 ± 2 h or at 7 days, or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength test.

For this purpose the values should be arrived at based on actual testing. In all cases, the 28 days compressive strength specified in Table 2 shall alone be the criterion for acceptance or rejection of the concrete.

15.2 Frequency of Sampling

15.2.1 Sampling Procedure

A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested that is, the sampling should be spread over the entire period of concreting and cover all mixing units.

15.2.2 Frequency

The minimum frequency of sampling of concrete of each grade shall be in accordance with the following:

| Quantity of Concrete in the Work, m ³ | Number of Samples |
|--|-------------------|
| 1-5 | 1 |
| 6-15 | 2 |
| 16 – 30 | 3 |
| 31- 50 | 4 |
| 51 and above | 4 plus one |

additional sample for each additional 50 m' or part thereof

NOTE---

At least one sample shall be taken from each shift. Where concrete is produced at continuous production unit, such as ready-mixed concrete plant, frequency of sampling may be agreed upon mutually by suppliers and purchasers.

15.3 Test Specimen

Three test specimens shall be made for each sample for testing at 28 days. Additional samples may be required for various purposes such as to determine the strength of concrete at 7 days or at the time of striking the formwork, or to determine the duration of curing, or to check the testing error. Additional samples may also be required for testing samples cured by accelerated methods as described in IS 9103. The specimen shall be tested as described in IS 516.

15.4 Test Results of Sample

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than ± 15 percent of the average. If more, the test results of the sample are invalid

16 ACCEPTANCE CRITERIA

16.1 Compressive Strength

The concrete shall be deemed to comply with the strength requirements when both the following condition are met:

- The mean strength determined from any group of four consecutive test results complies with the appropriate limits in col 2 of Table 11.
- Any individual test result complies with the appropriate limits in col 3 of Table 11.

16.2 Flexural Strength

When both the following conditions are met, the concrete complies with the specified flexural strength.

- The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2 .
- The strength determined from any test result is not less than the specified characteristic strength less 0.3 N/mm^2 .

16.3 Quantity of Concrete Represented by Strength Test Results

The quantity of concrete represented by a group of four consecutive test-results shall include the batches from which the first and last samples were taken together with all intervening batches. For the individual test result requirements given in col 2 of Table 11 or in item (b) of 16.2, only the particular batch from

which the sample was taken shall be at risk. Where the mean rate of sampling is not specified the maximum quantity of concrete that four consecutive test results represent shall be limited to 60 m'. 16.4 If the concrete is deemed not to comply pursuant to 16.3, the structural adequacy of the parts affected shall be investigated (see 17) and any consequential action as needed shall be taken.

Item No.2 :- Providing and supplying in standard length ISI mark rigid unplasticised PVC Pipes suitable for potable water with elastomeric sealing ring fit joint including cost of rings, as per IS specification No:-4985/1988 including all local and central taxes, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to department stores or site of work and including cost of jointing materials etc. complete.

1)140 mm dia 6 Kg/cm² PVC Pipe

2)90mm dia 6kg/cm² PVC pipe

UNPLASTICIZED PVC PIPES :

The agency shall provide and procure the PVC pipes from latest approved vendors of G.W.S.S.& B. The list of approved vendor is given separately.

Attached Annexure-1

STANDARDS:

The UPVC Pipes to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance and conforming to IS:4985-2000 or its latest revision or amendments or other authoritative standard that ensure at least a substantially equal quality to the IS:4985-2000 or its latest revision or amendments

Elastomeric sealing ring shall be as per specification of IS – 5382-1985, and ISO: 4633-1996 or it shall be EPDM rubber ring.

The dimensions, material compositions, tests etc. shall be as per IS:4985-2000 or with its latest revision or amendments.

The minimum wall thickness weight shall be as per Appendix I of the tender.

The colour of pipes shall be as per IS 4985-2000

Bureau of Indian Specifications (BIS) / Indian Standard (IS) shall mean the Latest version issued by BIS.

The material from which the pipes are made shall consist substantially of unplasticized polyvinyl chloride conforming to IS: 10151, to which may be added only those additives that are absolutely needed to facilitate the manufacture of the polymer, and the production of sound, durable pipes of good surface, finish, mechanical strength and opacity.

The bulk density of the UPVC compound shall be 0.50 to 0.53 and the density of UPVC pipe shall be 1.40 to 1.46 g / cm³.

The additional of the manufacturer's own rework material shall comply to clause 4.2 of IS: 4985.

PVC resin of suspension grade K-66/K-67 shall be used for extrusion of UPVC pipe.

In line with BIS 4985-2000 the tolerance on outside diameter of the pipe shall be as under:

| Nominal outside Diameter | Min. outside diameter in mm | | Outside diameter at any point in mm | |
|--------------------------------|-----------------------------|--------------|-------------------------------------|--------------|
| | Minimum | Maximum | Minimum | Maximum |
| 90 | 90 | 90.3 | 88.9 | 91.1 |
| 110 | 110 | 110.4 | 108.6 | 111.4 |
| 140 | 140 | 140.5 | 138.3 | 141.7 |
| 160 | 160 | 160.50 | 158.0 | 162.0 |
| 180 | 180 | 180.6 | 177.8 | 182.2 |
| 200 | 200 | 200.6 | 197.6 | 202.4 |
| 225 | 225 | 225.7 | 222.3 | 227.7 |
| 250 | 250 | 250.8 | 247.0 | 253.0 |
| 280 | 280 | 280.9 | 276.6 | 283.4 |
| 315 | 315 | 316.0 | 311.2 | 318.8 |

“The pipes shall be transported to the store by flat floored trucks in pre packed wooden crate. The height of crate should not be exceeding more than 2 meters. The both ends of packaging unit (crate) shall be covered with plastic sheet to ensure adequate protection during transport. At the time of packing and stacking of pipes, the sockets shall be alternated within the pipe of pipes and shall project sufficiently for the pipes to be correctly supported along their whole length. The pipes shall rest uniformly on the vehicle bed over their whole length during transport to avoid sagging or deformation.

The packing material like wooden crate, plastic sheet etc. shall be the property of tenderer and he is permitted to reuse the packing material for transporting next batch of pipes”.

The pressure rating of pipes shall be in accordance with IS 4985 with a maximum continuous M working pressure at 27⁰ C. of 6 & 10 kg/cm². This working pressure shall be down graded for ambient underground soil temperature of 45⁰ C. as per the figure given in IS 4985 for design purposes.

The pipes when subjected to internal hydrostatic pressure in accordance with IS: 12235-1986 (part – 8) shall not burst during the prescribed test duration. The temperature, duration and test and induced internal stress shall conform to the parameters given below:

| Sr. No. | Test | Temp. (°C) | Min. duration (h) | Induced Stress (Mpa) | Requirements |
|---------|-----------------|------------|-------------------|----------------------|--------------|
| 1 | Type test | 60 | 1000 | 10 | No failure |
| 2 | Acceptance Test | 27 | 1 | 36 | No failure |

The integral socket of the pipe shall be tested for internal hydrostatic pressure in accordance with ISO: 3603 and ISO 1167.

The UPVC pipe shall not contain vinyl chloride monomer (VCM) exceeding 1 ppm when determined by means of gas phase chromatography using the “headspace” method according to IS: 10151.

The wall of the socket and the wall of the plain pipe shall not transmit more than 0.2% of visible light falling on them when tested in accordance with IS:12235 (part -3).

The pipes shall be supplied in straight length of 6 mtrs with tolerance of +20mm and -0mm. The effective length of socket pipe shall be considered as shown in figure 2 of IS 4985.

All plastic and non plastic material for components of the UPVC piping system e.g. Elastomeric sealing ring, lubricants, when in permanent or in temporary contact with water which is intended for human consumption, shall not adversely affect the quality of the drinking water.

Concentrations of chemicals, biological agents or other substance leached from pipe materials in contact with drinking water and the values of the relevant physical parameters, shall not exceed the maximum values recommended by IS: 10500.

The pipe material shall be in accordance with IS 4985, clause 6.3.

The quality control system and sampling model shall be as under:

TEMPerature variations:

All the pipes to be manufactured, supplied and delivered shall be subjected to weather conditions like sun, dust, rain, wind as available in State of Gujarat. They shall be also subjected to carry and convey drinking water under variable temperature conditions ranging from 4 C⁰ to 45 C⁰.

MARKING :

The methods of marking all the pipes to be delivered under scope of contract shall ensure that all the information will remain legible even after transportation, storage in open space etc. In general the legible and indelible marking upon the goods shall indicate the followings;

- Certification mark on each pipe.
- Manufacturers brand name and/or trademark.
- Purchasers mark as “GWSSB” be inscribed.
- The outside diameter and pressure rating.

Batch number or lot number.

Inspector’s mark on each pipe

- Any other important matter that the manufacturer or purchaser deems fit to be inscribed.

Elastomeric sealing ring

These sealing ring shall be Sturine Butadin in red color as specified in IS. The lubricant applied for jointing of elastomeric rubber ring shall be of good quality and comply the following specifications:**MUST HAVE PASTE LIKE CONSISTENCY AND BE READY FOR USE, PREFERABLY SOAP JELLY.HAS TO ADHERE WET AND DRY SURFACES OF UPVC PIPES AND RUBBER RING.MUST BE NON-TOXIC.MUST BE WATER-SOLUBLE.**

MUST NON-AFFECTING PHYSIO-CHEMICAL AND ORGANOLEPTIC PROPERTIES OF DRINKING WATER CARRIED ION THE PIPE.

MUST NOT HAVE AN OBJECTIONABLE ODOUR.

MUST NOT HARMFUL TO THE SKIN.

Elastomeric sealing ring shall be in accordance with one of the types (Type - 1 to Type – 6) as per ISS 5382. These sealing rings shall be EPDM rubber ring. The sealing ring shall be with ISI mark.

In case of imported EPDM Ring, such rings shall conform to relevant International Standards or the Standards of country of origin, which are equivalent or higher than the Bureau of Indian Standard Specifications. In case of manufacturers who have applied for getting a BIS certification mark, it would be mandatory for such bidders to produce the BIS certification license on or before the date of opening of the price bids. An undertaking in this regard shall have to be provided along with the technical bid.

The rubber sealing rings shall be vulcanized from Ethylene Propylene (EPDM) with strengths as per table 2 of IS 5382-1985.

type test:

Type test capacity, test for effect on water, test for resistance to Sulfuric Acid, internal Hydrostatic pressure test for 1000 Hrs. shall be carried out at least once at any time during the contract. Or shall be taken at least once during every six months irrespective of the ordered quantity.

color of pipes:

The color of the pipes shall be as per IS 4985-2000.

