4.6 The Contractor shall keep wet all brickwork for at least 10 (ten) days after laying. The surface of unfinished work shall be cleaned and thoroughly wetted before joining new work to it.

5. PLASTERING, PAINTING AND SURFACE TREATMENT

5.1 Cement Plaster

5.1.1 The plastering work shall be governed by IS:1661. Unless otherwise specified cement plaster shall be composed of 1 part of cement and 6 parts of sand. For ceiling plaster, the composition shall be 1 part of cement and 4 parts of sand. The thickness of ceiling plaster shall be 6 mm. The thickness of plaster to the fair faces of brickwork shall be 19 mm. The thickness mentioned shall be minimum thickness. The Contractor shall allow in his rate for any rubbing out due to inequalities of brickwork.

5.1.2 The rate shall also include for forming of any moulding drip course etc., and for extra thickness due to corbelling of brick work in parapet or at any other place. If required, all internal angles shall be rounded off as per drawing or as directed by the Engineer without any extra charges.

5.1.3 Cement and sand shall be measured and mixed dry thoroughly to a uniform colour on a platform specially constructed for the purpose. Care should be taken to see that no foreign matters get mixed with the mixture. Only enough water shall be mixed to make the mixture workable. The mix shall then be turned over and again to a uniform colour and texture. No. more cement mortar shall be mixed at a time than cannot be used within thirty (30) minutes of mixing.

5.1.4 Surface to be plastered are to be brushed clean, wetted for 24 hours before the plaster is put in and the joints of the brick work raked out 12 mm. deep minimum. The concrete faces to be plastered shall be chipped, roughened and soaked with water for achieving required bond with the plaster without any extra cost.

5.1.5 The surface of the plaster shall be finished absolutely in one plane. Any unevenness shall be rubbed down by the Contractor with carborandum stones at his cost and expenses. Care shall be taken to see that no mark remains at the junction of plastering done at different times. If necessary, the junctions shall be rubbed with carborandum stones to eliminate such undesirable marks. The Contractor may be required to use normal sprinkling of thin cement slurry on the surface for satisfactory finishing of the plastering work for which no extra payment shall be made.

5.1.6 Plaster shall be protected and cured by keeping it thoroughly wet with sprinkling of water for 10 (ten) days continuously.

5.1.7 The cost of plastering work shall also include the cost of necessary scaffolding, staging etc. as would be required for the work.

6. SURFACE FINISHING

6.1 General

The cost of all the items of work under this section should include the cost of necessary scaffolding, staging, preparing sub-base, removing stains from the floor, skirting, wood work, glass etc. caused through execution of the work.

6.2 White Washing

6.2.1 White washing shall be done with 5(five) parts of stone lime and 1 (one) part of shell lime with necessary gum (about 2 Kg. per CUM. of lime) using a small quantity of blue as per direction of Engineer. The lime shall be brought to the site un-slaked and shall be slaked at site with an excess of water and allowed to remain under water for (two) days. To the mixture fresh water may be added to bring the consistency to that of a thin cream. When thoroughly mixed, the mix is to be strained through coarse cloth. The surface of the wall is to be brushed thoroughly cleaned before the white washing is applied. Each coat of white wash has to be laid on with

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brushes. Each coat of White Wash means one continues strike of brush with the prepared wash from top downwards. Another similar strike bottom upward over first strike followed by another similar strike from right to left and another from left to right over the right application of brush before it dries. Each coat must be perfectly uniform when finished and free from brush mark etc.

6.2.2 Three coats of white wash will mean a minimum of 3 (three) coats to produce an opaque white surface to the entire satisfaction of the Engineer. If the surface is blotchy or otherwise unsatisfactory, more number of coats shall be applied till the desired effect is produced to the satisfaction of the Engineer without any additional cost.

6.3 Snowcem or Similar Decorative Cement Finish

6.3.1 Where specified, external surface shall be finished with two coats of 'Snowcem' or similar decorative cement finish of approved colour, shade and manufacturer. The surface to be finished it to be previously cleaned down to remove loose dust or dirt by use of stiff wire brush. All inequalities to be rubbed down and defects rectified. The surface to be wetted well with water and the surface water is to be allowed to run off. The 'Snowcem' or equivalent to be mixed will be strictly as per manufacturer's specification. The mixed 'Snowcem' or equivalent to be applied to the surface with a brush of good quality. The first coat should be well brushed into the surface to form a good bond. Second coat should be applied carefully to give a good finished appearance may be applied by brushing or spraying. Each 'Snowcem' or equivalent application shall be wetted at the end of the day with a fine water spray.

6.4 Painting to Steel Works

6.4.1 Any shop coat of paint shall not be considered as a coat of paint for the purpose of specification.

6.4.2 Ready mixed synthetic enamel paint of 'Jenson & Nicholson' 'British Paints', 'Shalimar Paints' or similar other approved make and approved colour and shade shall only be used. The primer shall be red oxide zinc chromate primer (IS:2074) or any other anticorrosive primer as approved and directed by the Engineer. The Contractor shall furnish the details of paints to the Engineer for approval of paints before commencement of painting work.

6.4.3 The surface to be painted shall be properly cleaned, derusted, all loose scales removed and smoothened with emery papers. Then a coat of anticorrosive priming shall be evenly applied. After this has dried up, two successive coats of best quality ready mixed synthetic enamel paint shall be given to the entire satisfaction of the Engineer. Brushes of approved size and make shall only be used for application of paint and use of cloth is definitely prohibited.

7. DAMP PROOFING WORK

7.1 Unless otherwise specified, damp proof course shall be 25 mm. thick cement concrete (1:2:4) with stone chips graded 10 mm to 3 mm with 3% Cico or similar approved water proofing compound conforming to IS 2645 by weight of cement. The proportioning, laying etc., shall be done is conformity with specification for cement concrete work. The damp proof course shall be used for all brick walls of the building.

8. ROOF WATER PROOFING TREATMENT

8.1 Both flat and curved roods, whether accessible or inaccessible, shall provided with polyurethane based water proofing paint.

Specification for Roof Water Proof Treatment with Polyurethane based Water Proof Paint:

8.2 Preparation of Surface

The top surface of the roof shall be chipped off where necessary and all loose particles, dust impurities, are to be removed by rubbing the entire roof surface with wire brush and by application of High Pressure Compressed Heated Air to have a complete dust free and moisture free surface.

The roof surface, receiving polyurethane based Water Proofing paint, shall be provided with cement punning having smooth finish. A cross slope of 1 in 300 shall be provided in the roof of Building to allow proper drainage of rain water.

8.3 Specification of Materials

The polyurethane based paint is essentially an elastic and water proof film having a good adhesion to concrete; water and abrasion resistant properties and shall have long term weather proof characteristics. The paint/film material shall be of two components which is to be mixed and processed as per manufacturer's specification. The mixture shall be homogeneous before applications, as it has tendency to settle.

