

**INDIRA GANDHI INSTITUTE OF MEDICAL SCIENCE,
PATNA BIHAR**

Name of work: **Construction of Cath lab at IGIMS, PATNA &
Construction of First Floor Trauma Centre Building at IGIMS,
Patna**

(Technical Specifications)

CONSULTANTS:

DDF CONSULTANTS PVT. LTD, NEW DELHI

Construction of Cath lab at IGIMS, Patna, (Bihar)

CIVIL

TECHNICAL SPECIFICATION

Construction of Cath lab at IGIMS, Patna, (Bihar)

PARTICULAR SPECIFICATIONS FOR CIVIL WORK

1.0 All works will be executed in the most substantial and workmanlike manner both as regards materials and otherwise in every respect in strict accordance with BSR/ Latest CPWD Specifications with up to date correction slips

2.0 EARTH WORK

2.1 Before commencing the earth work, the ground levels shall be taken at 5 to 15m interval as shall be directed by the Engineer-in-charge. Where local mounds, pits or undulations are met with closer interval shall be adopted.

2.2 The ground levels shall be recorded in the level books and plotted on plan on suitable scale as per direction of Engineer-in-charge. The North direction and position of Bench Mark shall be shown on the plans. The ground levels for building and the sub-soil water level shall be determined with respect to the bench mark approved by the Engineer-in-charge before commencement of the work and these levels shall be recorded in the level book and also indicated on the 'Plan' showing ground levels. These plans shall be signed by the Contractor and the Engineer-in-charge before the earth work is started.

2.3 All labour and material for setting out and making profile and taking ground levels shall be supplied by the contractor and nothing extra shall be payable on this account.

2.4 The Bidder shall co-operate and provide all possible assistance to the other agency / agencies executing other works. He shall adjust his execution program to accommodate such essential activities of construction.

2.5 Rate for earth work shall include the following operations:

- a. Setting out works, profiles
- b. Site clearance
- c. Protection measures and putting up caution signs and lights.
- d. Handling useful materials and Antiques.
- e. Bailing out or pumping of rain water out of excavation.

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3.0 CONCRETE / REINFORCED CEMENT CONCRETE WORK/ DESIGN MIX CONCRETE

3.1. Cement concrete work using nominal mix concrete shall be executed as per BSR/CPWD Specifications with up to date correction slips.

3.1(a) The item machine batched , machine mixed and machine vibrated design mix concrete used in the nomenclature of “ Sub head RCC Work” shall mean the concrete produced in automatic concrete batching and mixing plant and transported by transit mixers (if necessary) , placed in position and vibrated by surface vibrator / needle vibrator / plate vibrator as the case may be to achieve required strength and durability.

3.2. All stone aggregate and stone ballast shall be of hard stone variety to be obtained from approved quarries or any other source to be got approved by the Engineer-in-charge.

3.3. Sand to be used for cement concrete RCC work shall not contain silt content by more than 8%.

3.4. Only Ordinary Portland Cement (OPC)/PPC not less 43 grade shall be used for the entire work.

3.5. All shuttering shall either be of steel or marine ply. All scaffolding shall be of steel. The contractor will have to manufacture new shuttering so as to obtain exposed concrete surface of even and uniform shade wherever required. Shuttering already used on other work(s) will not be permitted to be used in this work for obtaining exposed concrete surface. The steel / marine ply centering, shuttering and steel scaffolding shall be as per BSR/CPWD specifications.

3.6. Keeping in view the flooring thickness as per nomenclature of the item, the structural drawings shall be reconciled with the architectural drawings to make appropriate adjustment in the level of shuttering for RCC slab so as to achieve the final floor finish level as per Architectural drawing.

DESIGN MIX CONCRETE

3.7. The contractor shall exercise “very good” quality control over site conditions for production of controlled concrete by using fresh cement and regular tests employing fully automatic cement batching plant for batching of all materials, grading of aggregate, determination of moisture contents and control of water cement ratio, frequent supervision and by conducting regular workability and strength tests and maintaining adequate field laboratory facilities to maintain the specified quality of concrete consistently.

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3.7(a) The aggregate used for RCC work shall be 20mm nominal maximum size aggregate. The minimum cement content and the maximum water cement ratio for various grades of concrete shall be as given below:

Grade Designation	Compressive strength on 15cm cubes min 7 days (N/mm²)	Specified Characteristic compressive at 28days (N/m m²)	Minimum cement content (kg per cubic metre)	Maximum water cement ratio
M-25	AS per Design	25	380	0.50
M-30	AS per Design	30	400	0.45
M-35	AS per Design	35	420	0.45

3.7(b) The concrete mix will be designed for minimum workability as per the table given below:

Placing conditions	Degree of workability	Slump (mm)
Lightly reinforced sections in slabs, beams, walls and columns	Low	40 –75
Heavily reinforced section in	Medium	75 -100

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slabs beams walls and columns		
Pumped concrete	Medium	100 – 150

3.8. The contractor shall engage one of the following approved laboratories, test houses for designing the concrete mix in accordance with the relevant I.S. Codes and to conduct laboratory tests to ensure the target mean strength and workability criteria for a given grade of concrete

- i. N.I.T., Patna, Bihar
- ii. State/Central Govt approved Lab
- iii. IIT Patna/ All govt. Engineering college

If all the above laboratories express in writing their inability to carry out designing and testing of concrete mixes by a specified date, the contractor may be allowed to engage any other laboratory with prior approval of Engineer-in-charge.

3.9. The source and quality of all ingredients of a concrete mix shall be got approved from the Engineer-in-charge before designing the mixes and their testing and the same shall be maintained during the execution of the work as well.

3.10. Any change in source or characteristic of any ingredient used in the concrete mix during the work execution shall require revised mix design and laboratory testing as per direction of the Engineer-in-charge and no further concrete work shall be proceeded without approval of the revised design mix.

3.11. In the event of use of admixtures to achieve the required workability, the mix shall be designed and tested using the admixture in suitable proportion.

3.12. All cost and charges of designing the concrete mix and its testing by approved laboratory including the redesigning of the concrete mix, whenever required and directed by the Engineer-in-charge, shall be borne by the Contractor and nothing extra shall be payable over the quoted rates.

3.13. The designed mix proportions shall be checked for target mean compressive strength by means of trial batches.

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3.14. The quantities of materials for each trial mix shall be sufficient for atleast six specimens (cubes) and the concrete required for carrying out workability test.

3.15. The workability of trial mix No. 1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required change in the workability.

3.16. With the modified water content, the mix proportions shall be recalculated by keeping with water cement ratio unchanged. The mix proportion, so modified, shall form the Trial Mix No. 2 and tested for the specified strength and workability.

3.17. In addition, trial mix No. 3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio by ± 10 percent of the specified value and tested for their design characteristics.

APPROVAL OF DESIGN MIX CONCRETE

3.18. Minimum three sets of separate preliminary tests shall be carried out for each trial batch of concrete mix. Each test shall comprise of six specimens and only one test-set of six specimens shall be made on any particular day.

3.19. Of the six specimens of each test-set, three specimens shall be tested at 7 days and remaining three at 28 days.

3.20. The Preliminary tests at 7 days are intended only to indicate the likely strength to be attained at 28 days while the design mix shall be approved only on the basis of test strength at 28 days.

3.21. The contractor shall submit the design mix report from the approved laboratory within 45 days of award of work for approval of Engineer-in-charge. No concreting work shall be executed until the mix design is approved.

3.22. The design mix shall be considered satisfactory and approved if at least three preliminary test-sets individually satisfy the following strength and workability criteria:

- a The average strength of each test-set is not less than the specified target mean compressive strength.
- b The strength of any specimen cube is not less than 0.85 times the target mean compressive strength.
- c The concrete mix is of required degree of workability and acceptable concrete finish.

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PRODUCTION OF CONTROLLED CEMENT CONCRETE

3.23 Automatic Batching Plant conforming to IS 4925-1968 and minimum 30 cum/ hour capacity shall be used for production of controlled concrete.

3.24 Automatic batcher shall be charged by devices which, when actuated by a single starter switch, will automatically start weighing operation of each material and stop automatically and interlocked when the designated weight of each material has been reached.

3.25 The batching system shall have rated capacity (in terms of concrete in a single batch) to match the maximum rated size of the mixer that could be adopted for use with the plant.

3.26 The mixers shall be free fall tilting type conforming to IS 1791-1968.

3.27 All measuring equipment shall be maintained in a clean and serviceable condition and their accuracy shall be checked at least once a month.