The pipes shall bear ISI mark confirming to IS:4985-2000 or its latest amendment/revision if any.

test for pvc resin & pipe:

Test For PVC Resin

It shall be sufficient to show the certificate of chemical test (in accordance with IS 4669) to the inspecting authority to confirm the 'K' value to be 64 to 67 as per clause No. 6.1.2. of IS 4985-2000

Specific Gravity and Ash Content Tests:

a) Density:

These tests shall be carried out by the inspection agency as per the IS:4985-2000 OR its latest revision OR amendments. The value shall be between 1.40 and 1.46 as per the ISS clause No. 10.6

b) Sulphate Ash content:

When tested as per Annex B, of IS 4985-2000, the sulphated ash content in the pipe shall not exceed 10 percent.

c) Other test shall be carried out as per ISS 4985-2000 or its latest revision or amendment

tolerance in weight of pipes:

(-) 1% tolerance in actual weight of pipes shall be allowed but in overall weight there should not be any minus tolerance i.e. minus tolerance may be compensated in overall weight. If the tolerance is in minus, the consignment shall be outright rejected. The weight of pipes as given in Appendix-I shall be considered. If required the consignee can weight the whole lot of supply for verification.

Quality Assurance

Unit weight and minimum wall thickness of un plasticizes ring fit type PVC pipes are as per IS 4985-2000.

The Quality assurance plan (QAP) shall be approved by concerned Executive Engineer,

The bidder shall have to arrange for testing of pipes in factory in the presence of TPI and G.W.S.S.B. representative. The payment for TPI shall be made by contractor.

The bidder shall have to arrange for post inspection of pipes brought on site. Random testing of pipes brought on site shall be done in CIPET and on satisfactorily report from the CIPET the payment of pipes will be made.

Price Variation: - Price variation shall be followed as per Clause no. 59 of General Contract condition.

METHOD OF MEASUREMENT OF PIPES:

The measurement shall be recorded in running meter of pipe length laid along center line or axis of pipe line including tees, enlarges, reducers and bends correct up to 0.01M. length. No payment shall be made for overlaps etc. .

Mode of measurement and payments

Payment will be paid as per Rmt.

| Sr. No. | Stage of works | Amount admissible payment |
|---------|---|---------------------------|
| 1 | 2 | 3 |
| 1 | On Receipt of materials duly inspected on site or store with maximum limit of 5000 Rmt (for One supply) irrespective of pipe dia.(size) | 65% |
| 2 | After lowering, laying & jointing of Pipe line. | 15% |
| 3 | On Hydraulic testing | 10% |
| 4 | On refilling and disposal of surplus stuff | 5% |
| 5 | After Commissioning | 5% |
| | Total.... | 100% |

Item No 3:-

Providing & Supplying P.V.C. Fittings suitable for P.V.C. Pipes at store or at site of work incl. freight, loading, unloading, stacking, insurance and all taxes etc. complete.

PVC Tee (molded) 140 X 140 mm dia

PVC Bend (Fabricated) 6.0 Kg 140 mm dia

PVC Bend (Fabricated) 6.0 Kg 90 mm dia

PVC Tee (molded) 90 X 90 mm dia

PVC tail piece with PVC flange heavy duty (molded) 90 mm dia

1. Scope of Work

The scope includes the sourcing, procurement, and delivery of Polyvinyl Chloride (PVC) fittings to the designated store or site of work. The rate shall be inclusive of the material cost, manufacturing, quality testing, packaging, freight, transit insurance, loading, unloading, and stacking at the site, including all applicable taxes (GST, duties, etc.).

2. Material Specifications

- **Material Quality:** All fittings shall be manufactured from high-quality unplasticized PVC (uPVC) resin. The material must be virgin, free from lead (where potable water is concerned), and resistant to corrosion, chemical erosion, and bacterial growth.
- **Standard Compliance:** Fittings must comply with relevant national/international standards (e.g., IS 7834 for pressure pipes or IS 14735 for SWR drainage systems).
- **Pressure Rating:** Fittings must have a pressure rating (PN) equal to or higher than the pipes with which they are to be used (e.g., 6 kgf/cm², or 10 kgf/cm²).
- **Surface Finish:** Both internal and external surfaces shall be smooth, clean, and free from grooves, blisters, or other surface defects. The ends shall be cleanly cut and square to the axis.

3. Types of Fittings

The supply shall include, but is not limited to:

- Couplers, Elbows (90° & 45°), Tees (Equal & Reduced).
- Reducers, End Caps, and Unions.
- Service Saddles and Solvent Cement (if specified).

4. Transport and Handling

- **Freight & Insurance:** The supplier is responsible for all transportation costs and must provide transit insurance to cover damages during movement.
- **Loading/Unloading:** Materials must be handled with care using appropriate equipment. Dropping fittings from heights or dragging them on the ground is strictly prohibited.
- **Stacking:** Fittings must be stacked in a shaded area, protected from direct sunlight (UV degradation), and organized by size and type for easy inspection and inventory management.

5. Inspection and Testing

- **Manufacturer's Certificate:** Each batch must be accompanied by a manufacturer's test certificate (MTC).
- **Visual Inspection:** Any fitting showing cracks, chipping, or distortion will be rejected.
- **Dimensional Check:** Fittings will be checked against standard diameter and wall thickness tolerances.

6. Measurement and Payment

- **Unit of Measurement:** Payment will be made per piece (Numbers) or by weight (Kilograms) as specified in the Bill of Quantities (BOQ).
- **Price Inclusion:** The quoted rate is "All-Inclusive," meaning no extra payment will be made for transportation, labor for unloading, or tax fluctuations unless explicitly stated in the contract.

Item No.4

Providing and supplying ISI mark CI D/F Sluice Valves as per IS:14846(Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete

125 mm dia Sluice valve PN 1.0 with ISI mark

80 mm dia Sluice valve PN 1.0 with ISI mark

SLUICE VALVE

Sluice valve as per I.S: Sluice Valves as per IS:14846 (Latest Edition & 2906/1984 IS- 13095)

For (6.1) 300 MM DIA (6.2) 250 MM DIA (6.3) 200 MM DIA (6.4) 125 MM DIA (6.5) 100 MM DIA (6.6) 80 MM DIA (6.7) 150 MM DIA , and quantity as per price schedule. The agency has to approve Quality Assurance Plan (QAP) as per Specification and latest IS code provisions before manufacturing.

Sluice valve as per IS: 14846 or its latest revision.

GENERAL

The contractor shall be covering manufacturing, supplying and delivery of:

Sluice valve conforming to IS: 2906-1984 & IS: 14846 or its latest revision (Specification for sluice valves (50 to 900 mm size) with ISI certification

2.0 STANDARDS

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications as given below: with ISI certification mark on each sluice valves.

3.0 TEMPERATURE VARIATION

All sluice valves manufactured, supplied and delivered shall be subjected to drinking water under variable temperature condition ranging from 4⁰ to 45⁰ C.

4.0 MARKING

The legible and in deniable marking upon each valve shall indicate the following:

- (1) ISI certification mark on each sluice valve only.
- (2) Manufacture's brand name and/or trade mark.
- (3) Size of valve and nominal pressure of valve.
- (4) Serial number of cast.
- (5) Serial number in punch
- (6) Where a valve has been tested for only open and test, it should be marked 'O' distinctly and permanently.
- (7) Any other important matter that the manufacturer deems fit to be inscribed embossed

5.0 TEST CERTIFICATE

5.1 The contractor shall always provide manufacture's test certificate in accordance with every batch/ lot as valves so manufactured and supplied.

5.2 The contractor shall also produce; in addition to manufacture's test certificate the inspection certificate issued by the authorized person /agency appointed by Board for the same purpose. The inspection charges of the authorized person/agency as fixed by Board shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of Board

6.0 NOMINAL PRESSURE

6.1 Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as "PN-II" (Mpa= 10 kgf/m² approx.)

6.2 The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

| Class of Valve | Working pressure of body | Working pressure for seat |
|----------------|--------------------------|---------------------------|
| PN 0.6 | 5 kg/sq.cm | 9 kg/sq.cm |
| PN 1.0 | 10 kg/sq.cm | 15 kg/sq.cm |

| | | |
|--------|-------------|-------------|
| PN 1.6 | 16 kg/sq.cm | 24 kg/sq.cm |
|--------|-------------|-------------|

7.0 MATERIAL:

- 7.1 The materials for the different component parts of the sluice valve shall confirm to requirements given in Table
Materials for components parts of sluice valve

| Sr. No. | Component | Material | Ref. to | Grade of designation |
|---------|---|------------------------|--------------|----------------------|
| 1 | Body, bonnet wedge stuffing box, gland thrust plate, cap. | Grey cast iron | 210-2009 | |
| 2 | Steam | High tensile brass | 320-1980 | Ally 1 of 2 |
| 3 | Wedge nut | Leaded tin bronze | 318-1981(3) | 2 |
| 4 | Body seat ring, wedge facing ring | Leaded tin bronze | 318-1981(3) | 2 |
| 5 | Bolts | Carbon steel | 1367-1967(4) | Class 4.6 |
| 6 | Nuts | Carbon steel | 1367-1967(4) | Class 4 |
| 7 | Bonnet gasket | Compressed fiber Board | 2712-1998(5) | C |
| 8 | Gland packing | Jute & hemp | 5414-1995(6) | -- |

- (1) Specification for grey iron castings (third revision).
- (2) Specification for high tensile brass rods and sections (revised).
- (3) Specification for leaded tin bronze ingots and casting (revised).
- (4) Specification for technical supply condition threaded fasteners (first revision)
- (5) Specification for compressed asbestos fiber jointing (first revision)
- (6) Specification for gland packing, jute and hemp.

8.0 MANUFACTURE

Sluice valve bodies for 80 mm to 900 mm size valves shall be provided with double flanged ends connection.

9.0 FLANGES

The flanges and their dimensions of drilling shall be in accordance with part IV and VI of I.S. 1538 (Part I to XXII) 1993 (Specification for cast Iron fittings for pressure pipes for water gas and sewage) or its latest revision.

10.0 TESTING:

10.1 Hydraulic test:

Each valve shall be subjected to hydraulic tests as described in Appendix – B of IS: 2906-1984 to the test pressure for a duration as specified in table – 7 of IS: 2906 and shall show no sign of leakage under these tests.

10.2 Liquid Penetration Test:

The forged steel stems shall not show any sign of flaw when subjected to liquid penetration flaw detection test in accordance with IS: 3658-1981.

11 LOWERING AND JOINTING IN POSITION

11.1 Supply of Material

- 11.1.1 Cast iron double-flanged sluice valve with two tailpieces suitable to pipe conforming to the latest relevant IS shall be supplied and carted by the contractor to the site of work including loading, unloading and stacking at site.