The polyurethane based water proofing system shall be manufactured by reputed manufacturers of proven recorded and shall be approved by the Central Building Research Institute (CBRI)/National Chemical Laboratory (NCL)/The Council of Scientific and Industrial Research/New Delhi (CSIR)/National Test House, or similar such Government/Public Sector Undertakings.

The materials are to be inspected/approved by the Engineer as per procedure to be mutually agreed upon the agency and in-charge of the work.

8.4 Since the product has a very short self life, the materials are to be used in the work shall not be older than four (4) months from the date of manufacture (i.e. the date of bottling).

Necessary Test Certificate of CBRI/NCL/CSIR/National House etc. are to be furnished by the contractor to the Department, for the materials procured for the water proofing work.

8.5 Application

The two components of polyurethane based water proofing system should be mixed as per manufacturer's specification before application. The tack coat should be applied by brushing or roller to the entire surface in normal temperature and 4/6 hours setting time should be allowed before application of the second coat. The record and final coat of polyurethane based mixed water proofing sealing over the priming coat to be applied at normal temperature and curing time between 36 to 48 hours should be allowed.

The application to be made by technically trained and approved applicators duly certified by the manufacturers.

8.6 Guarantee Period

The entire water proofing job shall be covered with a written guarantee of leak proof performance for a minimum period of 10 (ten) years.

8.7 Defects Liability Period

The percent (10%) of the cost of water proofing work shall be retained by the Department for one (1) year from the date of completion of work. Any defect observed during the Defect Liability Period shall be rectified by the Contractor without any extra cost to the department.

9. **FLOORING**

9.1 Patent Stone Floorings shall be 25mm. thick in M20 grade concrete with 10mm to 6mm stone chips laid in rectangular panel with diagonal length not exceeding 3.00M and finished smooth with neat cement punning 1.5mm thick. After finishing, the surface shall be left undisturbed for two hours and then with wet bags and after 24 hours cured by flooding with water and kept wet for at least 7 (seven) days. Required Camber or Slope should be provided in floor draining wash water, if necessary.

9.2 Cast-in-Situ Mosaic in floor shall be 25mm thick (finished) laid in panels as directed with necessary underlay of cement concrete (1:2:4) with stone chips with 12mm thick terrazzo topping finished to 9 mm. after final grinding with 6 to 10 mm. size Mosaic chips highly polished etc. - complete as per specification of IS:2114-1962. Cast-in-situ Mosaic in Skirting

and Dado shall be 12mm. thick. The Mosaic work shall be of approved colour and to the entire satisfaction of the Engineer in Charge.

9.3 'Ferrosite' or 'Ironite' Flooring shall be 50mm. Thick to be laid in two layers. First a layer of 25mm. thick patent stone flooring shall be laid in M15 grade concrete and allowed to dry. Then the second layer of 25mm thick flooring of M15 grade concrete with 10mm to 6mm stone chips using at least 1Kg/Sq.m of floor hardening compound of approved quality and make shall be laid and cured. The flooring shall be laid in rectangular panel with diagonal length not exceeding 3.0 Meters.

10. IRON MONGERY

10.1 The rain Water pipe of the materials and of size as specified shall be of approved manufacture and jointed as follow :

10.1.1 For heavy cast iron pipes with gasket and lead properly caulked.

10.1.2 Where required these are to be run in chase left out in walls, columns, slabs and to be encased in cement concrete 1:2:4 (1 Cement, 2 Sand 4 washed Stone Chips 19mm down) with metal lath wrapping or with M.S. loops placed at approximately 325mm centers or as directed by the Engineer. All pipes encased in walls, columns or under floors must be heavy cast iron with lead caulked joints. For exposed lengths of pipes, these are to be neatly secured clear from the finished wall face with nails and bobbing in the case of cast iron pipes, nails or screwed to hard wood tapping pugs embedded in wall.

10.1.3 All cast iron rain water pipes shall be painted two coats inside with approved anticorrosive paint. The exposed cast iron pipes shall be painted outside with two coats of ready mixed Synthetic Enamel Paints of approved make, shade and colour over a coat pf priming of approved make.

10.1.4 The mouth of rain water pipes shall be fixed with C.I. grating and the pipe jammed in position in 1:2:4 cement concrete with stone chips and neat finish on the surface.

10.1.5 The work shall include all supply, fitting and fixture of materials cutting, making cheses, encasing, painting, jointing, etc. complete in all respect. The work shall include supplying, fitting, fixing, and jointing of all the specials required for the completed work.

10.1.6 Rain water Spouts shall be of C.I pipes cut to exact length as per approved drawing or direction of the Engineer and laid in position in 1:2:4 cement concrete with stone chips, acjoining roof being finished in neat cement. The interior faces shall be painted two coats with anticorrosive paint and the faces shall be painted with two coats of ready mixed Synthetic Enamel paint of approved make, shade and colour over a coat of priming of approved make.

10.2 **Metal Casement**

10.2.1 Unless specified otherwise, all doors, windows and ventilation in general should be of mild steel casement with sections as per I:1038. They shall be of approved make. The Contractor will submit the name and address of the manufacturers whose metal casements he intends to use for approved of the Engineer. The workmanship shall be of high quality and shall be up to the entire satisfaction of the Engineer.

10.2.2 All the steel doors and Windows sashes shall be given a shop coat of Red Oxide Zinc Chromate Primer I.S:2070 after these are thoroughly cleaned off dust, dirt, scales etc., and passed after inspection by the Engineer.

10.2.3 Windows are to be prepared for puffy glazing from the outside and for opening outwards unless otherwise mentioned. All steel sashes shall have holes drilled at suitable places for inserting glazing clips which shall also be supplied by the Contractor. All glazing shall be fixed to the shutters or frames in addition to glazing clips with quality putty of Shalimar or equivalent make. Glass must not be placed directly against the metal. A thin layer of putty must be evenly spread over the glazing rebate and the glass pressed firmly against it.

10.2.4 Ventilators shall be constructed from solid folded universal casement section being double weathered at all points to ensure water tightness and embedded in mastic and screwed to the sashes.

10.2.5 The fitting shall be of heavy pattern bronze oxidized brass and of approved quality, side hung casement will have two point locking handle and casement fasteners . The hung windows shall have 200mm. long adjustable casement stay, arrange to lock the windows from inside horizontally at the centre, hung windows shall have spring catch designed for half cord or pole operation as approved by the Engineer. The fitting to be fitted either by screwing to the window sections or to steel bracket welded to the window section as approved by the Engineer.

10.2.6 Galvanized weather bars shall be provided to sills of all windows.

10.2.7 Metal casement is on no account to built in at the time the walls are constructed. Holes to accommodate the fixing lugs are to be left or cut and the casement fixed after all rough masonry plaster works have been finished. The lugs of the casement shall be filled and fixed with 1:2:4 cement concrete with stone chips after holding the casement in proper position, line or level.