3.28 Only single sized good quality stone aggregate shall be brought to site of work from the approved source. The grading of the stone aggregate shall be controlled by blending the aggregate of different sizes in the required proportions at site of work.

3.29 The aggregate of different sizes shall be stock-piled separately at least a day before use. The grading of coarse and fine aggregates shall be checked as frequently as possible and as directed by the Engineer-in-charge to ensure that the specified grading and quality of aggregate is maintained.

3.30 It is important to maintain the water cement ratio constant at its specified or approved value by making adjustment for the moisture contents of both fine and coarse aggregates.

3.31 The moisture contents in the aggregate shall be determined as frequently as possible in keeping with the weather conditions as per the provisions of I.S 2386 (Part III) 1963.

3.32 All other operations involved in concrete work like laying, placing, compaction and curing etc. shall be done as per CPWD specifications 1996 Volume I to VI with up to date correction slips.

3.33 For RCC Work, the contractor may be permitted to use ready mixed concrete (RMC) procured from the approved suppliers of RMC instead of producing concrete at site. The specifications for RMC shall be same as for Design mix concrete produced at site. The prescribed tests for design mix concrete shall also be carried out for RMC in addition to getting the test report from the supplier. Nothing extra shall be paid for using RMC.

3.33(a) The contractor shall obtain prior approval of Engineer –in - Charge for using RMC, which shall be granted only in exceptional cases like failure of plant or other exigencies.

SAMPLING AND STRENGTH OF WORK TEST OF CONCRETE

3.34 Samples from fresh concrete shall be taken as per IS-1199-1959 and the test cubes shall be made, cured and tested in accordance with IS 516-1959.

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3.35 Each test sample shall comprise of six test cubes (specimen), three of which shall be tested at 7 days and remaining for tests at 28 days.

3.36 A random sampling procedure shall be adopted to ensure that the sampling is spread over the entire period of concreting and cover all mixing units.

3.37 The concrete work shall be notionally divided into lots as under for the purpose of sampling conditions:

- a Footings, rafts, etc.
- b Columns and walls at all levels
- c Beams at all levels
- d Slabs at all levels

3.38 At least one test sample shall be taken for each lot of concrete work.

3.39 Each grade of concrete shall form different lot of testing.

3.40 The minimum frequency of sampling of concrete of each grade shall be as given below:

Qty. of Concrete work (in Cumt.)	Number of Samples
1-5	1
6-5	2
16-30	3
31-50	4
51 and above	4+ one sample for additional 50m ³ or part thereof.

The concrete work shall be assessed on day to day basis and samples shall be taken as specified.

TEST STRENGTH OF A SAMPLE

3.41 The test strength of the sample shall be taken as the average of the strength of its three specimens, the individual variation between the three specimens should not be more than ± 15 percent of the average test results of the sample.

3.42 If individual variation in strength of three specimens is more than ± 15 percent of average, the test results of the sample shall be invalid.

3.43 90% of the total work tests shall be done at the field laboratory established at the site of work and the remaining 10% work tests shall be got done from any Govt. laboratory or the lab

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laboratory approved by the Engineer in charge.

MEASUREMENTS

3.44 The measurements of work and the allowable tolerances shall be governed by provisions of CPWD specifications read with up to date correction slips.

3.45 The theoretical consumption of cement in designs mix concrete shall be worked out on the basis of proportions approved for Design mix subject to the permissible variations under clause 42 of the tender documents.

RATE

3.46 The rate shall include cost of all materials and labour involved in all operations described above including the cost of designing and testing of concrete mix in the approved laboratory including admixture but excluding the cost of centering, shuttering and reinforcement.

4.0 WATER PROOFING TREATMENT

4.1 GENERAL

4.1.1 The waterproofing treatment shall be carried out as per detailed specifications indicated for the same from the agency to be approved by the Engineer in Charge.

4.1.2 Two samples of the waterproofing materials / compound proposed to be used shall be submitted to the Engineer-in-charge along with test result from a testing laboratory of repute confirming its quality and performance and the constituents making it.

4.1.3 Total quantity of the waterproofing material / compound required shall be arranged only after obtaining the prior approval of the Engineer-in-charge in writing. Materials shall be kept under double lock and key and proper account of the waterproofing / material compound used in the work shall be maintained. It shall be ensured that the consumption of the material / compound is as per specified requirement.

4.1.4 Cement based integral waterproofing compound

Shall be of specified quality and also satisfy all the performance requirements indicated in IS Code 2645-1975. The compound shall be used @ 2% by weight of cement used (or as recommended by the manufacturer).

Any other waterproofing compound, if specified for use, shall satisfy the manufacturer's specifications.

4.2 MEASUREMENT

4.2.1 The measurement shall be taken along the finished surface of treatment including the rounded and tapered portions at junctions. Length and breadth shall be measured correct to one centimeter and area shall be worked out nearest to two decimals.

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4.3 RATE

4.3.1 The rate shall be inclusive for all operations described in the nomenclature and the specifications applicable to the item, including any incidental expenditure. Nothing extra shall be payable on any account whatsoever.

5.0 BRICK WORK

5.1 The brick work shall be carried out with good quality well burnt bricks of specified designation, free from ash, dust or mud etc.

5.2 Only well wet bricks shall be used for brick work in cement mortar.

5.3 The cement mortar of specified mix shall be uniformly mixed to the required consistency in the Mixer Machine with hopper attached only and measuring boxes shall be used for proper proportion of mortar mix.

5.4 All the joints of brick work both horizontal and vertical shall be filled in completely with cement mortar. The joints shall be of uniform thickness of not more than one cm.

6.0 WOOD WORK (Doors / Cup Board frames and shutters)

6.1 The contractor shall procure the shutters and get them fixed only from approved manufacturer / contractor for manufacturing such shutters as per the specification specified herein.

6.2 The specialized agency manufacturing factory made shutters shall be got approved from the Engineer-in-charge before placing bulk supply order.

6.3 The contractor shall get at least 4 shutters of each type of door fabricated from the approved manufacturer immediately after start of the work and give written intimation to the Engineer-in-charge who shall arrange inspection of the samples at factory premises for approval. The two approved samples shall be left with manufacturer / suppliers and the remaining two samples will be delivered at the site of work for sample fixing.

6.4 The officer approving each shutter shall put his signature on each of the approved shutter and the contractor shall fix such approved shutters only and preserve the officer's signature until the completion of work.

7.0 Powder coated Aluminum Work for Doors and windows:

7.1 The Contractor shall engage specialized agency for doing the aluminum work and the agency shall be got approved from the Engineer –in -Charge.

7.2 The materials conforming to specifications as mentioned in the nomenclature of item shall only be used for fabrication of Aluminum doors and windows.

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7.3 All Aluminum work shall be free from defects impairing strength, durability and appearance. The make of aluminum sections shall be as given in “List of approved Makes for Civil Work”

7.4 The contractor shall submit shop drawings and samples of each type of doors and windows to the Engineer-in-charge for approval. The shop drawings shall show full size sections of doors and windows. Shop drawings shall be based on actual dimensions available on site, which should not vary from those on drawings by 1.5mm.

7.5 The glazed aluminum windows shall be made completely water proof to the satisfaction of the engineer-in-charge. Silicon/ Polysulphide sealants etc; shall be provided wherever required to make the window water proof.

7.6 All joints shall be accurately fabricated. The finished surface shall be free from visible defects.

7.7 The Powder coating shall be of approved colour and conform to IS code

7.8 Doors, windows or fixed glazing, frames shall be fixed to concrete /brick work / base frame with approved metal fasteners. Method of fixing shall be approved by the Engineer-in-charge before mass fabrication.

7.9 A thick layer of the clear transparent lacquer based Methacrylates or Cellulose Butyrate shall be applied on the powder coated surfaces before they are brought to site. The same shall be removed on completion of erection.

7.10 All screws shall be stainless steel screws.

7.11 The corners of the frame shall be fabricated true to right angle. Both the fixed and openable frames shall be fabricated out of sections, which have been cut to length, mitred and jointed mechanically. All members shall be accurately machines milled and fitted to form hair line joints. The joining accessories such as cleats, brackets, etc shall be such material so as not to cause any bimetallic corrosive action.

All frame members shall be in plumb and level and jointed in such a way that the expansion and contraction shall not cause distortion or leakage. The contractor shall be responsible for their satisfactory performance/ operation after fixing is complete.

7.12 Clear glass : The glass shall be float glass of Brand Modi or equivalent. Clear glass used in glazing of openable / fixed doors ,windows and ventilators shall provide clear, completely undistorted vision and reflection. It shall be free from any bubbles, waves or blemishes. Glass used shall be of required size as per drawings.