- 11.1.2** The sluice valve and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect.
- 11.1.3** The sluice valves shall be cleaned before laying.
- 11.1.4** All grits and foreign materials shall be removed from the inside of the valves before placing.
- 11.1.5** All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.
- 11.1.6** The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

11.2 JOINTING MATERIAL

- 11.2.1** The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing, white zinc, jute, lead wool etc.
- 11.2.2** All tools and instruments, which are to be required for installation of sluice valve shall be provided by the contractor.
- 11.2.3** All jointing materials shall be got approved from the engineer-in-charge before use The nuts and bolts shall conform to the relevant IS. The rubber packing shall conform all specifications as narrated in respective IS.

11.3 INSTALLATION

- 11.3.1** The sluice valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.
- 11.3.2** If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.
- 11.3.3** The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice valve bore. It shall be even at both the inner and outer edges.
- 11.3.4** The flange faces thoroughly greased.
- 11.3.5** If flange faces are not free, the contractor shall use thin fibers of lead wool.
- 11.3.6** After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.
- 11.3.7** The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.
- 11.3.8** Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.
- 11.3.9** The sluice valve shall be installed in such a way that its Spindle shall remain in truly vertical position.
- 11.3.10** The other end of tailpiece shall be fitted with pipes so that continuous lines can work.
- 11.3.11** Extra excavation required for facility of lowering and fixing sluice valve shall not be paid for.

11.4 TESTING

- 11.4.1** After installation of sluice valve the same is tested to 1½ times of its test pressure.
- 11.4.2** The joints of sluice valve shall withstand the test pressure of pipelines.
- 11.4.3** Defects noticed during test and operation of sluice valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

12.0 MEASUREMENT AND PAYMENT:

The rate shall be paid per number of valves Supply and tested as directed.
Payment shall be made as per Break up of schedule of Payment.

Item No.5

Providing and supplying ISI mark CI D/F Reflux Valves as per IS:5312(Latest Edition) of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete.

Reflux valve class PN 1.0 80 mm dia

1. Scope of Supply

The contractor shall provide and supply **ISI-marked Cast Iron Double Flanged (D/F) Reflux Valves** conforming to **IS:5312 (Latest Edition)**, including:

- Manufacturing and testing
- All taxes and duties
- Insurance charges
- Transportation and freight charges
- Octroi and inspection charges
- Loading, unloading, conveyance to departmental stores/site
- Stacking and handling

Supply shall be **complete in all respects**.

2. Valve Details

- **Type:** CI Double Flanged Reflux Valve (Non-return valve)
- **Nominal Diameter (DN):** 100 mm
- **Pressure Class:** PN 1.0
- **Standard:** IS:5312 (Latest Edition)
- **Marking:** ISI certification mark embossed on valve body

3. Materials of Construction (MOC)

| Component | Material Specification |
|-----------|------------------------|
|-----------|------------------------|

| | |
|-------------------------|--|
| Body & Cover | Cast Iron (CI), conforming to IS:210, minimum Grade FG 200 |
|-------------------------|--|

| | |
|---------------------|---|
| Disc/Clapper | Cast Iron (CI) with rubber facing or equivalent sealing arrangement |
|---------------------|---|

| | |
|------------------|---|
| Hinge Pin | Stainless Steel (SS 304/316) or Bronze, machined for durability |
|------------------|---|

| | |
|------------------|--|
| Seat Ring | Bronze / Gunmetal / Stainless Steel, securely fixed to ensure leak-tight performance |
|------------------|--|

| | |
|-------------------------|--|
| Bolts & Nuts | Mild Steel (MS) or High Tensile Steel, conforming to IS:1367 |
|-------------------------|--|

| | |
|----------------|---|
| Gaskets | Compressed fibre / rubber sheet as per IS:638, thickness 1.5 mm to 3 mm |
|----------------|---|

| | |
|-------------------|-------------------|
| Hinge Bush | Bronze / Gunmetal |
|-------------------|-------------------|

| | |
|----------------|---|
| Coating | Internal and external surfaces coated with anti-corrosive epoxy paint |
|----------------|---|

4. Design & Performance Requirements

- **Working Pressure:** PN 1.0 (10 Kg/cm²)
- **Hydraulic Test Pressure:**
 - Body: 15 Kg/cm²
 - Seat: 10 Kg/cm²
- **Flow Direction:** Unidirectional (non-return function)
- **Flanges:** Drilled as per IS:1538 / IS:5312, suitable for PN 1.0 rating
- **Leakage:** Valves shall be leak-tight under specified test conditions

5. Inspection & Testing

- All valves shall be **hydrostatically tested** as per IS:5312 requirements.
- Manufacturer shall furnish **test certificates** and inspection reports.
- Valves shall bear **ISI mark** and manufacturer's identification.

6. Delivery & Payment Terms

The rate shall be for a unit of one number. The payment shall be made only for satisfactorily work done with all respect.

Item No.6

Providing and supplying C. I. Temper proof Air valves with SS 304 Float gun metal- nozzle of approved make & quality of following class and diameter including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc. complete.

Without Isolating Sluice Valve PN 1.0

50 mm dia temper proof

➤ General

- Tamper proof air valve confirming to AWWA C 512, having outlet for admission and release of bulk volume of air during emptying and filling of the pipeline. The ball sealed orifice shall always remain open while air is exhausting and is immediately closed when Water rises in the chamber, lifts the ball and seals the orifice.
- It shall also ensure that there are no recesses or pockets, sheltering, escaping air for the large orifice (low pressure) ball to drop into when the valve open. Turbulent air at the time of filling of pipe shall not circulate in such cavities and cause the ball to blown into when the valve is open.
- Turbulent air at the time of filling of pipe shall not circulate in such cavities and cause the ball to blown into the discharging air streams, blowing the valve shut prematurely. The cone angle of the lower pressure chamber shall be such that even at the critical velocity of all air escape at 300 m/sec.
- The total impact force on the ball is less than the suction force on the angular area between the ball and the cone. The design of the valve should be such as to allow maximum free air discharge at various pressure differentials.
- The low pressure cover shall be massive and designed to withstand full operating thrust in working Conditions. The seat ring shall be held securely in place under the low pressure cover by a joint support ring to prevent it from sagging when the ball is not sealing the orifice.

➤ Testing

- All valves shall hydrostatically tested by the manufacturer before dispatch. The pressure shall be obtained without any significant hydraulic shock. Testing shall be carried on before application of paint. There shall be no air entrapped within the part of the valves subjected to test pressure. Test pressure as per AWWA C512 or API 598.

➤ Positive material Identification (PMI Test)

- PMI test shall be checked at random for Stainless steel parts.

➤ Test Certificates

- When specified by Owner, the manufacturer shall issue a test certificate confirming that the valves have been tested in accordance with this standard and stating the actual pressures and medium used in the test.

➤ Marking

- Marking shall be cast integral on the body or on a plate securely attached to the body for 'DN' size, 'PN' rating, Heat Number and Serial number.

➤ Painting

- Each valve shall be drained, cleaned, prepared and suitable protected with 2 coats of red oxide and then black bituminous paint for minimum of 150 micron DFT on surfaces before dispatch.

➤ Datasheet:

| TAMPER PROOF AIR VALVE | | | | |
|------------------------|-------------|---------------------|---------------------|---------------------------|
| Sr No | Component | PN- 1.0 | PN-1.6 | PN-2.0 |
| 1 | Body | CI IS 210 Gr. FG260 | CI IS 210 Gr. FG260 | ASTM A216 Gr. WCB |
| 2 | Cover | CI IS 210 Gr. FG260 | CI IS 210 Gr. FG260 | ASTM A216 Gr. WCB |
| 3 | Float | SS 410 | SS 304 | SS 304 |
| 4 | Seat | EPDM | EPDM | EPDM |
| 5 | Float Guide | SS 410 | SS 304 | SS 304 |
| 6 | Orifice | SS 410 | SS 304 | SS 304 |
| 7 | Gasket | EPDM | EPDM | EPDM |
| 8 | Nut Bolt | Carbon steel | Carbon steel | Stainless Steel |
| 9 | Flange End | IS 1538 | IS 1538 | ASME/ANSI B16.5 Class 150 |

MODE OF MEASUREMENT AND PAYMENT

Measurement shall be paid on number basis as per relevant dia of the item as per payment schedule.

Item 7: -

Excavation for pipe line trenches for water supply, sewerage line, manhole etc. all with shoring and strutting if required as per required gradient and line including safety provisions using site rails and stacking excavated stuff including up to all required lead cleaning the site etc. complete for all lifts and strata as specified. Upto 1.50 Mt depth from avg GL

- all sorts of soil
- Hard Murrum
- Soft Rock
- In Hard Rock

1.1 GENERAL

1.1 The excavation for trenches will generally, refers to open excavation for trenches in wet / dry conditions for pipe laying work.

2.0 CLEARING OF SITES:

2.1 The site on which the pipelines are to be laid and shown on plan and the area required for setting out and other operations shall be cleared and all obstruction loose stones and materials, rubbish of all kinds, stumps, brushwood as trees shall be removed as directed the roots shall be entirely grubbed up.

2.2 The products of the clearing to restocked in such a place and in such a manner, as directed by the engineer in charge.

2.3 In jungle clearings, all trees not specially marked for preservation, bamboo's jungle wood and brushwood shall be cut down their roots grubbed up. All wood and materials from the clearing shall be the property of the Board shall be arranged as directed by the Engineer-in-charge or his authorized agent; the material pronounced as useful by the Engineer will be conveyed and properly stacked as directed within the specified limit. Unless materials will be burnt or otherwise disposed off as directed.

2.4 All holes or hollows whether originally existing or produced by digging up roots, shall be carefully filled up with earth, well earth, well rammed leveled off, as may be directed.

3.0 SETTING OUT:

The center lines of all pipe trenches etc. shall be given by the Engineer-in-charge and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required true to line, level curve and slopes. The contractor shall assure full responsibility for alignment, and dimension of trench.

The labor materials etc. required for setting out and establishing benchmarks and other reference marks shall be arranged by the contractor at his own cost.