10.2.8 Glazing for windows and ventilators shall weight not less than 8.0 Kg/Sq.m. For doors, 6mm. thick wire net reinforced glazing shall be used as approved by the Engineer. The glasses shall be cut to size accurately to suit all openings to glazed with slight margin of about 1.50mm on all sides or as directed. These shall be securely fixed in position in the manner described earlier. On completion of the building, the Contractor shall clean all the glass and leave the same perfectly in a tidy condition.

10.2.9 The cost of marginal doors, windows and ventilations shall include supplying fixing, fitting, glazing cleaning, necessary scaffolding, staging etc. and shall be for the complete work in all respects to the satisfaction of the Engineer.

10.2.10 The Contractor shall without any extra charge, submit three sets of shop drawings from the manufacture showing full details of each type of doors, windows and ventilators including section, position of all fittings and fixtures for the approval of the Engineer before manufacture and finally six sets of approved final drawings with notes on the method of fixing.

10.2.11 Where specified, mosquito fly proof brass wire screen of approved gauge and mesh shall be used in combination with windows. The screen shall be fixed to the inside of the frames and the windows to be opened outside and be fitted with 'Folo operator' for opening to any position and closing. Additional intermediate members be fixed to the frames to receive the fly screen so that the clear span of the screen does not exceed 3.00 m or as approved by the Engineer.

10.2.12 All windows shall be provided with grills of approved design made of 25 mm x 6 mm M.S. Flats and the other clean openings not exceeding 100 mm.

10.2.13 The work for metal casements shall also include the cost of painting with 2 coats of ready mixed synthetic enamel paint of approved made, quality colour and shade over a coat of approved anticorrosive primer.

10.3 **Collapsible Gate**

The M.S. collapsible gates will be obtained from manufacturer as approved by the Engineer. These shall be of mild bar type, out of 20 mm. channels and shall be top hung with roller bearing and shall have locking arrangement. Collapsible gates under 2.700 m. height shall be with 4 sets of lattices. Guide tracks shall be to the entire satisfaction of the Engineer. The gates shall be fixed in position, de-rusted, discaled and painted with 2 coats of approved ready mixed paint over a coat of approved anticorrosive primer.

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10.4 **Rolling Shutter**

10.4.1 The M.S. roller shutter shall be obtained from manufacturer as approved by the Engineer. The roller shutter shall be of 18 G x 75 mm. galvanized mild steel laths of convex corrugation complete with one piece construction. These shall be fitted with pressed side guides and pressed bottom rail, brackets, door suspension shafts, top rolling springs (of strong English Continental Spring Steel Wire) with a four lever concealed lock as also separate locking arrangements for padlocks, pulling hooks, handles and top cover. The roller shutters shall be fixed in position with all accessories and the design and the workmanship shall be to the entire satisfaction of the Engineer. This shall be finished with two coats of approved ready mixed paint over a coat of approved anti corrosive primer.

11. STRUCTURAL STEEL WORK

11.1 All Structural Steel to be used for gantry beam etc. shall be of tested quality conforming to IS:226 and IS:2062 latest addition.

Finished steel shall be free from cracks, lamination and other visible defects. Section shall be adequately protected from rusting and scaling. Rivets and bolts, nuts and washers shall be of mild steel and comply with requirements of relevant IS Codes. Steel used for rails shall have tensile strength of about 50 60 Kg/Sq. mm. and yield point at 26 Kg/Sq. mm. The electrodes for welding shall conform to IS:814. All steel work shall be fabricated and erected as per IS:800 and IS:806. Welding shall be carried out as per IS:814, IS:815, IS:816 and IS:823, all of the latest editions.

11.2 All steel work, after preparation of surface, shall be given a coat of red oxide zinc chromate primer (IS:2074) and finished with two coats of Synthetic enamel paint. Surface to be painted shall be thoroughly cleaned of mill scale, oil grease, rust etc. over coating and finishing paints shall be of well known make (viz. Johnson & Nicholson / British Paints (Berger Paints) / Shalimar Paints). The Contractor shall furnish details of Paints to the Engineer for approval of paints before commencement of painting work.

11.3 Steel work shall be hoisted and erected in position in a safe and proper manner. No. riveting or permanent bolting shall be down until proper alignment has been made. For grouting, cement and clean fine sand shall be used in a proportion of 1:2 and properly mixed with water. All trapped pockets shall be fully vented for full penetration of grout. All grouting shall be cured for a minimum period of seven days.

12. CABLE TRENCHES

12.1 The cable trenches should normally be of dimension 750mm x 600 mm (D x W) with insert plates made of M.S. of dimension 100 mm x 750 mm x 12 mm (W x D x Th) are to be provided on the wall side of the cable trench 600 mm apart all along.

12.2 The Cable Trenches shall be covered with precast concrete slabs of dimension 650 x 600 x adequate thickness to withstand a load of 500 Kg/m2 are to be provided as covers of trench all along. For easy access of cable from room to room, the design of the tie beam and level of the rooms may be adjusted to avoid bend in the cable.

12.3 The cable trenches shall be absolutely free from any obstructions as to allow the cables to be lowered in the trenches from top only during laying. The space inside the trenches throughout the entire lengths shall in no case be encroached by any beam or columns.

13. POCKETS & HOLDING DOWN BOLTS

Provisions have also to be kept for pockets and holding down bolts as per requirement of the electrical and mechanical equipments at no extra cost. The extract details of such pockets and holding down bolts will be supplied to the Contractor as per specifications of the suppliers of the equipment after award of the contract. It is contemplated that M.S. hangers shall be provided from the underside of slab/beam of the operating floor, and is to be executed in a separate contract. However, for the above arrangement suitable pockets and holding down bolts are to be left.

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19. M.S. PIPELINES

M.S. Pipe lines in required lengths and should be spirally welded from reputed manufacturers and M.S. specials will be fabricated from the said SWMS pipe or from M.S. Plates cut to exact size and shape, bent true to curvature and welded using standard electrodes after necessary edge preparations. Both the inside and outside surfaces of the SWMS pipes and specials shall thereafter be thoroughly cleaned after de-rusting and brushing. The outside and inside surface then be coated as specified in special coating (Page N-11).

The pipes and specials will be lowered in tranches for laying only after testing the same with spark test by holiday detector so as to ensure that the pipes and special are free of holidays. The pipes thus lowered will then be interconnected by welding and the portions of 150 mm. width left unwrapped on either side of pipes will then the wrapped with said insulating tape.

Internal dia of SWMS pipe	Thickness of SWMS pipe (inclusive of corrosion thickness of 2mm to 3mm)
Upto 800 mm	8.1 mm
900 mm – 1200 mm	10 mm
> 1200 mm	12.5 mm

20. P.S.C. PIPELINES / N.P.-2 CLASS PIPELINE

P.S.C./N.P.-2 Class Pipes will be laid on suitably designed 1:3:6 concrete bedding of 150 mm. thickness. The pipes will joined by rubber rings. Bends and specials will be of mild steel. The P.S.C./N.P.-2 Class pipes will be joined with M.S. special end machined ends will be wrapped and coated with an approved protective coal tar based insulting tape of 4 mm. average thickness over one coat of approved primer. The inside surface will be provided with 3 (three) coats of non-toxic paint over one coat of primer.