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7.13 Tinted Glass : Tinted glass shall have same quality and specifications as indicated above for clear glass. It shall however be transparent glass tinted to Bronze/ Blue/Green/Smoke grey shade as required and would be expected to absorb a greater proportion of sun's radiant heat and reduce transmission than clear glass.

7.14 Rate: The rate shall include the cost of all materials as mentioned above and in the nomenclature of item , labour and T&P required for proper completion of the work including the sealant but excluding the clear/ tinted glass which shall be measured and paid separately under relevant item. For payment purposes, the weight of aluminium sections finished to size as provided in doors and windows excluding the cleats shall only be measured .

7.15 Five years guarantee bond in prescribed Performa `B' attached in Tender Document Volume - I shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liability/ liabilities under the guarantee bond against structural stability, water leakage, faulty materials, workmanship and defective anodized finish.

In addition (Five) percent of the cost of this work shall be retained as security deposit and the amount so withheld would be released after Five years from the date of completion of the entire work under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period it shall be rectified by the contractor along with any incidental repairs to structure, flooring, finishing, fixtures and any other related damaged work within fifteen days of receipt of intimation of such defects in the work. If the defects pointed out are not attended to within the specified period, the same shall be got done from another agency at the risk and cost of the contractor and the cost of attending such repairs shall be deducted from any dues payable to the contractors. However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Sr. Project Engineer ,BRPNL , Works Division Nalanda in the prescribed Performa.

The security deposit against this item of work shall be in addition to the security deposit deducted @ 5% of the tender cost.

8.0 Flooring

8.1 Only machine cut Kota stone, sand stone marble, granite slabs shall be used for flooring and veneering work.

8.2 Proper gradient shall be given to flooring for toilets, verandah, kitchen, court, yard etc and shall be determined by providing required gradient in the lean concrete/ sub-grade surface.

8.3 The bed mortar on concrete shall be fully compacted, particularly at the junctions of panels,

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during laying of flooring so that the finished floor does not give hollow sound.

9.0 Roofing

9.1 The roofing shall be executed as specified in the nomenclature and detailed specifications for the item.

9.2 The work of fixing rainwater pipes, grouting around mouth of rain water pipes and making khurra shall be done before starting the items of roofing. The roofing shall overlap the khurra surface by about 100mm.

9.3 Plastering of parapet wall shall only be done after providing required cement concrete gola at the junctions with horizontal surface of roofing. In case of RCC parapet wall 75 x 75mm cement concrete gola shall be provided after making groove at at least 20mm in depth. Cement slurry shall be applied over the groove before laying cement concrete gola. For parapets walls in brick work, the cement concrete gola shall be provided as per operations described in BSR/CPWD Specifications with up to date corrections slips.

10.0 Finishing

10.1 The cement paint, primer, synthetic enamel paint, bitumen, plastic emulsion and distemper etc. of approved manufacturer shall only be brought to the site of work in the original sealed containers. The material brought to the site of work in lots of atleast 25% of the total requirement.

The materials shall be kept under the joint custody of contractor and Engineer-in-charge. The empty containers shall not be removed from the site till the completion of the work.

10.2 Nothing extra shall be paid for providing drip course or moulding in RCC projected slabs wherever required.

10.3 The item of glass mosaic tiles included under the sub head of "Road and Path Work " shall also be executed on building facias in bands of required width as shown in the Architectural drawings and nothing extra shall be paid for the same.

10.4 The rate for relating to stainless steel cramps shall include the cost of 100mmx100mm x100mm cement concrete 1:2:4 (1cement:2 coarse sand:4 graded stone aggregate 20 mm nominal size) blocks in brick masonry wall in which the cramp shall be embedded.

10.5 The rate for to stainless steel cramps of size 15x6mm-16.5cm long shall include the cost of two nos. Wedge expansion type hold fasteners (with threaded dia of size 6mm) for fixing each cramp to RCC / CC backing.

10.6 Nothing extra shall be paid for shuttering and other inputs required at the locations of construction joints in RCC work.

11 RCC WORK

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11.1 To ensure proper cover only factory made approved cover blocks will be used to avoid displacement of bars in any direction.

11.2 The Steel bars of different diameters should be stored about 30 to 45 cm above ground level to avoid corrosion of steel. No extra payment shall be made on this account.

12 WOOD WORK

12.1 Thickness of glass in glazing shall be as specified in the item in woodwork / steel works. Glazing in toilets shall be of opaque type.

13 FLOORING:

The rate of items of flooring is inclusive of providing sunk flooring in bathrooms, kitchen etc. and nothing extra on this account is admissible. The flooring is to be laid in pattern of various combinations as per architectural drawings. The flooring in treads and risers of stair case is to be laid in single piece. Nothing extra shall be paid on these accounts. The measurement shall be made for finished work of flooring.

Misc (Non-Schedule Items)

1. Diluting and injecting chemical emulsion for pre constructional anti-termite treatment and creating a continuous chemical barrier under all round the column pits, wall trenches, basement excavation, top surface plinth filling, junction of wall and floor, along the external perimeter of the building, expansion joints over the top surface of consolidated earth on which apron is to be laid, surrounding of pipes and conduits etc. complete as per specifications.(plinth are of the building at ground floor only shall be measured in sqm for payment).

With chloropyriphos emulsifiable concentrates of 20 % with 1 % concentration, at the rate of 7.5 litre per sqm for vertical surface and 5 litres per sqm of horizontal surface.

General

The specifications of the item are similar to BSR item, the work shall be strictly executed as per IS 6313. The work shall be executed by specialized agency having adequate technical capability and experience for similar nature of work.

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Submittals

Ten years guarantee certificate from the executing agency.

Mode of Measurement

Plinth area of the building at ground floor shall be measured for payment.

Rate

It includes the cost of all material and labor required for all the necessary operations that may be undertaken to execute the item described above.

2. Structural glazing

General

- | | | |
|----|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) | Framing system | Aluminium anodized extruded sections manufactured by reputed manufacturers. For all types of members like brackets, mullions, transom etc. |
| 2) | Sealant | As specified in the item of silicon sealant |
| 3) | Insulation | 50mm thick glass wool of minimum density 48kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminium foil of 100 Micro on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion. |
| 4) | Heat reflective Toughened Glass | (a) St. Gobain – Reflectosolar as specified.
(b) Glaverbel/ Glavermass – Super Silver
(c)Visteon Ford |

Brown or Grey Color or any shade approved by the Client/ Engineer-in-Charge/ Architect.

SCOPE OF WORK

Preliminary Requirements

- (i) The contractor shall design, test, fabricate, deliver, install and guarantee all construction necessary to provide a complete curtain wall system for the proposed building, all in conformity with the drawings as shown.
- (ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the drawings.

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- (iii) The curtain wall system shall also include the following activities:
 - (a) Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings, metal closure, windows etc.
 - (b) All anchors attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
 - (c) All thermal insulation associated with the system
 - (d) All fire protection associated with the system
 - (e) All copings and closure and metal cladding to complete the system
 - (f) All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.
 - (g) Isolation of dissimilar metals and moving parts.
 - (h) Anticorrosive treatment on all metals used in the system.
 - (i) Polyester powder coating aluminium sections.
- (iv) The contractor shall also be responsible for providing the following:
 - (a) Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.
 - (b) Mock-ups, samples and test units.
 - (c) Performance testing of the curtain wall framing and glazing assembly.
 - (d) Co-ordination with the work of other trade.
 - (e) Insulation with glass wool 48 kg/ cum at spandrels area.
 - (f) Protection.
 - (g) All final exterior and interior cleaning and finishing of the curtain wall system.
 - (h) As built record drawings and photographs.
 - (i) Guarantees and warranties.
 - (j) All hoisting, scaffolding, staging and temporary services.
 - (k) Conceptualizing and design of a suitable maintenance system for curtain glazing.
 - (v) The water tightness and structural stability of the whole curtain wall system are prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good at all the risk and cost of the contractor.
- (vi) The curtain wall system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.