4.0 EXCAVATION

4.1 The excavation incl. Bailing out of water for the pipe trenches shall also incl. Removal of all materials of whatever nature and whether wet or dry condition necessary for laying of pipelines exactly in accordance with alignment, levels grades and curves shown on the plans or as directed by the Engineer-in-charge. Trenches shall be excavated to the exact width and depth according to the size of pipe and the sides shall be left vertical as far as possible or according to the angle of repose various soils. Unless there is a specific extra provision in the contract for shoring and strutting or for cutting side slopes the contractor shall at his own cost do the necessary shoring and strutting or cutting of slopes to a safe of repose or both approved by the Engineer-in-charge. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purpose of measurements before the ground is disturbed. The bottom of the trenches shall be leveled both longitudinally and transversely or slopped as directed by the Engineer. The contractor shall at his own cost to remove such portions of boulders or rocks, as are rectified to make the bottom of the trench level. No filling shall be allowed to bring the trench to level. If by contractor's mistake excavation is made deeper than shown on the plans and if ordered by the Engineer

the extra depth shall have to be made with selected excavated stuff only with watering, remedying etc. as directed, by the Engineer and at the cost of the contractor. Other hard excavation shall be cleared of all sorts and loose materials and cut to firm surface, either level, stepped as directed by the Engineer. The Engineer may order such charges in the dimensions and alignment of pipe trench as may be deemed necessary to secure satisfactory cover over pipeline. The contractor shall, at his own expense, make provision for bailing out of draining water and the trenches shall be kept free of water, during laying work.

After each excavation is completed, the contractor shall notify the Engineer to that effect and no lying of pipeline will be allowed to lie until Engineer has approved the depth and dimensions of trenches level and measurements.

Excavation by the use of Explosives

Unless otherwise stated herein, I.S. Specification "IS: 4081: Safety Code for Blasting and related Drilling Operations" shall be followed. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines specified for the excavation, in the soundest possible condition. The quantity and strength of explosives used shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Employer's Representative, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Employer's Representative at his cost. As excavation approaches its final

lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

The contractor shall obtain a valid Blasting License from the authorities concerned. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done; and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as a way as possible from the area to be blasted. Employer's Representative's prior approval shall be taken for the location proposed for the magazine.

In no case shall blasting be allowed closer than 30 meters to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old. Blasting for excavation in hard rock will only be allowed if permitted by competent authority otherwise shall be done with chiseling only.

For blasting operations, the following points shall be observed.

- i) Contractor shall employ a competent and experienced supervisor and licensed blaster in-charge of each set of operation, which shall be held personally responsible to ensure that all safety regulations are carried out.
- ii) Before any blasting is carried out, Contractor shall intimate Employer's Representative and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.
- iii) Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200 m radius from the firing point, at least 15 minutes before firing time by sounding warning whistle. The area shall also be given a warning by sounding a distinguishing whistle.
- iv) The blasting of rock near any existing buildings, equipments or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by MS plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Employer's Representative; a trench shall have to be cut by chiseling prior to the blasting operation, separating the area under blasting from the existing structures.
- v) The firing shall be supervised by a Supervisor and not more than 6 (six) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.
- i) A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the

balance of the hole shall be filled with stemming, which may consist of sand or stone dust or similar inert material.

- vii) Contractor shall preferably detonate the explosives electrically.
- viii) The explosives shall be exploded by means of a primer, which shall be fired by detonating a fuse instantaneous detonator (F.I.D) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.
- ix) In dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatin with detonator and fuse wire may be used. Underwater or for excavation in rock with substantial accumulated seepage electric detonation shall be used.
- x) Holes for charging explosives shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.
- xi) When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level.

Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by Employer's Representative, with concrete of strength not less than M10. Stopping in rock excavation shall be done by hand trimming.

- xii) Contractor shall be responsible for any accident to workmen, public or Employer's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of explosives, or any other Authority duly constituted under the State and / or Union Government as applicable at the place of excavation.

Stripping loose Rock

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

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

Classification of Strata:

The decision regarding, classification of strata shall rest with the Engineer in charge and his decision shall be final and binding to the contractor.

All the materials encountered in the excavation shall be classified as under :-

Ordinary soil and soft murrum:

These will include all materials of an earthy or sandy nature, which can be easily ploughed or small shingle, and gravel, which can be easily removed.

Hard murrum:

This shall include all kinds of disintegrated rock or shale or inundated clay which can be removed with a shovel without difficulty and which do not require blasting.

Soft rock:

This shall include all materials which is rock or hard conglomerate, all decomposed and weathered rock, highly fissured rock old masonry and also soft rock boulders bigger than 1/2 cubic meter and other varieties of rock. Which do not require blasting and which can be removed with the pie crowbars wedges and hammer.

Hard rock & Bhat rock

This shall include rocks, occurring in masses, which could best be removed by chiseling.

5.0 SHORING AND STRUTTING:

- 5.1** Shoring & strutting and dewatering if required shall have to be carried out by the contractor, for which any extra charge will not be paid
- 5.2** During excavation if water connections, sewage connections, telephone lines, khal kuva (soak pits) all other utility services like gas pipe line, Oil pipe line, drainage lines, Storm water line etc. are damaged by the contractor, the same shall have to be restored by the contractor without any extra payment.

6.0 PROTECTION

- 6.1** The trenches shall be strongly fenced and red light signal shall be kept at night and arrangement of watchman to prevent accidents should be done, sufficient care protective measure shall be taken to see that the excavation shall not affect or damage the adjoining structure. The contractor shall be entirely responsible for any injury to life and damage to the properties etc. Necessary protection work such as guide ropes, crossing places, barricades, caution boards etc. shall be provided by the contractor.
- 7.0** The excavation in all sorts of soil, hard murrum, soft rock or hard rock or any type of soil shall have to be carried out up to the required depth by the agency.

8.0 DISPOSAL OF EXCAVATED STUFF

- 8.1** No excavated stuff from trench are to be placed even temporarily nearer than 1.5 meter or greater distance up to 90 meter or as prescribed by the Engineer from the outer edge of trench. All excavated material will be the property of the board. The rate of excavated includes sorting out of useful materials and stacking then separately as directed within

specified lead. The excavated stuff suitable and useful for refilling or for other use shall be stacked at convenient places. The materials not useful in any wet shall be disposal off as directed by the Engineer from the outer edge of trench.

- 8.2** The site should be cleared off on completion of work.

9.0 ADDITIONAL REQUIREMENTS

- 9.1** At the joints of pipes, the trench shall be excavated to an additional depth of 15 cm. and width of 30 cm. And length of 15 cm. beyond the edge of collar on both the sides or as directed. The rate include for such extra excavation made at the joints. The trenches shall be excavated perfectly in straight line. The bottom of the trench shall be kept as per invert level or as directed. To maintain the proper slop the usual method of site rails and boning rods shall be adopted. The contractor shall have to provide and fix and maintain sight rails and boning rod without any extra cost.

If the contractor fails or makes delay to give hydraulic test of the pipe line laid in any of the section, without any genuine reason, he shall be responsible to get any part of the length trenches refill in such case i.e. before tasting for safety of pedestrian and/or vehicular traffic as found necessary by the engineer-in-charge without any extra cost. If found necessary any directed by the Engineer-in-charge. The contractor shall have to excavate the refilled trenches, during hydraulic test without any extra cost. At all road crossings, trenches shall be excavated only for half width of the road and pipe shall be laid. The other half shall be excavated only after back filling over the laid pipeline is done so as to make it suitable for the traffic. The contractor shall provide direction when the pipeline is to be laid along the road as required and shall maintain the diversion or any part of it, without any extra cost. At all road crossings, the pipe shall be laid below the crest of read.

- 9.2** The contractor shall break the road surface by excavation chiseling to the exact width and length as shown on the drawing or as directed by the Engineer-in-charge.

The excavated stuff shall be deposited in uniform layers to avoid mixing with other kind of materials at non-objectionable place or as directed by the Engineer-in-charge.

10.0 MEASUREMENT AND PAYMENT

- 10.1** The payment of excavation shall be made at the unit rate per cubic meter for the quantity actually excavated and accepted by the Engineer in charge limited to dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation in excess of the sanctioned dimensions shall not be measured not paid for and if an ordered by the Engineer the contractor shall have to fill up the excess depth with excavated stuff with watering ramming etc. (Completed as specified) for trench without any extra payment to the contractor.
- 10.2** Dimension shall be correct to two places of decimals of a meter and individual quantity shall of decimals of a meter and individual quantity shall be calculated to two places of decimals of a cubic meter.
- 10.3** The rate for the item of excavation shall include unless and otherwise mentioned.
- (a) Clearing of site
 - (b) Setting out work including all materials and labor.
 - (c) Providing and subsequently removing, shoring and strutting outing Slopes etc.
 - (d) Excavation and removal and staking of all excavated stuff as directed.
 - (e) Necessary protection including labor materials equipment etc. to ensure safety and protection against risk or accident.
 - (f) Providing facilities for inspection and damage to property if caused during progress of work.
 - (g) Compensation for injury to life and damage to property if caused during Progress of work.
 - (h) Restoring of water supply connections, sewer connections, telephone Lines, khalkuva soapiest etc. if damaged by contractor without extra Payment.
Dewatering of excavated pit trench during the progress of work.
 - (j) Clearing the site on completion of works directed by the Engineer.
- Mode of Measurement & Payment & as per Schedule-B .

Item No.8:-

Lowering, laying, fixing and jointing PVC/uPVC/cPVC pipes and specials of following class and diameter including cost of conveyance from stores to site of works including cost of labour, material, cement solvent, giving satisfactory hydraulic testing as per ISI code.

140 mm dia 6Kg PVC Pipeline

90 mm dia 6Kg PVC Pipeline

(1) LAYING AND JOINTING :

This items for laying and jointing pipe lines and does not include the work of excavation. Every pipes and specials shall be cleared properly and examined for any cracks or defects. The rejected pipes and fitting shall have to be removed from site by the contractor immediately and stacked as directed at his own cost. Before lowering laying the pipe into the trenches, the excavation shall be got checked and approved. Necessary solvent cement for P.V.C. Pipes shall be applied with brush inside the fittings and out side the end of pipe after using the pipes sand comb with sand paper the coupler shall then be pressed till there remain no recess between the ends of pipes. The joints shall be protected from direct sun as they finished.

The refilling shall be done after necessary hydraulic testing carried out according to the instruction of Engineer-in-Charge.

The interior of the pipe already laid must be kept clean as the work under process. The ends of pipe shall be closed with a wooden plug the temporary stop of the work.

(2) TESTING :

The Contractor shall give at his own cost necessary hydraulic testing section by section. Minimum length of 500 mt. per section pipe line should with stand the required highest pressure in the section without showing leakage any where in the pipe joints specials valves etc. if any defects are found the contractor shall be made good the same at his own cost.

The contractor shall have to make necessary arrangement for pressure meter and plugging all ends of pipes without claiming extra cost. If the pipes are broken during testing due to test pressure, the contractor shall be responsible to replace the pipe without any

extra claim however the pipes shall be supplied by the Department Free of Cost. The pressure water shall be installed at appropriate place as directed by Engineer-in-Charge. Before actual testing the pipe section shall be filled with water for a period of at least 24 hours. The required pressure subject to class of pipe shall be maintain for at least 30 minutes in presence of Engineer-in-Charge. No extra claim shall be maid to contractor for pumping and pressure arrangement and plugging the pipe section.