P.S.C./N.P.-2 Class pipes will be supplied free of cost the Tenderer, all other materials required for P.S.C/N.P.-2 Class pipes laying will be supplied by the Tenderer.

21. ELECTRICALLY OPERATED OVERHEAD CRANE

Provisions have to be made for a 10.0 M.T. capacity Electrically Operated Travelling Crane (E.O.T.) suitable for inching operation with a lift up to motor floor level and cross travel of 12 M for handing pump, motor and other accessories. They shall be of reputed make as per vendor list and as approved by Engineer. Suitable type of crane rails, girders and all other accessories as necessary for installation and operation of the crane are to be designed and provided by the contractor within the Lump Sum pipe quoted. The two travels and two hoists i.e. long, cross & main Auxiliary etc. must be electrically operated with provision for mechanical operation. The buffers must be spring loaded operation. The speed and other criteria are as follows :

Speed for Hoisting	4-5 (normal) MPM
Speed for Cross Travel	1-12 (normal) MPM
Speed for Long Travel	15-20 (normal) MPM

Type of Brake - AC (Electromagnetic) shoe type for hoist and disc type for C.T.

Motor - Ship disc type.

Suitable vertical clearance is to be provided over the rail level to the bottom of the roof beam.

CHEQUERED PLATES ETC.

These shall be manufactured from structural steel conforming to IS:226. They shall be of the specified size, thickness and pattern as per relevant drawings or as directed by the Engineer. Cover plates will generally be of chequered plates with or without stiffeners as detailed in the drawings. For convenience, the Contractor shall prepare detailed floor plans of the layout of cover plates for floors and platforms so as to include all openings, cuts etc. and so as to match the patterns of adjacent cover plates/gratings. Where necessary, the floor will have to be made leak proof by properly welding cover plates. If necessary, pickings shall be welded to the bottom of cover plates to raise the cover plates on sides, so as to provide necessary slopes as shown in the drawings or as directed by the Engineer in the floors and platforms to drain away any liquid falling on the floors and platform. Necessary gutters at the ends of platforms shall be provided for sloping floors and platforms as shown in the approved drawings or as directed by the Engineer. Kerbs of flats shall be provided where necessary, around openings and cuts in order to prevent liquids falling to lower floors or platforms.

HAND RAILING

Double rows of 30 mm dia. G.I. tubular hand railing fixed in G.I. stanchions shall be provided on the edge of walkways and platforms as specified. The stanchions shall be fixed with mild steel rag bolts with chromium plated cap nuts. The stanchions shall not be less than 1000 mm. high and placed at a distance not exceeding 2500 mm. The hand railing shall be fixed true to exact line and level. G.I. stanchions and hand railing layout shall be of architectural design with pleasing appearance.

SANITARY INSTALLATIONS

The Urinals shall be of flat back, front lipped having a size of 46.5 cm. x 36.5 x 26.5 cm. or nearest available size. The Indian type W.C. shall be of minimum 58 cm. Complete with foot rest in one piece

All Sanitary works shall be of "Parry, "Neycer", "Hindustan" or any other equivalent make. They shall be of approved quality conforming to relevant IS Codes and shall bear ISI Certification marks. All G.I. pipes shall be of ITC or equivalent make heavy quality conforming to relevant IS Code. Wheel valves and stop cocks shall be of gun metal and of "leader" or "Annapurna" or equivalent make as approved by the Engineer and shall conform to relevant IS Codes.

Two urinals, one Indian W.C., one European W.C. (Commode) have to be provided in the toilet block.

MANHOLE COVERS

Heavy duty plastic fib re reinforced concrete manhole covers shall be of heavy duty type conforming to IS:1726.

TIMBER DOOR

The timber door shall be of 1st. Class CP Teak Wood for both frame (100 mm x 100 mm) and shutters (49 mm thick). All such doors shall be fully panelled. All timber shall be of best quality, well seasoned and/or well treated for prevention and protection against decay etc. It shall be uniform in substance, straight in fibres, free from large or dead knots, sap, flaws, sub cracks, shakes, or blemishes of any kind. Any insect damage or splits across the grain shall not be permissible. The colour of the timber shall be uniform throughout, firm and shining with a silky lusture when placed and shall not emit dull sound when struck. The doors shall be made as per approved drawings and as directed by the Engineer and the timber shall be sawn in direction of the grains and shall be straight and square. The door fittings shall be highly polished as per direction of the Engineer.

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SLUICE GATE/PEN STOCK GATE

Cast iron single faced Thimble mounted Sluice Gate/Pen Stock Gate will be designed as per IS:13349-1992.

C.I. SLUICE VALVE

C.I. Sluice Valve conforming to IS:2906-1669 suitable for water works purposes be class-I with maximum working pressure of 7 Kg/Sq. Cm. and 5 Kg./Sq. Cm. for 450 mm. dia. and 750 mm. dia C.I. Sluice Valves respectively can be used specifically mentioned otherwise all DI Sluice valves shall be used..

C.I. COWL VENTILATOR

150 mm. dia Specially designed C.I. Cowl Ventilator shall be provided in the outer peripheral walls in between the underside of the reservoir roof and Top Water Level (T.W.L.) of the reservoir, in order to prevent breakage of the Cowl Ventilator, the same shall be encased with cement concrete of grade M 20 with nominal reinforcement as typically shown in the tender scheme drawing.

ARRANGEMENTS OR PLASTIC FIBRE REINFORCED CONCRETE MANHOLE COVER M.S. LADDER ETC.

Manhole Cover

Heavy duty plastic fibre reinforced concrete manhole covers with frame should conform to relevant IS Code. The clear opening for access to the M.S. Ladder for going inside the reservoir shall be 600 mm. and the overall dimension of the heavy Duty Manhole Cover shall be specified by the Tenderer conforming to relevant IS Code. The manhole cover with frame shall be of 'Double Seal Type'. Location of manhole covers and frames are specified in the tender scheme drawing and the Tenderers are to include the cost thereof in their offer.

M.S. Ladder

M.S. Ladder for going inside of the reservoir has been typically shown in the tender scheme drawing. The width of the ladder shall be 750 mm with G.L. hand railing with M.S. angle posts. The steps of the ladder shall be provided with M.S. chequered plates with minimum 6 mm. in thickness. The rise and treads of the steps work of the ladder shall be provided with suitable anti-corrosive paints over two coats of primer as per manufacturer's specifications to be approved by the Department. There shall be 6 (six) numbers M.S. ladder in the locations shown in the Tender drawings.