Quality Consideration and Other Activities

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- (i) The contractor while submitting the detailed design calculations should submit the following information on the quality of materials to be used and other aspects as detailed below:
 - (1) Metal quality, finishes and thickness
 - (2) Glass quality, coating and thickness and proposed manufacturer's brand names
 - (3) Aluminium extruded sections including mullions and transoms together with structural calculations and proposed manufacturer's brand name and also the name of agency proposed for fabrication work
 - (4) Arrangement and jointing of components.
 - (5) Field connections especially mullion to mullion and transom to mullion.
 - (6) Fixing and anchorage system of typical wall unit together with structural calculations.
 - (7) Drainage system and provision in respect of water leakage in the curtain wall system
 - (8) Provisions for thermal movements.
 - (9) Sealant and sealing methods.
 - (10) Glazing method.
 - (11) Wind load and seismic load and any other specific load considered in the design
- (ii) Design concept over lightening protection link-up system of the curtain wall for connection and incorporation into the lightening conductor system of the building (Lightening conductor system of the building to be done by any other agency)
- (iii) The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

Tolerances

Any parts of the curtain wall, when completed, shall be within the following tolerances:

- (1) Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m length of any member or 6mm in any total run in any line.
- (2) Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle must not exceed 9mm total at any location.
- (3) Change in deviation must not exceed 3mm for any 3.5m run in any deviation.

Test of Wind Pressure

- (i) The equivalent load of wind pressure or wind suction shall be given to the test unit as increasing or decreasing the inside pressure in the "pressure chamber" at which the test unit is fixed.
- (ii) The static wind pressure shall be applied up to 1.5 kpa at maximum wind pressure.

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- (iii) The variation of dynamic pressure shall be of any approximate sine curve line.
- (iv) Deflection on each observational points of the test unit shall be observed and recorded under static pressure as described above.
- (v) Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.
- (vi) The deflection on the main structural parts in this condition shall not exceed:
 - (1) 1/175 of the span between supports or 20mm, whichever is less for vertical elements.
 - (2) 1/250 of the span between supports for horizontal elements.
 - (3) The extent of recovery of deformation, 15 minutes after the removal of the test load, is to be at least 95%.

Test of Lateral Deflection per Floor Height

- (i) Lateral deflection per floor height shall occur on the test unit, when the structural frame which fixes the test unit is deflected horizontally.
- (ii) The deflection of every ± 2.5 mm shall be increased up to ± 13 mm on the test unit (static deflection test)
- (iii) The dynamic deflection shall be applied up to ± 13 mm.
- (iv) The variation of dynamic deflection shall be of an approximate sine curve line, on period of 3 seconds.
- (v) The dimensions of the deflection on each observational point of the test unit shall be measured under the condition as described above and the same shall be observed.
- (vi) Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall except the damage to sealant at maximum deflection.

Water Tightness Test

- (i) Water shall be sprinkled to the 'Test Unit' under wind pressure.
- (ii) Pressure shall not be applied to the test unit
- (iii) The volume of the sprinkling water in one minute shall be 5 litres per sqmt minimum (01.gal/ sq.ft.)
- (iv) All water leakage and drainage system at the joint and the openable sash of the curtain wall system shall be observed from the outside of the chamber.
- (v) Hold the test two times, in sequence as described below, conforming to the above mentioned conditions.
 - (1) Install the test unit.

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- (2) Hold first water tightness test
- (3) Hold test of wind pressure as described above
- (4) Hold second water tightness test.
- (5) Lateral deflection test
- (vi) Water leakage shall not be observed inside at all parts of the test unit during first water tightness test.

Mode of Measurement

the breadth and the height of the finished work including the openable windows shall be measured in meters and centimetre and the net quantity for payment shall be calculated in sqm up to two place of decimal, the area to be considered for measurement shall be the net area of the exterior face of the curtain wall as fixed including the openable windows if any as part of the curtain wall.

Rate

The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, mock-up test units, fabrication, erection, finishing, scaffolding, undertaking performance guarantee. No other claims of any kind pertaining to this work shall be entertained.

3. Steel Hand Railing

GENERAL

All the components of the railing system including pipes, all fasteners and accessories shall be brushed finish stainless steel of 304 grade. The surface of the stainless steel used shall be free from any depression, bends etc. The work will be executed as per Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest version / edition including all applicable official amendment / revisions shall be referred to IS:6603, IS:6911, IS:1367(part14-section 1 to 3).

Toughened Glass shall be comply with AS 1288 toughened glass specification. The glass shall be clear and free from scratches of the required thickness as per the drawing and specification. The contractor is required to ensure that there is no scratch or blemish to the surface of all glasses and glasses which breaks or sustain damage shall be replaced. The glass shall be supplied at site with proper foam cover & it shall be maintained up to hand over.

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A specimen shall be done by the Contractor at one stair height for two landing. The further work shall be carried out strictly as per the working specimen in terms of Materials, finishes, and Tolerance.

SUBMITTALS

The work shall be executed as per the approved shop drawings only. Any deviation from the approved shop drawings shall not be accepted. The detail consisting of the design calculation shall be submitted for the approval of the Engineer-in-charge. Any damage portion railing shall be replaced by contractor at his own cost.

INSTALLATIONS

Perfect line and level shall be maintained while fixing the same. The welded joints shall be grind to smooth, uniform finish & made good same as per the finish of the approved system samples. Any and all components containing defects from approved finish shall be rejected and removed from the site. The contractor shall immediately replace such components at his own cost.

MODE OF MEASUREMENTS

Measurements will be made on running meter basis of the length of the starting point of SS railing till the wherever end point of the railing comes and inclusive of fixation of toughened glass to places of 3 decimal.

RATE

The rate shall be inclusive of toughened glass and all fabrication work including cutting, bending, welding, necessary grinding in the factory & at site, transportation and installation including all wastages etc.

4. PVC FLOORING

PVC flooring material is normally used for covering floor from decorative point of view in residential and non-residential buildings. This material gives a resilient and non-porous

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surface which can be easily cleaned with a wet cloth as dust and grime do not penetrate the surface. Since a burning cigarette will damage the neat surface of the PVC sheet, special care should be taken to prevent burning cigarette stumps to come in contact with the PVC flooring materials.

It shall be laid on a base that is finished even and smooth such as concrete, metal or timber boarding. Unevenness or undulations in the base will show badly on the surface and are liable to damage the PVC sheets/ tiles.

Materials

The PVC flooring material shall conform to IS: 3462. It may be in the form of tiles, sheets or rolls as specified. It shall consist a thoroughly blended composition of thermoplastic binder, filler and pigments. The thermoplastic binder shall consist substantially of one or both of the following:

- (a) Vinyl chloride polymer
- (b) Vinyl chloride copolymer

Thickness

The preferred thickness of PVC tiles for normal floor covering shall be 1.5, 2.0, 2.5, 3.0 or 4.0mm.

Thickness of PVC sheets shall be measured with micrometer of Ratchet type or a dial gauge graduated to 0.02mm. The micrometer shall have flat bearing surfaces of at least 6.5mm diameter at both contract points.

For sheets and rolls the thickness of the specimen shall be measured at twenty scattered points.

For polystyrene wall tiles, the cavity depth of the test specimen shall be measured at five points taken at random on the rear surface of each tile with a suitable depth gauge.

The width of flooring sheets and rolling in continuous length shall be 1000, 1500 and 2000mm. When supplied in rolls the length of the rolls shall not be less than 10 metre.

The measurement shall be carried out with a travelling microscope or suitable scale graduated to 0.02mm. Each tile shall be measured for length and width at the three quarter point in each direction.

Tolerance

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(a)	Thickness	$\pm 0.15\text{mm}$
(b)	Width	
(i)	300mm square tiles	$\pm 0.2\text{mm}$
(ii)	600mm square tiles	$\pm 0.4\text{mm}$
(iii)	900mm square tiles	$\pm 0.6\text{mm}$
(iv)	Sheets and rolls	± 0.1 per cent

Adhesive

Rubber based adhesives are suitable for fixing PVC flooring over concrete, wooden and metal sub-floors. PVA based adhesives shall be used for concrete and wooden sub-floors. PVA based adhesives are not suitable for metallic surfaces and also for locations where there is constant spillage of water.

Preparation of Sub-Floors

Before laying PVC sheets/ tiles, it is essential to ensure that the base is thoroughly dry and damp proof as evaporation of moisture cannot take place once the PVC flooring is laid. Moisture slowly damages the adhesive resulting in PVC sheet/ tiles being separated from the base and curled up. In case of new work a period of 4 to 8 weeks shall be allowed for drying the sub-floor under normal conditions.

Concrete sub-floors on the ground floor shall be laid in two layers. The top of the lower layer of concrete shall be painted with two coats of A-90 grade (conforming to IS:1580) applied at the rate of 1.5 kg/ sqmt. The top surface of the lower layer shall be finished smooth while laying the concrete so that the bitumen can be applied uniformly. The bitumen shall be applied after the concrete has set and is sufficiently hard. Bitumen felt conforming to IS:1322 shall be sand-witched in the sub-floor laid in two layers.