(3) The payment for untested section part rate at 70% of the tendered rate for the item shall be paid in R.A.Bill.

(4) Balance amount will be paid after the satisfactory test of the pipes line is given by the contractor as prescribed above.

(5) The rate shall be paid per R.M.T of complete work in all respect.

Item No.9

Providing CC M:10 for encasing pipes using trap metal size 12 mm to 50 mm including form work curing consolidation etc complete for various location on pipeline

... By using trap metal 40 mm size

- For all practical purpose and in absence of proportioning of concrete on base of preliminarily tests, C.C. 1:3:6 may be provided as a levelling course i.e. one part of cement three parts of sand and six parts of black trap kapachi. Specification for various ingredients of concrete such as sand, cement, kapachi, water shall be as these given in specification for C.C. M 100.
- 2.2 While laying base concrete for levelling course the concrete shall not be dumped from above but shall be carried out to the bottom and gently placed from a height not exceeding 1.5 meter. If concrete is transported by chutes, then the same shall be remixed at bottom of chutes to overcome any segregation that might have occurred.

1. General

The concrete shall consist of one part of ordinary Portland cement conforming to IS 269-1976 Three parts of well graded angular best quality river sand free of dust and organic matter and size 1 mm. To 3 mm and Six parts of approved quality black trap kapachi of size 12 mm to 25 mm. All C.C. work shall be carried out as per I.S.S. regulations and as per standing practice and ordered prevailing in PWD. All the items are to be carried out as per details supplied and as required and directed by the engineer in charge or his authorized agencies. The work will have to be strictly as per approved design and as directed by the engineer in charge.

2. Aggregate

The course aggregate and the fine aggregate for the concrete shall be hard, clean ,tough & durable and shall be free from all deleterious matter such as dust, lump of clay, soft & flaxy pieces, shale alkali, organic matter.

The materials shall be got approved by the Engineer-In-Charge or his agent.

3. Proportion

The proportion of course and fine aggregate shall be that one part of cement, three parts of fine aggregates & Six parts of course aggregates by volume. The proportion of cement & water of the water cement ratio shall be as specified, having regard to the nature of work & strength to be developed.

4. Mixing

Whether the concrete is mixed by hand or in a mechanical mixture. it shall be thoroughly mixed and the concrete placed in its final position with the minimum of delay. every pieces of aggregate shall be uniformly coated by cement paste.

5. Laying & Consolidation

The concrete must be laid gently (Not dumped) from height so as not to pent segregation of aggregates .after placing it shall be well compacted by tampl and/or mortar to cream up. in no case ramming shall be prolonged after the cement has begun to take its initial set. In no case, more water be added in order to reduce the work of completion.

6. Curing.

As soon as the concrete has set sufficiently the surface shall be protected from rapid during by being covered with wet sand, wet gunny bags or where possible by foaming shallow pools water on the top. the setting shall be continued for at least 10 days & usually two to three weeks.

7. Workmanship

Water stops shall be cleaned before placing them in position. Oil or grease shall be removed thoroughly using water and suitable detergents. Water stops shall be procured in long lengths as manufactured to avoid joints as far as possible. Standard L or T type of intersection pieces shall be procured for use depending on their requirement. Any non-standard junctions shall be made by cutting the pieces to profile for jointing. Lapping of water stops shall not be permitted. All jointing shall be of fusion welded type as per manufacturer's instructions. Water stops shall be placed at the correct location/level and suitably supported at intervals with the reinforcement to ensure that it does not deviate from its intended position during concreting and vibrating. Care shall also be taken to ensure that no honey-combing occurs because of the serrations/end grips, by placing concrete with smaller size aggregates in this region. Projecting portions of the water stops embedded in concrete shall be thoroughly cleaned of all mortar/ concrete coating before resuming further concreting operations. The projecting water stop shall also be suitably supported at intervals with the reinforcement to maintain its intended position during concreting so as to ensure that it does not bend leading to formation of pockets. In addition, smaller size aggregates shall be used for concreting in this region also

8. Mode of payment

80% payment if necessary shall be made after laying of concrete & 20% payment shall be release after completion of curing period of exposed surface.

The rate shall be paid per cum. of completed work.

ITEM NO : 10

Refilling the pipeline trenches incl. ramming, watering, consolidating disposal of surplus stuff as directed within a radius of 3 km.

The contractor shall do refilling in a systematic manner. Before refilling, the trenches the contractor shall get checked the trenches, ready for refilling.

- All space between pipeline and the sites of excavation shall be refilled to the original surface with earth or selected materials in layers of 20 cm. well rammed.
- Each layer shall be completed before the upper layer is laid till the final level is reached to form a thoroughly compacted base.
- Trenches for pipeline shall be back filled after the pipeline is laid to a depth of 30 cm. above the pipe accepted the joint portion. The ramming filling shall be done after hydraulic testing of pipeline.
- Refilling on top of pipe shall be carried out carefully with selected soft stuff out of the excavated stuff. The filling shall be raised about 5 cm. to take care of subsequent settlement.
- The contractor shall be responsible for any settlement during passage of time or during monsoon and the same shall be refilled with stuff brought from the outside, if necessary.
- The process of refilling trenches, ramming, shall be carried out in such a way as not to endanger the pipeline already laid.
- The contractor shall carry out refilling 15 cm above road surface to take care of any settlement till completion of work and handing over to local body.
- Surplus earth after refilling at the trenches shall be removed from the site within a radius of 3 km as directed by engineer in charged. No extra payment shall be made for clearance the site.
- Mode of Measurement and Payment
The rate shall be per Cubic Meter of refilled volume.
The Payment shall be made as per cum.

ITEM NO- 11:-

Lowering, laying and jointing in position following C. I. / D/F Reflux valves, Butterfly valves, Sluice valves and Air valves including cost of all labour, jointing material, including nut bolts and giving satisfactory hydraulic testing, etc. complete

1)125mm dia sluice valve

2)80 mm dia sluice valve

3)80 mm dia reflux valve

4) 50 mm Air valve temper proof

1.0 JOINTING MATERIAL

- 1.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool C. I. tailpiece etc.
- 1.2 All tools and plant required for installation of sluice valve shall be provided by the contractor.
- 1.3 All jointing materials shall be approved from the engineer-in-charge before use
- 1.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.
- 1.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials.

2.0 INSTALLATION

- 2.1 The sluice valve/ reflux valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.
- 2.2 If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.
- 2.3 The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice/butterfly valve bore. It shall be even at both the inner and outer edges.
- 2.4 The flange faces thoroughly greased.
- 2.5 If flange faces are not free, the contractor shall use thin fibers of lead wool.
- 2.6 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.
- 2.7 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.
- 2.8 Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.
- 2.9 The sluice valve/reflux valve shall be installed in such a way that its Spindle shall remain in truly vertical position.
- 2.10 The other end of tail piece shall be fitted with pipes so that continuous lines can work.
- 2.11 Extra excavation required for facility of lowering and fixing sluice valve shall not be paid for.

3.0 TESTING

- 3.1 After installation of sluice valve/ reflux valve the same is tested to 1 1/2 times of its test pressure.
- 3.2 The joints sluice valve/ reflux valve shall withstand the test pressure of pipelines.
- 3.3 Defects noticed during test and operation of sluice valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

4.0 MODE OF MEASUREMENT AND PAYMENT

Measurement shall be paid on number basis as per relevant dia. of the item as per Schedule-'B'

AIR VALVES

➤ SUPPLY OF MATERIAL

- 1.1 Cast iron double-flanged Air valves with two tailpieces suitable to pipe shall be supplied and carted by the contractor as per latest IS. The rate shall include loading, unloading and stacking at site.
- 1.2 The sluice air valves and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect.
- 1.3 All grits and foreign materials shall be removed from the inside of the valves before placing.
- 1.4 All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease.
- 1.5 The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

➤ JOINTING MATERIAL

- 1.1 The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing white zinc jute lead wool C. I. tailpiece etc.

- 1.2 All tools and plant required for installation of air valve shall be provided by the contractor.
- 1.3 All jointing materials shall be approved from the engineer-in-charge before use
- 1.4 The nut and bolts shall conform to Item No MSP-19 of specification of materials.
- 1.5 The rubber packing shall conform all specifications as narrated in Item No MSP-20 of specifications of materials.
- 2.0 INSTALLATION
- 2.1 The air valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.
- 2.2 The flange faces thoroughly greased.
- 2.3 If faces are not free, the contractor shall use thin fibers of lead wool.
- 2.4 After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.
- 2.5 The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.
- 2.6 Each bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.
- 2.7 Extra excavation required for facility of lowering and fixing air valve shall not be paid for.
- 3.0 TESTING
- 3.1 After installation of air valve the same is tested to 1.5 times of its test pressure.
- 3.2 The joints air valve shall withstand the test pressure of pipelines.
- 3.3 Defects noticed during test and operation of Air valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.
- 4.0 MODE OF MEASUREMENT AND PAYMENT

Measurement shall be paid on number basis as per relevant dia. of the item as per Schedule-'B'

Item No.12

**Construction of valves chambers in brick or Bela stone masonry, locally available in C. M. 1:6. Foundation concrete 150 mm thick in C. C. 1:4:8 of trap metal size 25 mm to 40 mm thick, inside cement plaster in C. M. 1:3 and cement pointing outside in C. M. 1:3 and top cover of precast RCC slab 100mm thick (with key hole in two parts, each with handles or MS bar etc. complete as given size) up to 1mt depth from GL to pipe invert level incl. complete civil work excl. cost of excavation & refilling. With cast in situ RCC slab size of chamber 0.60X0.60X1 mtr deep
With precast slab with single piece 10 cm with fixing M. H. cover**

Scope of work:

The Brick or Bella masonry valve chambers of size mentioned in Schedule-B shall be constructed at various places including all materials and labours.

1. Location

Valve chambers shall be constructed at places as shown on relevant drawings or as directed by the Engineer-in-charge.

2. Excavation

Excavation, shoring, dewatering etc. for the pits of chamber, laying of pipes and fittings/specials shall be done as requirement of work or directed by engineer in charged.

3. Plain Cement Concrete (1:4:8):

The water, sand, cement & stone aggregate of 25mm to 40 mm nominal size shall be used of approved quality as per standard specification in I.S. 456.

3.1 Workmanship: Before starting concrete the bed of foundation trenches shall be cleared of all loose materials, levelled, watered and rammed as directed.

3.2 Mixing: The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quality of work if approved by the Engineer-in-charge. When hand mixing is permitted by the Engineer-in-charge in case of breakdown of machineries and in the interest of the work, it shall be carried out on a water tight platform and shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However, in such cases 10% more cement than otherwise required

shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period of 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

3.3 Transporting and placing the concrete: The concrete shall be handed from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into the final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences. The concrete shall be laid in layers of 15 cm to 20 cm.