Rung Ladder

Where over specified, shall be formed out of 20 mm. dia M.S. Rods. The rods forming Rung Ladder shall be properly bonded inside the R.C.C. walls. The spacing of Rung Ladder shall not exceed 300 mm. and the size of the rung formed shall be 300 mm. wide x 150 mm. deep. The rods are to be painted with anti-corrosive paint with suitable primer as per manufacturer's specification to be approved by the Department.

LEVEL INDICATOR (Manual & Remote sensing)

One (1) Manual and one (1) Remote sensing Level indicator shall be provided at the Pump Sump so that they can be visible from inside the operator's room in Pump House Building. The level indicator shall be manual and remote sensing type with PVC floor, guide wire, level indicator board etc. as per requirements. The arrangement of remote indications with electrical / digital display from inside the operator's room shall also be made. The arrangement and details to be get approved by the department.

LIGHTENING ARRESTOR

Required sets of Lightening Arrestor shall be provided by the tenderer at the highest point of the Pump House Building conforming to the I.E. Rules specifications as per standard practice.

The job includes supplying, fixing and commissioning of sufficient no. of lightening arrestors which includes air-terminals, separate earth electrodes, grid earthing and individual earthing with approved size of air-terminals, earth electrodes, earthing strips as per IE rules/IS codes. Detail Calculations to be vetted by the department in the final design.

27. **MOTOR FLOOR AND CONTROL ROOM**

There must not be any column in the motor floor for easy movement of the E.O.T. Crane. Similarly in the Control room cum office room, these must not be any column in the room. The motor floor should have suitable openings at appropriate location as per requirement of the pump manufacturer for lowering and taking up of pumps, motors, valves, entry of cable etc. The motor floor shall be suitably designed to take care of the vibration generated from the motor pump assembly while in operation.

28. **TRIAL RUN**

When, in the opinion of the Engineer the initial performance tests as specified in Section I are satisfactory the Contractor shall arrange for trial run of the plant at its rated capacity and also their performance tests. During such tests, the Contractor shall arrange to collect samples of effluents from the clarifier and representative. A minimum of SIX samples of each effluent shall be collected at intervals specified by the Engineer each day fro 14 consecutive days. These samples shall be sent by the Engineer or his authorised representative to the plant laboratory or any other laboratory nominated by the Engineer, for analysis and determination of the quality of the two effluents. All costs of the sample collection, delivery to the laboratory and test shall be borne by the Contractor.

The Plant shall be deemed to be ready to be put into normal use when trial run of the plant and the quality of the clarified water and filtered water are certified satisfactory by the Engineer. The period of maintenance shall be reckoned from the date of the Engineer's certificate.

29. **OPERATION AND MAINTENANCE (For defect liability period)**

After the plant is deemed to be ready to be put into normal use the Contractor shall operate and maintain the same for a period of 12 months by his own men under the overall supervision and other consumable stores required for the operation of the plant shall be supplied by the Employer at his cost. The Employer shall also bear the cost of electrical energy. During the aforesaid period of operation of the plant the Contractor's supervisory staff shall train and instruct technicians and other staff deputed by the Employer about the correct method of operation and maintenance of the plant as a whole and its various mechanical and electrical components. The Training shall be such as would enable the Employer's staff to take over the plant from the Contractor for its operation and maintenance independently. The Contractor's training personnel shall give special attention to this.

During the period of defect liability the Contractor shall arrange to take regular samples of the clarified and filtered effluents as directed by the Engineer and shall have such samples tested at his cost in the plant laboratory or any other laboratory nominated by the Engineer, to determine the quality of the samples and the performance of the plant. Such tests shall be continued up to the penultimate week prior to the end of this period and the plant shall be taken over by the Employer subject to the final performance tests being certified as satisfactory by the Engineer.

The successful Tenderers shall submit a list of technical and non-technical staff required for operation and maintenances of the plant inducing a manual prepared during this period.

30. **GUARANTEE PERIOD**

The Contractor shall stand guarantee for the successful operation of the plant for 12 (Twelve) months period from the date of the certified commissioning within which any defects and short coming due to faulty design of the plant, defective mechanical and electrical equipment or defective construction will have to be made good without any extra cost to the Authority. During the guarantee period the Contractor shall ensure thorough checking of the plant at

least once every month and arrange for immediate rectification of any defects detected during this special checking by his experts.

31. GUARANTEES

The Contractor shall give the performance guarantee of each equipment.

31.1 Civil and Structural Works

The Contractor shall guarantee the plant against any structural failure due to faulty design, bad workmanship, substandard materials, etc. for a period of twelve months. Any defect found during the guarantee period shall be rectified by the Contractor to the satisfaction of the Engineer without any extra cost.

31.2 Plant and Equipment

Even when a plant or equipment has been manufactured and / or marketed by a vendor, it would be deemed to have been supplied and installed under the contractor's supervision. The Contractor shall provide back to back guarantee along with the vendor but shall solely be responsible for its repair/replacement. He shall not cite the vendor and claim absolvement. In addition, all equipment shall be free from any defects due to faulty designs, materials and / or workmanship. The equipment shall operate satisfactorily and performances and efficiencies shall not be less than the values guaranteed by the manufacturer and endorsed by the Contractor.

Formal acceptance of the work or equipment covered under the Contract by the Engineer shall not be made until all the work done by the Contractor has satisfactorily passes all tests required by the specifications.

If, during testing of work and / or equipment prior to formal acceptance, any equipment or materials shall fail in any respect to meet the guarantees, the Contractor shall replace such equipment in a condition which will meet the guaranteed performance. Any such work shall be carried out by the Contractor at his own cost and expenses shall in the opinion of the Engineer be due to the use of materials or workmanship not in accordance with the Contract or to neglect or failure on the part of.

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SECTION - G

DETAILED TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

1. SPECIAL NOTES

1.1 The layout of the plant (Modular form of two-mirror image of one) as shown on the drawing attached is indicative. The floor areas and other requirements specification Section – B are to be followed as far as possible.

1.2 The tenderer shall not quote for works differing from the specifications of the tender unless specifically permitted elsewhere in the tender documents.

1.3 The suitability of the plant will not be decided only by the low capital cost but the economy in the operational costs will also be considered. For this purpose all relevant details should be furnished. The concept plan as in this document should not be changed.

1.4 There shall not be any ambiguity in the offer. Tender containing any ambiguity may be interpreted in a manner advantageous to the Employer.

1.5 If not mentioned elsewhere in the tender documents, the contractor shall provide the following arrangements:

a) Water supply to different treatment processes namely chemical dosing; disinfection shall not be made solely dependent on the operation of clear water pumps. Separate pumping arrangement for supplying water to alum solution tank and chlorine dosing equipments are to be provided. Maximum pressure available in the proposed supply main may be considered as 3.0 kg/cm^2.

b) Disposal of drainage of the treatment units shall be made by gravity system as far as practicable. If ultimate disposal has to be pumped, emergency gravity overflow must be provided.

c) Particular care shall be taken for satisfactory disposal of sludge from the clarifier.