In new concrete floor, the smooth finish required shall be produced by using cement slurry spread on fresh concrete floor and finished smooth. If the concrete floor is old and surface not even, the surface should be made smooth by first cleaning it free of all foreign material and then a layer of cement mortar 1:2 (1 cement: 2 coarse sand) of average thickness of 6mm shall be applied on the surface finishing the surface smooth. The finished surface shall be cured for 7 days and then allowed to dry thoroughly.

Where it is expected that the dampness may find its way from the surrounding walls, the same shall also be effectively damp-proofed up to at least 150mm above the level of the sub-floor and the damp-proof treatment below the floor shall be extended over the walls.

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Laying and Fixing

Prior to laying, the flooring tiles/ rolls/ sheets shall be brought to the temperature of the area in which it is to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours.

Where air-conditioning is installed, the flooring shall not be laid on the sub-floor until the conditioning units have been in operation for at least seven days. During this period the temperature shall neither fall below 20⁰C nor exceed 30⁰C. These conditions shall be maintained during laying and for 48 hours, thereafter.

Before commencing the laying operations, the sub-floor shall be examined for evenness and dryness. The sub-floor shall then be cleaned with a dry cloth. The PVC flooring shall not be laid on a sub-floor unless the sub-floor is perfectly dry.

The layout of the PVC flooring on the sub-floor to be covered should be marked with guidelines. The PVC flooring shall be first laid for trial, without using the adhesive, according to the required layout.

The adhesive shall be applied by using a notched trowel to the sub-floor and to the back side of the PVC sheet or tile flooring. When set sufficiently for laying, the adhesive shall be sticky to touch, but will not mark the fingers. In general, the adhesive will require about half an hour for setting. It should not be left after setting for too long a period as the adhesive properties will be lost owing to dust films and other causes.

Care should be taken while laying the flooring under high humidity conditions so that condensation does not take place of the adhesive. It is preferable to avoid laying under high humidity conditions.

The area of adhesive to be spread at one time on the sub-floor depends entirely upon local circumstances. In case of a small room, adhesive may be spread over the entire area but relatively small areas of tiles/ sheets flooring should be treated in a larger room.

When the adhesive is just tack free the PVC flooring sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface. After laying the sheet in position, it shall be pressed with suitable roller weighing about 5kg to develop proper contract with the sub-floor. The next sheet with its back side applied with the adhesive shall be laid edge to edge with the sheet already laid and fixed in exactly the same manner as the first sheet

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was fixed. The sheets shall be laid edge to edge so that there is minimum gap between joints.

The alignment should be checked after laying of each row of sheet is completed. If the alignment is not perfect, the sheets may be trimmed by using a straight edge.

The tiles shall be fixed in exactly the same manner as for the sheets. It is preferable to start laying of the tiles from the centre of the area. Care should be taken that the tiles are laid close to each other with minimum gap between joints. The tiles should always be lowered in position and pressed firmly on to the adhesive. Care should be taken not to slide them as this may result in adhesive being squeezed up between the joints. PVC tiles after laying shall be rolled with a light wooden roller weighing about 5kg to ensure full contact with the under layer. Any undulations noticed on the PVC surface shall be rectified by removing and relaying the tiles after thorough cleaning of the underside of the affected tiles. The adhesives applied earlier in such places shall be thoroughly removed by using proper solvents and the surface shall be cleaned to remove the traces of solvents used. Work should be constantly checked against guidelines in order to ensure that all the four edges of adjacent tiles meet accurately.

Any adhesive which may squeeze up between sheets or tiles should be wiped off immediately with a wet cloth before the adhesive hardens. If, by chance, adhesive dries up and hardens on the surface of the sheet or tile, it should be removed with a suitable solvent. A solution of one part of commercial butyleacetate and three parts of turpentine oil is a suitable solvent for the purpose.

A minimum period of 24 hours shall be given after laying the flooring for developing proper bond of the adhesive. During this period, the flooring shall not be put to service. It is preferable to lay the PVC flooring after completion of plastering, painting and other decorative finish works so as to avoid any accidental damage to the flooring.

When the flooring has been securely fixed, it shall be cleaned with a wet cloth soaked in warm soap solution (two spoons of soap in 5 litres of warm water).

Where the edges of the PVC sheets of tiles are exposed, as for example, in doorways and on stair treads, it is important to provide protection against damage of flooring materials. Metallic edge strips may be used and should be securely fastened to the sub-floor to protect edges of the flooring.

Precaution for Maintenance

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PVC flooring subject to normal usage may be kept clean by mopping with soap solution using a clean damp cloth. Water shall not be poured on the PVC flooring for cleaning purpose as the water may tend to seep through the joins and cause the adhesive to fail. To maintain a good wearing surface a good appearance, the flooring may be periodically polished. When polish is applied frequently, a thick layer builds up which collects dirt and dust and is tacky to walk on.

If the traffic is light, the floor shall be given frequent brushing regular polishing by an application of new polish every 4 to 6 weeks. Under moderate traffic conditions the floor shall be given an occasional wash with a wet mop but no detergents shall be used so that the polish is not removed.

Application of polish may be done every one to three weeks. PVC flooring should not be over waxed. When this condition develops, the coatings should be cleared off with white spirit or paraffin and a light even coat of polish applied. When the PVC flooring has been polished, it will remain bright for a considerable period if dry mop is applied each day. It is this daily 'dry polish' that maintains the glossy surface. After exceptionally heavy traffic PVC flooring should be swept with a hair groom, rubbed with a mop or cloth frequently rinsed in clean water and finally rubbed dry.

Measurements

Length and breadth shall be measured correct to a cm and its area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqmt. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqmt. Nothing extra shall be paid for providing PVC flooring in borders and margins, irrespective of their width.

Rate

The rate shall include the cost of all materials and labor involved in all the operations described above, except those described. The rate does not include the cost of sub-floor or damp proof treatment, if any. It also does not include the cost of metallic edge strip to protect edge of flooring, wherever provided, it shall be paid separately.

5. Providing & fixing 10mm thick Dovetex tiles with grooves on rear side. Made from special Vitrified Clay.

General

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Tile shall be of the type specified; the tiles are made by extrusion process enabling 10 mm wide dovetailed grooves at the rear part of the tiles. These grooves are broader at the base and narrow at the surface. These locking grooves ensure that the tiles can not fall off.

Firing temperature

Made from special vitrified clay fired at 1120 Celsius degree which gives the tile a high strength body and low water absorption. The vitrified tiles body ensures no surface flaking of the tiles for more than 50 years.

Related sections

All work related to this specification section should be coordinated with the works described in other specification sections, including:

Mortar
Joints
Providing
Curing

Mode of Measurement

The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal.

Rate

The rate shall include the cost of materials and labor required for all the operations described above.

6. Foam concrete: - This is light weight concrete block (made out from cement, coarse sand, aggregate and chemical as per manufacturers specifications) for filling in sunken portion only.

Mode of Measurement

The measurement shall be taken along the finished surface of treatment including the rounded and tapered portions at junctions. Length and breadth shall be measured correct to one centimetre and area shall be worked out nearest to two decimals.

Rate

The rate shall be inclusive for all operations described in the nomenclature and the specifications applicable to the item, including any incidental expenditure. Nothing extra

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shall be payable on any account whatsoever.

Granite work gang saw cut (polished and machine cut) of thickness 18mm for wall lining,skirting and dado (veneer work) in cement mortar 1:3 (1 cement : 3 coarse sand) including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust) with an admixture of pigment to match the marble shade: (To be secured to the backing by means of cramps, which shall be paid for separately).

General

Granite Stone shall be of the type specified and the material promptly in accordance with specifications, it shall be hard sound durable and tough free from cracks, and defects like cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

MATERIALS

Granite Standard: Granite shall comply Standard Specification for material characteristics, physical requirements, and sampling for selection of granite.

All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be within the range of samples approved by the Engineer – in -charge.

Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone in place.

Provide chases, reveals, ringlets, openings, and similar features as required to accommodate adjacent work.

Shop Drawings

The Contractor shall submit: copies of required shop drawings to the Engineer-in-charge for approval. These drawings shall show all bedding, bonding, jointing and anchoring details, and the dimensions of each piece of granite. No final sizing or finishing shall be done until the shop drawings for that part of the work have been approved.

STONE INSTALLATION

Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

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Cleaning

After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements Stainless steel wire brushes or wool may be used, but the use of other wire brushes or of acid or other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted before cleaners other than detergents are used.

Protection of Finished Work

After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive. All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

Defective Work

Any area or piece of granite found defective it shall be removed, and to be patched or redressed for use. Nothing extra on this account will be entertained.