3.4 Compacting: The concrete shall be rammed rapidly with heavy iron rammers to get the required compaction and to allow all the interstices to be filled with mortar.

3.5 Curing: After the final set, concrete shall be kept continuously wet, if required by pounding for a period of not less than 7 days from the date of placement.

4. Cement Mortar

Valve chamber shall be constructed in brick masonry/bella stone masonry with cement mortar (1:6) unless otherwise specified.

5. Brick Masonry

The valve chamber shall be constructed by locally available brick or bella stone. Brick or Bella stone shall conform to its standard specification. 230 mm thick masonry work shall be carried out for valve chamber of size mentioned in schedule – B in cement mortar CM 1:6. Workmanship for masonry work shall conform to its standard specification.

6. Cement Plaster

All joints in masonry shall be raked to a depth of 12 mm with hooked tool made for the purpose when the mortar is still green and in any case within 48 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

The proportion of the cement mortar shall be as approved on relevant drawings. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as per relevant I.S. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to remain for more than 25 minutes after mixing with water. Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days. Plastering shall be done on inner face of brick/Bella stone masonry in cement mortar 1:3 and 20 mm thick unless otherwise specified. Plastering work shall be carried out in two layers, to the inner face the first layer being 12 mm thick and the second layer being 8 mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise approved by the Employer's Representative.

7. Scaffolding For masonry work in chamber, necessary scaffolding shall be carried out.

8. Precast Manhole Frame & cover shall be fixed on cast in situ slab.

9. Deformed / TMT bars conforming to relevant IS of grade Fe 415 shall be used with RCC work for fixing M.H. frame & cover on M.H.

10. Top slab concrete

Precast reinforced concrete slab shall be casted on top of valve chambers in two parts with locking arrangement.

11. Measurement

The payment for valve chamber will be made on No. basis of relative item mentioned in Scheduled-B.

Item No.13

Erection of airvalve riser by installing new MS pipe of 6 mm thick and 3.2 mt length with necessary fittings such as flange of appropriate size, nut bolts and embed the pipe in RCC M:15 with offset of 10 cm around pipe with necessary steel etc complete Dia of Airvalve 50 mm & MS pipes

- 1The materials shall be carted to store or site of work including all freight, loading, unloading including all taxes, insurance, including necessary jointing materials such as G.I Nipple saddle pieces shall be brought by the contractor for fixing of air valve.
- 1.2A suitable hole shall be drilled on the pipeline. The pipeline shall be of any type such as AC, PVC or CI pipes. A clamp shall be got prepared with a nipple welded on it. The clamp shall be fixed on pipe with bolts and nuts in such a way that the part of nipple fixed in the clamp shall remain in the hole drilled in pipe. The rubber packing shall be provided between the clamps and the pipe. White zinc spun yarn shall be used for fixing the nipple of air valve.
- 1.3Bolt holes shall be drilled according to center- lines. Bolt heads and nuts shall be hexagonal and shall conform to IS: 1363 (specification for black hexagonal bolts, nuts and lock nuts and black hexagonal screws).

- 1.4 The neoprene seat ring shall be held security in place under the low pressure cover by jointing support ring to prevent it from sagging when the ball is not soaking the orifice.
- **2.0 JOINTING MATERIAL**
- 2.1 Jointing material shall be brought by contractor with all necessary joint rings, nuts, bolts and washers for completing the joints on all the flanges of valve supplied under this contract including these flanges which will be jointed to pipe system. The lengths of bolts shall be assumed to be suitable for jointing material supported under the contract shall be inclusive of rates.
- 2.2 Joint rings shall be of flat section at least 3 mm thick. They shall be of rubber in accordance with Is: 638-1965 or its latest edition (specifications for rubber and insertion jointing) of hardness proven in practice so as form a water tight joint and use of jointing paste shall not be allowed.
- Specifications for Air Riser for Pipeline are as under;

For all dia of pipe

- 1) The work of Air valve riser shall be carried out as per the approved drawing and as per the instruction of Engineer in charge
- 2) The work shall be carried out as per the description of the Item
- 3) The M.S. pipe of 6 mm thick shall be 3.20 m Long of As per Drawing dia
- 4) Necessary reinforcement @0.12 % at cross section Area shall be placed in footing and column as per the Grade of RCC Work will be **M:15**
instruction of Engineer in Charge
- 5) Necessary flanges, Nuts, bolts, Clamp and all type jointing materials shall be provided and fixed by agency
- 6) Air valve shall be fixed by agency with jointing materials
- 7) Item includes all type labors, excavation, refilling etc.
- 8) Item includes necessary cost of form work etc.
- 9) Minimum 10cm Offset has to be Provided Both Side of shaft and water main pipeline
- 10) PCC has to be provided at bottom of the Foundation as instruction of Engineer in Charge

18.0 MODE OF MEASUREMENT AND PAYMENT

Measurement shall be paid on number basis as per relevant dia of the item as per payment schedule.

Item 14: -

Excavation for foundation up to 1.5 M. depth including sorting out and stacking of useful materials and disposing of the excavated stuff up to 50-meter lead

Loose or soft soil

Dense or hard Murrum

(A) Loose or soft soil

1.0. General

- 1.1. Any soil which generally yields to the application of pickaxes and shovels, phawaras rakes or any such ordinary excavating implement or organic soil, gravel silt, sand turf loam, clay, peat etc., fall under this category
- 2.0. Clearing the site
- 2.1. The site on which the structure is to be built shall be cleared, and all obstructions loose stone, materials and rubbish of all kind bush wood and trees shall be remove! as directed The materials so obtained shall be property of the Government and shall be conveyed und stacked as directed within 50 m lead. The roots of the trees coming in the sides shall be cut and coated with a hot asphalt
- 2.2. The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.
- 3.0. Setting out After clearing the site the 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 work. Contractor shall supply labours materials, etc. required for setting out the reference marks and bench 'marks and shall maintain them as long as required and directed.
- 4.0. Excavation The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and shutting or providing necessary slopes to a safe

angle, at his own cost. The payment for such precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transversely as directed by removing and watering as required. No earth filling will be allowed for bringing it to level. If by mistake or any excavation is made deeper or wider than that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 m depth shall be measured under this item.

- 5.0. Disposal of the excavated stuff
- 5.1. The excavated stuff of the selected type shall be used in filling the trenches and plinth or leveling the ground in layers including ramming and watering etc.
- 5.2. The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead up to 50 M. and all lift.
- 6.0. Mode of measurements & payment
- 6.1. The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by the Engineer-in-charge. No payment shall be made for surplus excavation made in excess of above requirements or due to stopping and sloping back as found necessary on account of conditions of soil and requirements of safety.
- 6.2. The rate shall be for a unit of one cubic meter

B) Hard murrum.

The hard murrum shall be clean of good binding quality and of approved quality obtained from approved quarries of disintegrated rocks which contain some materials and natural mixture of clay of local origin. The size of hard murrum shall not be more than 20 mm.

- 2.0. Workmanship The relevant specification of item No. 14 (A) shall be followed except that the excavation work shall be carried in hard murrum.
- 3.0. Mode of measurements & Payments
- 3.1. The relevant specifications of item No. 14 (A) shall be followed.
- 3.2. The rate shall be for a unit of one cubic meter.

Item No 15: -

Providing and laying cement concrete 1:3:6 (1- Cement: 3- Coarse sand: 6- Graded brick bat aggregate 40mm normal size) and curing complete excluding cost of formwork in (A) Foundation and Plinth

1.0. Materials:

1.1. Water:

Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete or cause efflorescence or attack the steel in R.C.C. Potable water will generally be found suitable for curing, mortar or concrete.

1.2 Sand:

Sand shall be natural sand, clean, well graded hard strong, durable and gritty particles free from injurious amounts of dust, clay lumps, nodules, soft or flaky particles, shale, alkali salts, organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-Charge.

1.3 Stone Aggregate:

Coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

The aggregate shall generally be cubical in shape unless special stones of particular quarries are mentioned. Aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall be generally as per IS 456.

Cement:

Cement shall be ordinary Portland slag cement as per I.S.269-1976 or Portland slag cement as per I.S. 455-197

2.0 Workmanship:

2.1 General:

Before starting concrete bed of foundation trenches shall be cleared of all loose materials, levelled, watered and rammed as directed.

- 2.2 Proportion of Mix: The Proportion of cement, sand and coarse aggregate shall be one part of cement, 3 parts of sand, 6 parts of stone aggregates and shall so measured by volume.

- 2.3 Mixing: The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the engineer-in-charge in case of break-down of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period 1 to 2 minutes. The quantity of water shall be sufficient to produce a dense concrete of required workability for the purpose.
- 2.4 Transporting & placing the concrete: The concrete shall be handled from the place of mixing to the final position in not more than 15 minutes by the methods directed and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences. The concrete shall be laid in layers of 15 cms to 20 cms.
- 2.5 Compacting: The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and allow all the interstices to be filled with mortar.
- 2.6 Curing: After the final set, the concrete shall be kept continuously wet, if required by ponding for a period of not less than 7 days from the date of placement.
- 3.0 Mode of measurement and Payment:
The concrete shall be measured for its length breadth and depth, limiting dimensions to those specified on plan or as directed. Measurement are taken per Cubic meter.

Item No.16 :-

Uncoursed Rubble Masonry with hard stone of approved quality in foundations and plinth in Cement Mortar 1:6 (1-cement : 6-coarse sand including levelling up etc. complete

1.0. Materials:

1.1. Water:

Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C. Potable water will generally found suitable for curing, mortar or concrete.

1.2 Sand:

Sand shall be natural sand, clean, well graded hard strong, durable and gritty particles free from injurious amounts of dust, clay kankar nodules, soft or flaky particles shale, alkali salts organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-Charge.

1.3 Stone Aggregate:

Coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

The aggregate shall generally be cubical in shape unless special stones of particular quarries are mentioned. Aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall be generally as per IS 456.

Cement:

Cement shall be ordinary Portland slag cement as per I.S.269-1976 or Portland slag cement as per I.S. 455-197

2.0. Workmanship

2.1. Dressing of stones:

Stone used for Uncoursed rubble masonry work shall be hammer dressed on the sides, and beds in which such a way as to close with the adjacent stone in the masonry work as strongly as possible. The face stones shall be dressed in such a manner as to give a specified pattern such as polygonal facing etc. The face of the stones shall be so dressed that bushing on the exposed face shall not project by more than 40 mm. from the general wall surface and on the face to be plastered, it shall not project by more than 19 mm., nor shall have depressions more than 10 mm. from the average wall surface.