1.6 All valves sluice gates, etc. shall be of reputed make and shall conform to available I.S.I equivalent specifications detailed in this tender and be of DI. In case of non availability of relevant I.S. specifications it should conform to British Standard Specification or Equivalent Standard Specification.

1.7 The water works being a process plant it is imperative that the layout of the plant inclusive of all Civil, Mechanical and Electrical Components should meet the requirements of Indian Factory Act. Indian Explosives Act. and all other relevant statutes of the State and Central Government. The contractor has also to procure Explosive License for use of chlorine during Trial Run. All Structures, Vats, implements etc. forming part of on-site emergency plan shall be provided by the contractor.

1.8 In order to provide a net output of 107 MLD, Filtration, the inflow, flash mixers, alum design and clariflocculators are to be designed for a flows as are given in Annexure of this document.

2. ITEMWISE SPECIFICATIONS

The requirements and the design criteria for different units of the treatment plant as given herein below are mandatory.

2.1.1. The raw water from Aerator/ Pre-setting Tanks will be delivered into a collecting well through a 750 mm dia pumping main. A Flow Control Valve of dia not less than 750 mm shall be provided by the tenderer to control the flow of raw water into the collecting well. Suitable valve arrangement shall also be provided to by pass the flow control valve so that the same can be removed for maintenance without requiring a complete shut down of the treatment plant, the valves (including by

pass) shall be electrically operated butterfly type. There shall be a provision for remote operation of the valves from the central control room.

The raw water shall pass from collecting well into a parshall flume of required throat width for measuring the entire flow of raw water into the treatment plant. Tenderers shall quote for the construction of this flume and for the supply and installation of one open channel flow meter of reputed and approved make. The flow meter shall be provided with a dial type indicator near the flume provide on this instrumentation panel a flow integrator and a flow recorder. The indicator on the panel shall be provided with an electrical contract point to give an alarm when the raw water flow reaches permissible maximum flow conditions. All necessary wiring and/or air tubing from the local indicator to the instrumentation panel and between the panel and the alarm device shall be included in the offer.

2.1.2 Civil Works

The collecting well and venturiflume shall be of R.C.C. construction. While the collecting well with detention time not less than 60 sec shall be provided with R.C.C. pile foundation, the soil condition of the site shall be duly considered when designing the foundation of venturiflume supports. The tenderer shall include in their offer the cost of construction of valve chambers for the butterfly valves. A 1000 mm wide walk way fitted with hand railings shall be provided all round the collecting well and on one side of the venturiflume. On M.S. step ladder 900 mm wide shall be provided for ready access into the walkway from ground level. Suitable gravity draining arrangement shall be provided with valve for emptying collecting well. All the basic constructions works and finishing works shall be carried out as per specifications contained in other Section of these tender specifications.

2.2 Flash Mixing

2.2.1 General

The raw water from the parshall flume shall enter into the flash mixing units for thorough dissipation of the coagulant chemicals added to the raw water, each designed for a flow of 2000m^3/hr. and to give a mixing time of not less than 60 Sec. Each flash mixing chamber will be fitted with electricity driven turbine type motor and with inlet and outlet penstock gates for the purpose of isolation. Individual flash mixers shall be provided with stainless steel impeller fitted at the bottom of stainless steel shaft under-slung from driving gears mounted on the roof of each mixing chamber. The electric motor shall be of weather proof type. Two push button starters shall be provided for the motor, one near the drive unit and the other in the central control room. The flash mixing unit shall be provided with R.C.C. slab fitted with hand railings partly covering the chamber for locating the driving unit of the mixer and for approach to the same. Adequate arrangement for cleaning and dislodging the flash mixing chamber and finally disposing the same into the plant waste water disposal system shall be made. The drain pipes shall be of 200 mm dia C.I. pipes fitted with 200 mm dia C.I. sluice valve provided with operating rod and hand wheel.

Tenderers shall provide suitable bypass arrangements for diverting the raw water directly into the filters to by pass any clarifier. The bypass arrangements shall be operated through sluice gates or sluice valves as the case may be.

2.2.2 Civil Works

The flash mixing chamber and channels shall be of RCC construction. While the flash mixing chamber and stand-wells shall be provided with R.C.C. pile foundation, the poor soil condition shall be duly considered when designing the foundation of channel supports. The walls and floors shall be designed on the basis of uncracked section. There shall be a 1000 mm wide walkway around the flash mixer, stand-wells and on one side of the channels. Hand railings shall be provided on the walkways. Suitable gravity drainage arrangements shall be provided with valve for emptying flash mixer and stand-wells. All the basic construction works and finishing works shall be carried out as per specifications contained in other Section of these tender specifications.

2.3 Chemical House

2.3.1 General

There shall be a single chemical house for the plant under this tender where provision shall be made for alum PAC storage, alum tanks, dosing equipment, etc. The alum solution shall be fed to the raw water before the venturiflume by gravity from the alum solution tanks in the chemical house. Provision shall also be made for over the ground storage & pumping of liquid alum and PAC as per I.S. specification for a minimum capacity of storage of 5 Ton of liquid alum. There shall be two suitable chemical pumps one in operation & the other standby for lifting liquid alum at a rate of 2.0 T/hr.

Alum dosing arrangement shall be designed to cater for a continuous dose using a 5% strength solution. The floor of the alum solution tanks shall be kept at a level which will permit sufficient head to feed the solution to the raw water by gravity. Provision shall be made in the alum solution tanks for providing timber slats to form trays in which alum blocks will be placed for preparation of the solution. Provision shall be made for a jet spray of water over the alum blocks to achieve rapid dissolution of alum. The alum solution tanks shall be provided with fiberglass reinforced epoxy lining.

Electrically driven mechanical agitators shall be provided for continuous stirring of the solution in the tanks. The agitators shall consist of FRP paddles mounted on stainless steel shafts. The shafts shall be mounted on top of the tank and no thrust or guide bearings shall be permitted below the liquid level. The paddles in the tank shall be driven by an electric motor through a speed reduction gear of appropriate ratio to provide gentle agitation of the liquid. The driving motor and the reduction gear shall be totally enclosed and easily accessible for maintenance.

Tenderers shall also quote for providing water jetting and flushing the alum solution tank when it is empty so that any settled insoluble material is flushed out. The drainage of such flushing shall be done in the flash mixer(s). Provision for water for the jetting shall be made both from supply main as well as provision of high pressure pumps. Tenderers shall include in their offer complete arrangements of valves and piping for delivery of the alum solution before the venturiflume through the dosing apparatus; discharge of waste water from the tanks during cleansing operations; overflow from the tanks; The solution delivery and waste pipes shall be of PVC pipes inside the chemical house and rubber-lined double flanged cast iron pipes outside the chemical house. No bends shall be used in the solution delivery pipeline and wherever a change in direction occurs cross pipes shall be used to facilitate rodding of the pipelines to remove chockages. All valves for solution delivery and waste water from the tank shall be rubber lined cast iron diaphragm valves. The entire pipe work including valves shall be easily accessible for maintenance for which a walkway at the appropriate level shall be provided.