Related sections

All work related to this specification section should be coordinated with the works described in other specification sections, including:

Mortar
Joints
Pointing
Curing

Mode of Measurement

The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal. The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained.

Rate

The rate shall include the cost of materials and labor required for all the operations described above.

7. Granite stone flooring with 18mm thick stone flooring (sample of shall be approved by Engineer-in-charge) over 20 mm (average) thick base of cement mortar 1:4

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(1 cement : 4 coarse sand) laid and jointed with grey cement slurry including rubbing and polishing complete with :

General

Granite Stone shall be of the type specified and the material promptly in accordance with specifications, it shall be hard sound durable and tough free from cracks, and defects like cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

MATERIALS

Granite Standard: Granite shall comply Standard Specification for material characteristics, physical requirements, and sampling for selection of granite.

All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be within the range of samples approved by the Engineer – in -charge.

Shop Drawings

The Contractor shall submit: copies of required shop drawings to the Engineer-in-charge for approval. These drawings shall show all bedding, bonding, jointing details, and the dimensions of each piece of granite. No final sizing or finishing shall be done until the shop drawings for that part of the work have been approved.

STONE INSTALLATION

Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

Cleaning

After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements Stainless steel wire brushes or wool may be used, but the use of other wire brushes or of acid or other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted before cleaners other than detergents are used.

Protection of Finished Work

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After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive. All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

Defective Work

Any area or piece of granite found defective it shall be removed, and to be patched or redressed for use. Nothing extra on this account will be entertained.

Related sections

All work related to this specification section should be coordinated with the works described in other specification sections, including:

Mortar
Joints
Pointing
Curing

Mode of Measurement

The finished work shall be measured correct to a centimeter in respect of length and breadth nearest to two places of decimal.

Rate

The rate shall include the cost of materials and labor required for all the operations described above.

8. Ceramic Ventilated Rainscreen Facade Tiles

General

The work shall be of the type specified and the material promptly in accordance with Manufacturers specifications, and before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

MATERIALS

Providing and fixing of FAVETON BERSAL (or equivalent) Extruded Hollow Clay/ Ceramic Ventilated Rainscreen Facade Tiles of dimensions 300mm / 400mm (c/c) x 600mm / 800mm / 1000mm (c/c) x 16mm thickness in horizontal direction on the building facade. The facade tiles shall be rigid and of adequate strength and shall satisfy all the

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performance parameters. The tiles shall have a total thickness of 16 mm ($\pm 10\%$) and shall be installed using the ventilated rainscreen principle, with provision for uninterrupted natural ventilation of the space between the cladding panels and the structural wall from top to bottom. The tiles shall be fixed to an extruded aluminium support framework consisting of vertical aluminium tubular sections measuring 40x40mm spaced at maximum 1000mm c/c intervals, fixed to the wall using aluminium L-brackets spaced at maximum 1200mm distance vertically.

Each aluminium bracket to be fixed to the brickwork/ RCC structure using stainless steel anchor fasteners for brickwork/ RCC as applicable, and to be fixed to the vertical aluminium tubes using two stainless steel screws of dimensions 23x5.5mm. Horizontal aluminium C-sections measuring 56x25mm to be fixed to the 40x40mm vertical aluminium tubes using stainless steel screws at maximum 1000mm intervals horizontally and at maximum 400mm c/c intervals vertically matching to the tile-grid. The tiles to be fixed to the horizontal aluminium C-sections using approved sealant adhesive. The vertical joint between adjacent tiles to be a 6mm open groove. The wall top and window sills to be protected using an aluminium-composite-panel flashing/ coping. External square angles between two vertical tile pieces to be a mitred corner formed by the two tiles complete.

Technical data:-

Properties	Rule	FAVETON (Values)
Tolerances	ISO 10545-2	Length (Extrusion Direction) +/- 1 mm * Height +/- 2 mm * Thickness +/- 10% * Straightness (Extrusion Direction) +/- 0.3% of length. * Surface flatness of diagonal or height +/- 0,5%
(*) According to dimension of format		
Weight		31 Kg / Sqm
Water absorption	ISO 10545-3	<1% or 3-6% depending on color
Linear Thermal Expansion	ISO 10545-8	Coefficient of expansion 5.7×10^{-6} (K-1). Test ITC.
Moisture expansion	ISO 10545-10	Mean value < 0,1 mm/m, máximum value <0,1 mm/m. Test ITC.

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Flexural Strength / Bending strength	ISO 10545-4	> 14 N/mm² depending on color
Impact Strength	ISO 10545 – 5	Coefficient of Restitution 0.83
Cracking Resistance	ISO 10545 – 11	In Compliance
Resistance to thermal Shock	ISO 10545-9	Unalterable up to 145°C, according to test.
Chemical resistance	ISO 10545-13	Only applicable in corrosive conditions. At Least G and B class.
Stain resistance	ISO 10545-14	At least CLASS 3.
Colour fastness	ISO 10545-16	ΔE <2.
Front resistance	ISO 10545-12	Unalterable according to test (100 cycles +5°C a -5°C).

Related sections

All work related to this specification section should be coordinated with the works described in other specification sections, including:

Fixing of Aluminium Frame
Scaffolding
Fixing
Jointing
Protection

Mode of Measurement

The finished work shall be measured correct to a centimetre. The area shall be calculated in square metre correct to two places of decimal. Any opening of area 0.01 sqm or less shall not be deducted.

Rate

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The rate shall include the cost of materials and labor involved in all operations described above including cost of support scaffolding stages, sealant, fixing of Aluminum frame, pouring guns, and required fasteners/cramps etc.

9. PVC Floor Base

General

The work shall be of the type specified and the material promptly in accordance with Manufacturers specifications, and before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

MATERIALS

Providing of 3 mm average thick layer of cementitious salt smoothing compound of Ardex CL-11 or equivalent as recommended by the Vinyl sheet flooring manufacturer over and including a priming compound of Ardex P-51 or equivalent as recommended by the Vinyl sheet flooring manufacturera on concrete surface to provide a smooth & homogenous surface for laying of vinyl sheet flooring complete.

Description:

Ready to use, rapid drying dispersion primer mainly for the pre-treatment of absorbent, mineral substrates prior to application of cement and calcium sulphate levelling compounds. For use under floor covering and wood flooring installations. For interior and exterior use.

Suitable for /on:

- very absorbent substrates, e.g. cement screeds, rapid cement screeds, cement- /gypsum-based levelling compounds or concrete
- calcium sulphate screeds
- gypsum-based substrates, plasterboard or plaster-fibre board
- renders and brickwork
- old, well-bonded, waterproof residues of adhesives and levelling compounds
- heavy wear in domestic, commercial and industrial locations
- warm water under floor heating systems
- exposure to castor wheels in accordance with DIN EN 12 529

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- **not suitable as a primer under dispersion wood flooring adhesives**
- as a system component in high-speed construction

As a primer prior to application of Ardex cement and cal - cum sulphate levelling compounds as a bonding agent, to reduce absorbency and to bind dust on predominantly absorbent substrates. Can also be used prior to direct adhesion with Ardex dispersion adhesives (not under wood flooring adhesives).

Product Properties/Benefits:

Water-based dispersion primer with good penetration and surface strengthening properties based on an especially fine-particle synthetic resin hydrosol. Binds surface dust, reduces the absorbency of the substrate, protects moisture-sensitive substrates from the water in levelling compounds and adhesives and avoids too rapid absorption of the mixing water in levelling compounds. Due to its special composition, Ardex is especially quick drying and therefore saves the user from long waiting times. Composition: Modified styrol-acrylate copolymers, wetting- and de-foaming agents, preservatives, water.

- Ready to use
- Very rapid drying
- Penetrates into the substrate
- Binds surface dust
- Reduces the absorbency of the substrate
- Sprayable
- High-speed construction product
- Solvent-free

Technical Data:

Packaging: plastic canister / barrel
Packsizes: 5 kg, 10 kg, 20 kg, 120 kg

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Shelf life:	min. 12 months
Colour liquid / dry:	light blue / transparent
Consumption:	100 – 150 g/m ²
Working temperature:	min. 10 °C / 50 °F at floor level
Drying time, ready for coating after:	1 – 6 hours*
	*At 20 °C /68 °F and 65% relative humidity.