2.2. Laying:

All the stone shall be sufficiently wetted before laying to prevent absorption of water from mortar. The wall shall be built true to plumb (or true to required batter when so specified). All connected walls in a structure shall be raised up informally and regularly. However if for any specific reason, one part of masonry is required to be left behind, the wall shall be racked back at an angle not steeper than 45. Vertical toothed joints in masonry shall not be allowed. The work shall be carried out regularly and masonry of any day wall not be raised by more than 1 meter in height.

2.3. The stone shall be laid in an Uncoursed fashion, or random facing etc. However the masonry is required to be brought to level at various stages viz. plinth level window sill level, roof level and any other level specifically shown in the drawings. This may

be done first by adjusting the laying of stone to one level and then by providing leveling coarse of cement concrete 1:6:12 (1 cement: sand: 12 graded stone aggregate 20 mm. nominal size) or as otherwise specified.

2.4. Proper bonding shall be achieved by closely filling in adjacent stones as well as by using bond stones or through stones as described herein below. Face stones shall extend back sufficiently, and bond well with the masonry. The stone shall be carefully set so as to break joints and avoid formation of vertical joints. The depth of stone from the face of wall inwards shall not be less than weight or breadth at the face. The hearing or interior filling of the wall shall consist of rubble stones which may be of any shape. Neither the face stone nor the hearing stone shall be so small to pass through circular ring of 150 mm. internal diameter in any direction nor shall any of them shall have minimum thickness 100 mm.

2.5. All stone shall be carefully laid, hammered down by a wooden mallet into position and solidly embedded in mortar, chips and spawns of stone may be used wherever necessary to avoid thick mortar bends or joints at the same time ensuring that no hollow space is left anywhere in the masonry. The chips used shall not be more than 20% by volume of masonry. The hearting shall be laid nearly level with face stones except that at about one meter intervals vertical bond stone or plumes projecting about 150 to 200 mm. shall be firmly embedded to from vertical bounding in masonry.

2.6. Bond stone:

Bond stones or through stones running right across the thickness of the wall shall be provided in wall upto 600 mm. thick. In thicker walls two stones overlapping each other by atleast 150 mm. shall be provided across the thickness of the wall to form bond stones. There shall be atleast one bond stone for every 0.5 sq. mtr of wall surface. The bond stone shall be marked by a distinguishing letter during construction for subsequent verification and shall be laid staggered in sub sequent layers.

2.7. Quoins:

The quoins or corners stones shall be selected stone neatly dressed with hammer and/or chisel to form the required corner angle and laid header and stretcher alternatively. The bed top surface of quoins shall be chiseled dressed to give horizontal joints. The quoins shall have a uniform chisel draft of atleast 25 mm. width at four edges of each exposed face, all the edges of the same face being in one plane. No quoins stone shall be smaller than 0.025 cum. in volume.

2.8. Jamb Stones:

The jamb stone shall be made with stone specified for quoins, that the stone provided on the jambs shall have their length equal to thickness of wall upto 600 mm. and a line of headers shall be provided for walls thicker than 600 mm. as specified for bond.

2.9 Mode of measurement and Payment:

Measurement are taken per Cubic meter.

Item No 17: -

Filling available excavated earth (excluding rock) in trenches. plinth, sides of foundations etc. in layers not exceeding 20 cm. in depth consolidating each dispirited layer by ramming and watering.

Workmanship

The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats, mortar dropping etc., and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with but ends of crow-bars, where rammer cannot be used.

The plinth shall be similarly filled with earth in layers not exceeding 20 cms adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

The finished level of filling shall be kept to shape intended to be given to floor.

The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.

Mode of Measurements & Payment

The payment shall be made for filling in plinth and trenches. No deduction shall be made for shrinkage or voids, if consolidated as instructed above. The rate shall be for a unit of one cubic meter.

Item No 18 :-

Precast concrete block masonry (including quoin blocks jamb blocks closer etc.) with solid concrete blocks of approved size made of cement concrete 1:3:6 mix (1- Cement: 3 coarse sand: 6- graded stone aggregates of 20 mm and down grade) cement mortar 1:6

- in foundation and plinth
- For Super structure above plinth

Stone Coarse Aggregate for Nominal Mix Concrete

coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar

The aggregate shall generally be cubical in shape Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall generally be as per the table given below.

However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6- mm. less than the cover whichever is smaller.

| I S. Sieve Nominal size | | | | Percentage passing for single Designation Sized aggregates of Nom | | | | I S. Sieve Nominal size | | | | Percentage passing for single Designation Sized aggregates of | | | |
|----------------------------|---------|-------|---------|--|-------|---------|-------|----------------------------|-------|-------|-------|--|-------|----|---|
| | 40 mm | 20 mm | 16 mm | | | | | | 40 mm | 20 mm | 16 mm | 80 mm | | | |
| - | 12.5 mm | - | - | - | 63 mm | 100 | - | - | 100 | - | - | - | 10 mm | 05 | - |
| 0.20 | 0.30 | 40 mm | 85-100 | 100 | - | 4.75 mm | - | 0.5 | 0.5 | 20 mm | | | | | |
| 0.20 | 85-100 | 100 | 2.35 mm | - | - | - | 16 mm | 85-100 | | | | | | | |

Note: This percentage may be varied some what by the Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests, indicated in I.S. 383-1970 and 456~197f shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If she aggregates are covered with dust, they shall be washed with water to make them clean.

(b) Sand as per Item No. 10s

(c) Cement

Cement snail be ordinary Portland slag cement as per I.S.269-1976 or Portland slag cement as per I.S. 455-1976

- 1.1. The solid cement concrete blocks shall be precast with concrete of 1:3:6 mix (1 cement: 3 coarse sand: 6 graded stone aggregate)
- 1.2. A block shall be deemed to be solid if the solid materials is not less than 75% of the total volume of the blocks calculated form overall dimensions.
- 1.3. The concrete mix used for block shall be one of the following:
- 1.4. The actual size of the block shall be one of the following: Size: A. 39 x 30 x 19 cms. Size-B 39 x 20 x 19 cms. Size C 39 x 10 2 19 cms. The size other than those specified above may be used with the approval of Engineer-in-charge.
- 1.5. The blocks may be either machine made or hand made. The concrete mix, the mixing of concrete the manufacture of blocks, curing and drying shall be in accordance with para-6 to 10 under I.S.: 2185-1967.
- 1.6. Faces of blocks shall be flat and rectangular Surface finish shall be rendered smooth or plastered with cement mortar 1:3 coarse sand)
- 1.7. The average compressive strength of eight blocks when determined in the manner described-in I.S. 2185 - 1967 shall not be less than 50 Kg/Sq. Cm. of gross area. The strength of lowest individual block shall not be less than 75 percent of average compressive strength of eight blocks.
- 1.8. Concrete blocks shall be stored and stacked property in such a way as to avoid any contract with moisture at site. They shall be stock plied on planks or other supports free from contract with ground and covered to protect against wetting. Cement mortar of proportion 1:6 shall conform to M-11. As per
- 2.0. Workmanship

- 2.1. The blocks need not wetted before or during laying in the walls. In case climatic conditions so required, the top and the sides of block may only be slightly moistures so as to prevent absorption of water from the mortar and ensure the development of required bond with mortar.
- 2.2. Operations of laying precast cement concrete block masonry shall be carried out in accordance with instructions detailed in I.S.: 6042 -1952. The mortar shall not be spread so much ahead of the actual laying of the units that it tends to stiffen and loose, its plasticity, thereby resulting in poor bond. For most of the work, the joints, both horizontal and vertical shall be 10 mm. thick except in the case of extended joint, construction, the mortar joints shall be struck off flush with wall surface and when the mortar has stated stiffening, it shall be compressed with rounded or U-shaped tool. The mortar shall be pressed against the units with a jointing tool after the mortar has stiffened in effect intimate contract between the mortar and the masonry unit and obtained a weather tight joint. 61
- 2.3. Quoins and closures: Special quoins blocks (with a return face equal to half the length of normal face) shall be cast for ail building blocks and slabs for external work. Proper half closures shall be cast and not cut form full size blocks. The returned ends of blocks for door windows revels and quoins shall be finished with a fair face in the mould.
- 2.4. Only double scaffolding shall be used. The scaffolding be strong and sound. No holes in the masonry for supporting shall be allowed.
- 2.5. curing: The curing of concrete block masonry shall be carried out for 7 days.
- 3.0. Mode of measurements & payment
- 3.1. All work shall be measured on the basis of finished dimensions and measured net except where otherwise specified. Only specified dimensions shall be allowed. Anything extra shall be ignored. The masonry work in foundation and plinth shall be measured under this item. No deduction shall be made, not extra payment made for the following:
 - (a) Ends of joints, beams, spots, girders, rafters, purloins, trusses, corbels, etc. each up to 500 sq. cm. in section.
 - (b) Opening each up to 0.1 sq.mt.
 - (c) Wall plates and bed plates, bearing of chhaja and like up to 10 cm. depth (bearing of floor and roof slabs shall be deducted from masonry).
 - (d) Drain holes and recesses for cement concrete blocks to embed hold fasts for doors windows.
 - (e) Building in the masonry iron fixtures pipes up to 300 mm. dia. hole fasts of doors and windows.
 - (f) Forming theses in masonry up to section of 350 sq.cm.
- 3.2. The work of concrete block masonry in foundation and plinth shall be measured under this item.
- 3.3. The rate shall be for a unit of one cubic mete

Item No 19: -

Providing and laying cement concrete flooring 1:2:4 (1-cement: 2-coarse sand: 4-graded stone aggregate 20mm nominal size) laid in one layer and finished with a floating coat of neat cement. (B) 50mm thick

1.0. Materials:

1.1. Water:

Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete or cause efflorescence or attack the steel in R.C.C. Potable water will generally found suitable for curing, mortar or concrete.

1.2 Sand:

Sand shall be natural sand, clean, well graded hard strong, durable and gritty particles free from injurious amounts of dust, clay kankar nodules, soft or flaky particles shale, alkali salts organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-Charge.

1.3 Stone Aggregate:

Coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

The aggregate shall generally be cubical in shape unless special stones of particular quarries are mentioned. Aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall be generally as per IS 456.

1.4 Cement:

Cement shall be ordinary Portland slag cement as per I.S.269-1976 or Portland slag cement as per I.S. 455-1976

2.0 Workmanship:

2.1 General:

Before starting concrete bed of foundation trenches shall be cleared of all loose materials, levelled, watered and rammed as directed.