Tenderers shall provide two basket type strainers in the alum solution delivery pipeline to the dosing tank. The arrangement of the strainers and the delivery pipeline shall permit isolation of any of the strainers for cleansing. The strainer shall be of cast iron construction and fitted with a stainless steel mesh screen basket.

Tenderers shall also provide suitable level indicators operated either electrically or by float. Gauges shall be provided for each tank placed at a convenient place easily visible by the operators.

Tenderers shall also submit a detailed description of the proportioning device offered by them. This device shall also incorporate a roto-meter to indicate the actual rate of flow of the alum solution. The roto-meter shall be supplied in duplicate and so arranged in the delivery pipeline as shall permit either one to be in operation when the second one is removed for cleaning. Where a constant head tank fitted with a ball valve and a tapered needle orifice is used for dosing and proportioning of the alum solution, there shall be only one tank, but the ball valve and the tapered needle shall be in duplicate. The piping for the ball valves shall be so arranged as will permit any one of them to be fed through either one of the duplicate rotameters. The dosing tank shall be of R.C.C. lined with FR P epoxy or of mild steel lined internally with rubber or of fiber glass. The ball valve, orifice and the tapered needle shall be of stainless steel and the float for the valve shall be of fiber glass.

Water supply for the preparation of alum solution shall be obtained from a tapping off the proposed pressure main in the vicinity (within 150 metres) of the filter house/chemical house. Tenderers shall include in their offer inter connection with the proposed main with a D.I sluice valve of required size and all pipes and fittings from this valve to the alum solution tanks. Tenderers shall also provide arrangements for supplying filtered water from the filtered water channel 1 in the filter house. Tenderers shall include in their offer the cost of all these arrangements including pipelines, valves, pumps, motors etc. There shall be a provision for 100% standby of pumps & motors for supplying water to alum solution tanks. Tenderers shall include in their offer for the supply and erection, where necessary, of the following ancillary equipment for use in the chemical house.

i) Two electrically operated 2 - tone capacity traveling hoists of reputed and approved make moving on rolled steel joists fixed on top of the alum tanks for lifting alum in trays from ground floor to individual tanks. There shall be sufficient head room for directly placing the trays in the dissolving trays of the solution tanks by the hoists. Both vertical and horizontal movement of the hoist shall be controlled by a single hand control switch connected by flexible cable of suitable length to control both vertical and horizontal movements separately. Easy inter changeability shall be guaranteed.

ii) Twelve (12) timber/stainless steel S.S. trays of suitable size of a suitable design to be approved by the Engineer. The trays will be charged with alum blocks and placed directly on the dissolving trays of the alum tanks for preparation of alum solution. The water tray shall be of best quality teak wood and shall be made with mortise and tenon joints and with timber nails. All the edges of the trays shall be strengthened with stainless steel angles or straps. In-case of S.S. strays it shall be made of robust S.S. tubes frames and slotted S.S. sheet of approved design. The top of trays shall be provided with hooks of stainless steel for lifting.

iii) Two 4 wheeled rubber tyre hand carts for transport of the trays charged with alum blocks.

iv) One 1000 kg dial type platform weighing machine of reputed and approved make.

Civil Works

The chemical house shall be of R.C.C. framed structure with brick panel walls and shall have R.C.C. pile foundation. Overall plinth area shall not be less than 320m^2. The minimum areas to be provided for different purposes shall be as follows :

On Ground Floor

Alum storage Operator's room Toilet	Total = 210 M^2

On First Floor

Chemical Volts Store Toilet	Total = 210 M^2

The tenderers shall be free to provide additional areas within their quoted price.

Tenderers may make minor adjustments to these areas to suit their own design requirements within the allowable overall plinth area.

Adequate common passage and circulation space shall be provided on each floor to give independent access to each individual room.

An independent stair case with 1000 mm wide steps shall be provided from alum storage area in the ground floor to the loading platform of the alum solution tanks. A separate stair case with 1200 mm wide steps shall be provided from the ground floor to the first floor for laboratory and chlorination room. The stairs shall be fitted with grilled handrailings.

The control panel switches room shall be separated from the alum storage space by a 375 mm thick brick-wall and shall be provided with a separate entrance.

The chlorine drum room also shall be separated from the alum storage space by a 375 mm thick brick-wall and shall be provided with independent 2400 mm wide entrance and exit. There shall be two ramps of mild slope of 2700 mm wide in front of the entrance and exit for the facility of handling chlorine drums. The clear head room between the floor level and the bottom of the roof beam shall be 5.5m. Similar clear head room shall be maintained for other appropriate areas of the chemical house except for the mezzanine floor. Additional covered storage space for 6 tonner drums shall be provided outside the chemical house in conformity with the statutory regulation of explosive departments.

For other parts of the chemical house the total shutter area of doors windows and ventilators shall not be less than 20% of the plinth area.

The alum storage shall be provided with an entrance a 4500 mm wide fitted with rolling shutter. To facilitate unloading of alum cakes from truck, provision of entering the truck into the store up to the stacking space shall be made. For this purpose there shall be a 5000 mm wide ramp for movement by commercial vehicles in front of the entrance. Suitable storage tanks for 6 tons of liquid alum or PAC of strength as per I.S. specification shall be provided over the ground adjacent to the chemical house with suitable facilities for unloading from tankers and pumping the liquid alum to the alum solution tank.

The main entrance door of the stair block for laboratory and chlorination room and the door of the laboratory shall be of 1st class C.P. teak wood all through including the frame. The design of the doors shall be approved by the Engineer. These doors shall be polished as per standard practice and shall be to the entire satisfaction of the Engineer. All other doors and windows shall be of steel. Their pattern shall be up-to-date and shall be approved by the Engineer.

There shall be a 2500 mm wide covered inter-connecting gangway between the chemical house, the collecting well and filter house at the first floor level. The gangway shall be provided with grilled handrailings of approved design.

The toilets shall be connected to a septic tank of 6 users capacity.

The roof of the chemical house shall be provided with roof water proofing treatment with adequate arrangements for rainwater drainage. The roof shall be accessible from the staircase for laboratory, etc. and shall be provided with a 250 mm thick parapet wall of 1000 mm height.

Tenderers shall provide a 1200 mm wide apron of 75 mm thick 1:3:6 cement concrete laid over brick on edge soling and a surface drain all round the chemical house.

All the basic construction works and finishing works shall be carried out as per specifications contained in other section of these tender specifications.