Substrate Preparation:

The subfloor must be sound, load-bearing, dry, free from cracks, clean and free from materials (dirt, oil, grease) that would impair adhesion. Calcium sulphate-screeds must be abraded and vacuumed as a chargeable service, either as a finishing treatment by the screed installer, or as a special project by the installer of the floor covering. Test the subfloor in accordance with applicable standards and notices and report any deficiencies. Brush, abrade, grind or shot-blast to remove any weakly bonded or soft surface sections, e.g. separating agents, loose residues of adhesives, levelling compounds, coverings or paints, etc. Thoroughly vacuum to remove loose material and dust. Test well-bonded residues of adhesives and levelling compounds to ensure they are waterproof. If not waterproof (water test: adhesive bed dissolves with shortterm exposure to water) use the water- and solvent- free 2-Component Epoxy Primer-Sealer Ardex. Always allow primers to dry thoroughly. Refer to the Product Data Sheets for other products used.

Application:

1. Before use, allow containers to come to room temperature and shake well – then decant the contents into a clean, oval applicator bucket.
2. Apply a full, even coat of the primer onto the subfloor using the Ardex fine-pored Foam Roller. On very absorbent surfaces, do not pour onto the surface so as to avoid localised saturation; if necessary, a second coat may be required.
3. Clean tools with water immediately after use.

Applications Chart:

Allow to dry to a clear, transparent, almost tack-free film.

Substrate

Consumption

Drying Time

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Cement-based substrates	100 – 150 g/m ²	approx. 1 hour*
Calcium sulphate substrates, gypsum-based substrates, renders	100 – 150 g/m ²	4 – 6 hours*
Substrates with poor absorbency, e.g. old, grinded, waterproof adhesive residues	100 – 150 g/m ²	4 – 6 hours*
UZIN gypsum-based leveling Compounds on calcium sulphate screeds	100 – 150 g/m ²	1 hour*

*At 20 °C /68 °F and 65% relative humidity and undiluted primer.

Mode of Measurement

The finished work shall be measured correct to a centimetre. The area shall be calculated in square metre correct to two places of decimal.

Rate

The rate shall include the cost of materials and labor involved in all operations described above.

10. Wooden Flooring – AC5

General

The work shall be of the type specified and the material promptly in accordance with Manufacturer's specifications, and before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

MATERIALS

12mm thick laminated wooden flooring of approved brand & shade of AC 5 category laid over 40mm thick leveling layer of cement works complete in all respects as per manufacture specifications and direction of Engineer-in-Charge.

Features:

Class 23/33 HPL-laminate flooring intended for heavy domestic and heavy commercial use. Very high resistance against scratches, indentation and wear.

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Fire Class Bfl-s1
Anti-static

Technical Data:

Build up:

Surface layer	High Pressure Laminate (HPL) with TitanX TM Advanced and SoftTech TM.
Core material	High Density Fibre board (HDF)
Backing/Attached Underlay	Compact SoundBloc TM

Installation:

Installation	Floating installation
Joint	PerfectFold TM

Classification Requirements, (EN 13329):

Characteristic	Test method	Requirement	Typical result
Abrasion resistance	EN 13329 Annex E	AC 5; ≥ 6000 rev	> 6500 rev
Impact resistance	EN 13329 Annex F	IC 3 Small ball ≥ 15 N Large ball ≥ 1600 mm	> 18 N > 2000 mm
Resistance to staining	EN 438	5 (group 1&2) 4 (group 3)	5 (group 1&2) 4 (group 3)
Resistance to cigarettes Burns	EN 438	Class 4	Class 5
Effect of a furniture leg	EN 424	Foot type 0 No change or damage	No change or damage
Effect of a castor chair	EN 425	Foot type 0 No change or damage	No change or damage
Thickness swelling	EN 13329 Annex G	≤ 18 %	≤ 12 %

General Requirements, (EN 13329):

Characteristic	Test method	Requirement	Typical result
Dimensional stability	EN 13329 Annex C	$\leq 0,9$ mm	$\leq 0,9$ mm
Light fastness	EN ISO 105B02	Blue wool scale: ≥ 6	Blue wool scale: ≥ 7
Light fastness	EN ISO 20105A02	Grey scale: ≥ 4	Grey scale: ≥ 5
Static indentation	EN 433	$\leq 0,01$ mm	0,00 mm

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Surface soundness	EN 13329 Annex D	$\geq 1,0 \text{ N/mm}^2$	$> 1,4 \text{ N/mm}^2$
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Essential Characteristics, (EN 14041):

Characteristic	Test method	Requirement	Typical result
Reaction to fire	EN 13501-1	National requirements	Class B _{fl} -s1
Content of pentachlorophenol	CEN/TR 14823	No content allowed	No content
Formaldehyde emission	EN 717-1	$< 0,124 \text{ mg/m}^3 \text{ (E1)}$	$< \text{E1}$
Slip resistance	EN 13893	Class DS : $\mu \geq 0,30$	DS
Electrical behaviour	EN 1815	$< 2,0 \text{ kV}$ (Antistatic)	$< 2,0 \text{ kV}$
Thermal resistance	EN 12667	Declare R-value	$< 0,08 \text{ m}^2 \text{ K/W}$

Additional Technical Data:

Characteristic	Test method	Typical result
Impact sound reduction	ISO 717-2	ΔL_w 17-19 dB
Risk of slipping	www.slipalert.com	$\mu_{dry} = 0,46-0,52$ (Low risk of slipping) $\mu_{wet} = 0,22-0,30$ (Moderate risk of slipping)
Slip resistance	DIN 51130	R9 for selected surfaces, see table below
Generic anti-microbial effect (without added preservative)	JIS Z 2801:2000	Reduction of MRSA $> 99,98\%$ (24h) Reduction of E Coli $> 99,70\%$ (24h) Reduction of H5N1 = $99,99\%$ (16h)
Resistance to micro-scratches	IHD-W-445	Grade 0, $\Delta R' < 10\%$
Staining of rubber tyres	ISO 3865	No discolouration of surface

Installation:-

Start the installation in the left-hand corner with the tongue facing the wall. The joint is designed for a installation from left to right. The recommended installation method is to install with the tongue into the groove. Only in few situations you need to fit the groove on the tongue. Remove the tongue facing the wall. Assemble the planks together in the first row so that they form a straight line.

If the starting wall is uneven or you need to scribe the contour of the wall on the panels in the first row, disassemble and cut. Check that the distance between the first row and the wall is correct, min 5 mm and use spacers in both short side and on long side. Make sure that on long side have a spacer at each short side joint and at least one in the middle of the plank. Ensure that the end joints line up with end joints in consecutive rows.

Put the first plank in the next row in place. Take the next plank. Place it on the subfloor and push it into the long side joint. Angle the plank a little bit so the tongue enters the groove. Slide the plank in place over the end joint and press it firmly down.

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Lining

To calculate the correct width of the last row. Place a full row of tiles directly on top of the last installed row of full tiles. Use the full width of a scrap piece of tile. Place the tongue side against the wall and the pencil against the extended groove and mark a line the length of the wall. Cut along the pencil line.

Finishing up

Remove all spacers before placing skirting's. Never use silicone or other compounds that will fix/glue down the skirting's, metal frames or such at the floor. Make sure the floor could move underneath skirting's.

Mode of Measurement

The finished work shall be measured correct to a centimetre. The area shall be calculated in square metre correct to two places of decimal.

Rate

The rate shall include the cost of materials and labor involved in all operations described above.

SPECIFICATION PLUMBING & FIRE INSTALLATION WORKS

TECHNICAL SPECIFICATIONS

1. BASIS OF DESIGN

The Plumbing, External Drainage and water supply System for the project is designed keeping in view the following:

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- 1.1 Requirement of adequate and equal pressure availability of hot and cold water lines in Public Toilets, Kitchen and other identified areas.
- 1.2 Adequate storage of water in underground raw + overhead treated domestic water tanks.
- 1.3 Levels of roads / pavements and other services in the area.
- 1.4 Landscape layout.

The execution of works and materials used shall be as per the latest relevant I.S. specifications. Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

2. CONCEPT OF THE SYSTEM

5..1 The following services are envisaged for the complex:

- 2.1 Water Treatment System for meeting the domestic water quality requirement with chemical parameters in acceptable limits as per SP: 35 (S&T) 1987 which is considered safe for human consumption.
- 2.2 Domestic/Flushing water supply through Hydropneumatic system.
- 2.3 Sewage and Sullage collection system based on IS:1742 and applicable standards for domestic drainage and connected to Sewage Treatment Plant and /or as otherwise specified with outfall into municipal system.
- 2.4 Storm / Rain water drainage system from various levels of the building and disposal to Rain Water Harvesting System / storm water drain.

3. WATER STORAGE & DISTRIBUTION SYSTEM

3.1 Water Requirement

The water requirement for the project is _____ The water requirement for this project is _____
proposed to be as per the provisions in IS : 1172 and prevalent practices.