- 2.2 Proportion of Mix: The Proportion of cement, sand and coarse aggregate shall be one part of cement, 2 parts of sand, 4 parts of stone aggregates and shall so measured by volume. total thickness of the flooring shall be kept 50mm.
- 2.3 Mixing: The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing may however be allowed for smaller quantity of work if approved by the Engineer-in-charge. When hand mixing is permitted by the engineer-in-charge in case of break-down of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However such cases 10% more cement than otherwise required shall have to be used without any extra cost. The mixing in mechanical mixer shall be done for a period 1 to 2 minutes. The quantity of water shall be sufficient to produce a dense concrete of required workability for the purpose.
- 2.4 Transporting & placing the concrete: The concrete shall be handled from the place of mixing to the final position in not more than 15 minutes by the methods directed and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences. The concrete shall be laid in layers of 15 cms to 20 cms.
- 2.5 Compacting: The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and allow all the interstices to be filled with mortar.
- 2.6 Curing: After the final set, the concrete shall be kept continuously wet, if required by ponding for a period of not less than 7 days from the date of placement.

3.0 Mode of measurement and Payment:

The concrete shall be measured for its length breadth and depth, limiting dimensions to those specified on plan or as directed. The rate shall be for a unit of one square meter.

The concrete shall be consisting of one part of approved quality cement with two parts of clean and angular sand without parts of coarse aggregates of 12mm to 20mm size.

Portable water shall be added as per required quantity and shall be mixed in best work manlike manner.

Necessary form work shall be done by the contractor. Lining work shall be carried out as per instruction of Engineer-in-Charge.

The entire work shall be cured at least for 14 days the total thickness of the flooring shall be kept 50mm.

The rate includes all materials labour for mixing finishing, lining curing form work etc. complete

The rate shall be paid per one square meter.

ITEM NO 20: -

Providing 15mm thick cement plaster in single coat on Rough (Similar) side of single or half brick walls for interior plastering upto floor two level and finished even and smooth in (i) Cement mortar 1:4 (1-cement:4-sand)

1.0 Materials

- 1.1 Water: Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete or cause efflorescence or attack the steel in R.C.C. Potable water will generally found suitable for curing, mortar or concrete.

- 1.2 Cement mortar of proportion 1:6 shall conform to its relevant IS

2.0 Workmanship

- 2.1 Scaffolding: Wooden bullies, bamboos, planks, trestles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.
- 2.2 Preparation of back-ground: The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing.

Smooth surface shall be toughened by wire brushing if it is not hard and by hacking if it is hard. In case of concrete surface, if a chemical retarded has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the residues are left on the surface. Trimming of projections on brick/concrete surfaces where necessary shall be carried out to get an even surface. Raking of joints in case of masonry where necessary shall be allowed to dry out for sufficient period before carrying out the plaster work. The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry, such area shall be moistened again. For external plaster, the plastering operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supports of the ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

2:3 Application of plaster:

The plaster about 15x15 cms shall be first applied horizontally and vertically at not more than 2 meters intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel or wooden float according as a smooth or a smooth or a sandy granular texture is required. Excessive troweling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Hounding or chamfering, corners, arises junctions etc. shall be carried out with proper templates to be size required. Cement plaster shall be used within half an hour after addition of water. And mortar or plaster which is partially set shall be rejected and removed forthwith from the site. In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically, when recommencing the plaster, the edges of the old work shall be scraped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15 cm. to any corners or arises. It shall not be closed on the body of features such as plaster bands and cornices not at the corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on. Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging matting or gunny bags on the outside of the plaster and keeping them wet.

3.0. Mode of measurements & payment

The rate shall include the cost of all materials, labour and scaffolding etc. involved in the operations described under workmanship.

All plastering shall be measured in square meters unless otherwise specified. Length breadth or height shall be measured correct to a centimetre. This item includes plastering up to floor two levels.

The rate shall be for a unit of one sq. meter.

ITEM NO 21:-

Finishing wall with water proofing cement paint of on wall surfaces (Two coats) to give an approved brand and manufacture and of required shape even shade after thoroughly brushing the surface to remove all dirt and remains of loose powered materials.

1.1. Materials

1.1. The clear colle shall be made from glue and boiling water by mixing. 1 Kg mixture shall be suitably tinted where required for use under coloured distemper if directed. Glue shall conform to I.s. 852-1969

(Specifications for animal give).

1.2. Lime used shall be Freshly burnt class "C Lime (fat lime) and white in colour conforming to I.S .712- 1973. Water shelf conform to M-1 Best quality of gum shall be used in the preparations of white wash. Ultramarine blue or Indigo: This shall conform to f.S. 55-1970 for points, and shall be used for preparation of white was, Pigments. Mineral colours, not affected by lime shall be used in preparing colour wash.

2.0. Workmanship

2.1. Preparation of white v/ash solution: Surface already white or colour; The fat lime shall be slaked as site and shall be mixed and stirred with about five liters of water for 1 kg. of unslaked lime to made a thin cream. This shale be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth, 4 Kg. of gum dissolved in hot water shall be added to each cubic meter of lime cream. Small quantity of ultramarine blue (Up to 3 gms. per kg. of lime) shall also be added to the last two coats of white wash solution and the whole solution shall be stirred thoroughly before use

2.2. Preparation of surface:

2.2.1. The surface shall be thoroughly cleaned of all dust, dirt, mortar cropping's and other foreign matter before white wash is to be applied.

2.2.2. The surface spoiled by smoke soot shall be scrapped with steel wire brushes or steel scrapers or shall be rubbed with over-burnt surkhi or brick bats. The surface shall be then boomed to remove all dust, dirt and shall be washed with clean water.

2.2.3. Oil or grease spots shall be removed by suitable chemical and smooth surface shall be rubbed with wire brushes -

2.2.4. All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly. Such portion shall be wetted and allowed to dry. They shall then be given one coat of white wash.

2.2.5. All unnecessary nails shall be removed, the holes, cracks, patches etc. shall be made good with material similar in composition to the surface to be prepared

2.3. Scaffolding:

Wherever scaffolding is necessary it shall be erected in such a way that as far as possible on part of scaffolding shall rest against the surface to be white r>r colour washed. A properly secured strong and well tied suspended platform (Zoie) may be used for

white washing. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the floors and walls. For white washing of ceilings, proper stage scaffolding shall be erected where necessary.

2.4. Application of white wash :

2.4.1. On the surface so prepared the white wash shall be applied with 'Moon' brush. The first stroke of the brush shall be from top downwards, another from bottom upwards over the first stroke and similarly one stroke from the right another from the left, over the first stroke brush before it dries. This will form one coat. Each coat shall be allowed to dry before and uniform finish free from brush marks and it should not come off easily when rubbed with finger.

2.4.2. Splashing and dropping if any on the doors and windows, ventilators etc. shall be removed and the surface cleaned.

2.4.3. Priming and Alkali resistant treatments, scraping of surface washing etc. surface spoiled by smoke soot removed of oil and grease spots, treatment for infection with efflorescence moulds mosses, fungi, algae and Kitchen and patch repairs to plaster wherever done shall not be paid extra.

The rate shall be for a unit of one sq. meter.

Item No 22:-

Providing and fixing at site of work MS Door, Window etc with Rly freight, loading, unloading, carting & all taxes etc comp as directed including paints 2 coats etc completed.

M.S. Door and window to be supplied and fixed in this pump room shall be of ISI marked only. Door and window shall be designed for manual operations, unless specified otherwise. These will be tested at the manufacturer's shop and such test certificate shall be provided on demand All packing glands shall permit replacement of packing while the Door and window is on lines. MS Door and window should have open/close rotational directions marked clearly on the wheels. Manual operation of Door and window shall be possible against the maximum unbalanced head. Oil paints shall be of the specified colour and as approved The ready mixed paints shall only be used. However, if ready mixed paint of specified shade or tint is not available white ready mixed paint with approved stainer will be allowed In such a case the contractor shall ensure that the shade of the paint so allowed shall be uniform. 2 coat of paint shall be applied on MS Door and window. There is no extra payment for colour work The Door and Window shall be fixed at the site of work and no extra payment will be made for replacement of old Gate. The rate shall include the cost of all materials and labour involved in all the operations described above.

The rate shall be paid per Kg.

Item No 23: -

Providing corrugated G.I. sheet of class-3 roofing fixed with galvanized iron J or L Hooks, Bolts and nuts 8mm diameter with bitumen and G.I. limpet washer or G.I. limpet washer. filled with white lead complete excluding the cost of purlins, Rafters and Trusses. (1) 0.80 mm thick sheet

1.0. Materials

1.1. The G.I. sheet overall in galvanized plain sheet of 0.8 mm. thickness shall be of class-3. The sheet shall be wide overall and flashing shall be 380 mm. wide overall. There shall be bent to the required shape without damage to the sheets in the process of bending.

2.0. Workmanship

2.1. Spacing of purlins: One purline shall be provided at the ridge and one at the eaves. The spacing of other purlins for 0.8 mm. thick G.I. sheets shall not exceed 1.80 meters. The purline shall coincide with the center line of the end lap. The ridge purlins shall be placed in such a way that the ridges can be fixed properly. The portion overhanging the wall support shall not be more than one fourth of the 'spacing of purlins.

2.2. The top surfaces of the purlins shall be painted before the sheets are fixed over them. Embedded portions of purlins shall be finished with two coats of coal-tar.

2.2. Wherever the edge of a roof sheeting or valley gutter is turned up against a wall, the edge shall be weather proofed with a flashing. Flashing shall be bent to shape and fixed. Lap over the sheet shall be not less than 150 mm. over the roofing sheets. The end between the flashing sheets shall not less than 225 mm.

2.3. The flashing shall be inserted into brick work or masonry joints to a depth of 50 mm. These joints shall be filled with cement mortar (1:3). The flashing shall be well secured to the masonry. Whenever flashing has to be laid at a slope, it shall be stepped at each course of masonry, the step being out back at angle or not less than 30 degrees to the vertical

2.4. Sheet shall be bent to shape and shall have end lap projection on either side under C.G.I. sheet not less than 225 mm. Sheet shall be fixed to the roof member below, with same 8 mm. dia. G.I. hook, bolts and nuts and bitumen and G.I. limpet washer which fix the sheets to these members. At least one of the fixing bolts shall pass through the end laps of the valley piece. If necessary extra bolts shall be provided for this purpose.

3.0. Mode of measurements and payment

3.1. The measurements for valley shall be taken for finished work in length along their center lines.

3.2. No laps shall be measured.

3.3. The rate excludes the cost of boarding underneath which shall be paid separately.

3.4. The rate of flashing includes the cost of mortar for fixing in wall and other labour and materials required for it.

3.5. The rate shall be for a unit of one Square meter.

Deputy Executive Engineer,
P.H.S.Sub-Dn.(G.W.S.& S.B.)
Bhuj-Kachchh