2.4 Flocculation

2.4.1 General

Tenderers shall quote in their offer for rectangular/ circular flocculators in the

Flocculating time : 30 minutes (Minimum)

2.4.2 Inclined plate settler 2 nos. of each module as per enclosed design.

Civil Works

The clarifier tanks shall be of R.C.C. construction founded on R.C.C. Piles. The peripheral wall and the base slab shall be designed on the basis of uncracked section. The thickness of the base slab shall not in any case be less than 150 mm thick. The floor of the tanks shall be provided with a slope not less than 1 in 12. A 1000 mm wide walkway shall be provided all around the top of the clarifier tank and it would give access to the adjacent clarifiers, as well as to the chemical house and filter house. Hand railings shall be provided on the walkways. Interconnecting walkways shall have railings on either side.

All the basic construction works and finishing works shall be carried out as per specifications relevant latest IS codes and contained in other Section of these tender specifications.

Filters and Filter House with Annexe Building – Nozzle based false bottom as described in the document

General

The filter house shall have not less than eight (8) filter beds for each module. The filter beds shall be designed to give the normal output with a filtration rate not exceeding 6 m/hr and with a filtered water turbidity less than 1 mg/l. The beds shall be capable of taking overloads upto 20% of the average flow, due to variations in the river without adversely affecting the quality of the filtrate. The filters shall be arranged in two rows with a space not less than 8 metres between them to accommodate pipe galleries and a filtered water channel. The filters shall be designed for a head loss not more than 2 metres and for cleansing by air followed by water. The minimum sizes of cast iron pipes, pipe fittings, sluice valves and sluice gates shall be as follows :

Filter inlet pipe and sluice gate	350 mm dia
Filter outlet piping & sluice valve	300 mm dia
Filter waste piping & sluice gate	350 mm dia
Filter wash sluice valve	300 mm dia
Pipes and fittings for ring main for backwash water	300 mm dia
Pipes and fittings for wash main from pumps to ring main	300 mm dia
Pipes and fittings for air scour	200 mm dia
Sluice valve for air scour	200 mm dia

All sluice gates and sluice valves on each filter shall be opened and closed by pneumatic cylinders which shall be of double acting type with adjustable air cushions. The inside surfaces of the cylinders shall be ground and honed to very fine tolerance for efficient and positive operation. The cylinders shall be of reputed and approved make. Tenderers shall submit the manufacturer's name and other details of the cylinders along with their offers. They shall also submit the manufacturer's name for sluice valves and sluice gates.

The cylinders and the operating air pressure system shall be designed to ensure positive action and to overcome all forces due to friction and unbalanced head against the gates. The cylinders shall either be mounted directly on the sluice valves or placed on the operating platform with extended spindles to connect the pistons of the cylinders to the valve spindles. Cylinders should be designed for 100% over load after assuming compressors to work at 60% of their rated capacity. Tenderers shall also include filter and lubricator to be provided to the cylinder more than 8 Meter away (measured along the pneumatic pipeline) and a separate mounting with a solenoid valve would be necessary, keeping the filter exposed. The power and control cables shall lead from the said mounting to the main console. The cylinders shall be designed for an operating pressure of 5 bar. Speed controllers should be provided to each cylinder - one for each direction of operation, the time of travel in the downward direction being 10 sec. with 20% tolerance either way.

The pneumatic cylinders shall be actuated by solenoid valves as stated below which shall be arranged on a console placed in front of each filter unit. Double coil solenoid operated two position valves shall be provided in the son-sole to be able to open or close the valves to the fullest extent

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except for the inlet sluice gate and back wash valves for both of which the solenoid valve shall be of three position type which shall permit inching so as to hold the valve or gate at any intermediate position. All air supply pipes to the individual valves and sluice gates and from the filter consoles and electrical wiring for pilot lamps on the consoles shall be neatly arranged on the walls in straight horizontal and vertical lines. An air filter regulator and lubricator of approved design and make shall be provided at each filter console.

The filter consoles shall be of fiber glass reinforced plastic with a smooth finish and shall be fitted with pilot lamps to indicate shout and open positions of the respective valves or sluice gates actuated by limit switches mounted on the cylinders. The consoles shall be provided with push button starters for each of the wash pump and air blower motors with indicating pilot lamps. The consoles shall also be provided with arrangements to give an audio visual signal to the central control room and to the wash pump/air blower room incase of emergency.

Tenderers shall include in their offer two (2) electrically driven air compressors of reputed make approved by the Employer mounted on a pressure storage tank for furnishing air power for actuating the pneumatic cylinders. The displacement of the compresser and the capacity of the storage vessel shall be so designed as will make available at all times with one unit in operation, sufficient quantity of air under required pressure to acturate the cylinders when the filters are washed one after the other at intervals of 30 minutes. The compressors shall be fitted with a pressure switch to maintain the required pressure in the storage vessel and a drier for dehumidifying to ensure dry air to the cylinders. An audio visual alarm shall be installed in the central control to indicate failure of the pressure system. One compressor shall work at a time and the other two shall be stand by. The compressors should have a minimum capacity of 15 bar and provided with a pressure switch each with both cut-in and cut-out facilities.

Each filter bed shall be provided with the complete set of under-drain system of latest improved pattern, the system being designed for efficient application of compressed air and wash water during filter cleaning. Tenderers shall have the option of providing in their offers under-drain system to suit their own designs, incorporating nozzles fixed on pre-cast slabs or A.C. Pipe (asbestos cement pressure pipes conforming to IS : 1592 - Class 10) or unplasticized PVC pipe (unplasticized PVC pipes for potable water supplies conforming to IS : 4985-10 kg/cm^2 pressure rating) laterals with drilled offices or any other system in common practice. Where nozzles are used these shall be of high density polyethylene nozzles and shall be spaced suitably on the filter floor to ensure uniform collection of the filtrate and even distribution of the backwash air and water over the entire area of the filter bed. The under-drain system shall be designed to ensure that there shall be no air binding during either filtration or backwashing and shall prevent mud ball formation in the sand bed. There shall be no loss of sand during filtration or backwashing and the sand bed shall settle down fairly uniformly. Tenderers shall submit with their offer detailed specifications and description of the under-drain system with necessary sketches they have incorporated in their design.

2.5.2 Civil Works

The filter house and annexe building shall be of R.C.C. framed structure with brick panel walls and shall be provided with pile foundation. The filter units and channels shall be of R.C.C. construction only. The annexe building will also be used as administrative purpose.

Total plinth area of the filter house excluding the areas covered by the inlet and waste water channels shall satisfy the following two norms :

i) The distance between the two rows of filters shall be minimum 8 metres to accommodate filtered water channel and pipe galleries.

ii) The total area of sand beds in the filter units (not less than sixteen in number) shall be sufficient to give the normal output of 2000 m^3 /hr of filtered water at the filtration rate of 6 m./hr after deducting for backwash loss.

The filter tanks shall have a minimum free board of 500mm and operating platforms walkways shall be provided at the level of the top of the tanks. The operating platforms over the pipe gallery and