3.2 Source of Water

It is expected that part of the daily domestic water requirement shall be through municipal mains supply. The rest will be obtained from bore wells/tankers.

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3.4 **Appurtenant**

Following components shall be included in the water supply system for efficient functioning:

- i. Automatic air vent
- ii. Pressure Gauge.
- iii. Water Hammer arrestors.

4. **WORKMANSHIP**

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Owner's Site Representative. All materials and/or workmanship which in the opinion of the Owner's Site Representative / Architect / Consultant are defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

MATERIALS

All materials shall be best of their kind and shall conform to the latest Indian Standards.

All materials shall be of approved quality as per samples and origins approved by the Owner's Site Representative / Architect / Consultants.

As and when required by the Owner's Site Representative / Consultant, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the Owner's Site Representative / Consultant, the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Owner's Site Representative / Consultant. To prove that the materials used are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

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SECTION I GENERAL INSTRUCTIONS

1.0 GENERAL REQUIREMENTS

1.1 Scope of Work

1.1.1 The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.1.2 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Drawings.

1.1.3 Without restricting to the generally of the foregoing, the sanitary installations shall include the following:-

A. Plumbing Works

- a. Sanitary ware Installation
- b. Water Supply System (Hot & Cold).
- c. Under ground water tanks with all sleeves.
- d. Sewerage & Storm water drainage system.
- e. Garden Irrigation System.
- f. High side works.
- g. Sewage treatment plant.

B. Fire Fighting Works

- a. Hydrant System
- b. Sprinkler System
- c. Fire Extinguishers

1.1.4 Services rendered under this section shall be done without any extra charge.

1.2 Specifications

1.2.1 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

1.2.2 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with upto date amendments as applicable in the contract and or as per the requirement of the client or its representative.

1.2.3 Works not covered above in para 1.2.1 and 1.2.2 shall be carried out as per relevant Indian Standards and in case of its absence as per British Standard Code of Practice.

1.3. Execution of Work

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- 1.3.1 The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.
- 1.3.2 The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural and Other specialized services drawings.
- 1.3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.
- 1.3.4 On award of the work, Contractor shall submit a schedule of construction in the form of a PERT Chart or BAR Chart for approval of the Project Manager/Architect/Consultant. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.
- 1.4 **Drawings**
- 1.4.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.
- 1.4.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.
- 1.4.3 Contractor shall verify all dimensions at site and bring to the notice of the Project Manager all discrepancies or deviations noticed. Decision of the Project Manager shall be final.
- 1.4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.
- 1.4.5 All drawings issued by the Architects/Consultant for the work are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.
- 1.5 **Inspection and Testing of Materials**
- 1.5.1 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.
- 1.5.2 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-
- a) Theodolite, Steel tapes
 - b) Dumpy level
 - c) Weighing machine
 - d) Plumb bobs, Spirit levels, Hammers
 - e) Micrometers, Tachometers
 - f) Thermometers, Stoves

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- g) Hydraulic test machine
- h) Smoke test machine
- 1.5.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager.
- 1.5.4 All Testing Equipment shall be preferably located in a special room meant for the purpose.
- 1.5.5 Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Architects or kept at site in a sample room as prepared by the owners. Any materials declared defective by Project Manager/Architect/Consultant shall be removed from the site within 48 hours.
- 1.6 **Metric Conversion**
- 1.6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.
- 1.6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.
- 1.7 **Reference Points**
- 1.7.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.
- 1.7.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.
- 1.8 **Reference Drawings**
- 1.8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.
- 1.8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Project Manager or Architects.
- 1.9 **Shop Drawings**
- 1.9.1 The Contractor shall submit to the Project Manager three copies of the shop drawings.
- 1.9.2 Shop drawings shall be submitted under following conditions:-
 - (a) Showing any changes in layout in the plumbing drawings.
 - (b) Equipment layout, piping and wiring diagram.
 - (c) Manufacturer's or Contractor's fabrication drawings for any materials or equipment supplied by him.
- 1.9.3 The Contractor shall submit two copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts as required by the Project Manager.

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1.10 Completion Drawings

1.10.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of “as built” drawings to the Project Manager. These drawings shall have the following information.

- a) Run of all piping, diameters on all floors, vertical stacks and location of external services.
- b) Ground and invert levels of all drainage pipes together with location of all manholes and connections upto outfall.
- c) Run of all water supply lines with diameters, locations of control valves, access panels.
- d) Location of all mechanical equipment with layout and piping connections.

No completion certificate shall be issued unless the above drawings are submitted.

1.10.2 Contractor shall provide two sets of catalogues, service manuals manufacturer’s drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

1.10.3 All “Warranty Cards” given by the manufacturers shall be handed over to the Project Manager.

1.11. Contractors Rates

1.11.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

1.11.2 Rates quoted are for all heights and depths and in all positions as may be required for this work.

1.11.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

1.11.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as directed by Project Manager. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

1.11.5 The Contractor shall furnish the Architects with vouchers and test certificates, on request, to prove that the materials as specified and to indicate that the rates at which the materials are purchased in order to work out the rate analysis of non tendered items which he may be called upon to be carried out.

1.12 Testing

1.12.1 Piping and drainage works shall be tested as specified under the relevant clause(s) of the specifications.

1.12.2 Tests shall be performed in the presence of the Project Manager/ Consultant.

1.12.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

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1.12.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

1.12.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

1.13 Site Clearance and Cleanup

1.13.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

1.13.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

1.13.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

1.14 License Permits and Authorities

1.14.1 Contractor must keep constant liaison with the Municipal/statutory authority and obtain all approval of all drainage, water supply and other works carried out by him.

1.14.2 Contractor shall obtain, from the Municipal and other authority's necessary completion certificate(s) with respect to his work as required for occupation of the building. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. Employer shall pay all fees/deposits as required to be paid to the authorities towards connection charges.

1.15 Recovery of Cost for Materials issued to Contractors Free of Cost

1.15.1 If any materials issued to the Contractor free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. plus 100%. The decision on the actual cost given by the Employer shall be final and binding on the Contractor.

1.16 Cutting of Water Proofing Membrane

No walls, terraces shall be cut for making and opening after water proofing has been done without written approval of Project Manager/Architects. Cutting of water proofing membrane shall be done very carefully to ensure that other portion(s) of water proofing is (are) not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per specifications and details of water proofing approved by Architects.

1.17 Cutting of Structural Members

No structural member shall be chased or cut without the written permission of the Project Manager.

1.18. Materials Supplied by Owner

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1.18.1 The Contractor shall verify that all materials supplied by the Employer confirm to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Project Manager.

1.19 Materials

1.19.1 Unless otherwise specified and expressly approved in writing by the Project Manager, only materials of makes and specifications mentioned in the list of approved makes attached with the specifications shall be used.

1.19.2 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Project Manager and returned to the Contractor at the appropriate time.

SECTION-II

SANITARY FIXTURES

2.1 SCOPE OF WORK

2.1.1 Work under this section shall consist of furnishing all material and labour as necessary and required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the schedule of quantities.

2.1.2 Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.

2.1.3 Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2.2 GENERAL REQUIREMENTS

2.2.1 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the schedule of quantities, specifications, drawings or not.

2.2.2 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural/interior designers requirements. Wherever necessary the fittings shall centered to dimensions and pattern desired.

2.2.3 Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of Architect.

2.2.4 All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shows on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at contractors cost.

2.2.5 When directed, contractor shall install fixtures and accessories in a mock-up room for the approval of the Architect. Sample room fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

2.3. INDIAN W.C.

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- 2.3.1 Indian W.C. pan shall be Orissa pattern of size as specified in the schedule of quantities. Each W.C. shall be provided with a 100mm dia cast iron or porcelain P or S trap with or without vent horn.
- 2.3.2 W.C. shall be flushed by means of a C.I. high level flushing cistern or low level cistern of polyethylene body complete with accessories on an exposed or concealed type flush valve or as specified in bill of quantities.
- 2.3.3 The W.C. shall be fixed in level in a neat workmanlike manner. The W.C. and trap shall be set in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). Joints between W.C. and flush pipe shall be made with a putty or white lead and linseed oil and caulked well or with an approved rubber joint.

2.4 ANGLO INDIAN W.C.

- 2.4.1 Anglo Indian W.C. shall be wash down type 'P' or 'S' Trap set.
- 2.4.2 Each Anglo Indian W.C. set shall be provided with a solid plastic seat with cover of colour given in the schedule of quantities, rubber buffers and chromium plated hinges.
- 2.4.3 Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.
- 2.4.4 Each Anglo Indian W.C. shall be flushed with a porcelain flushing cistern or an exposed or concealed type flush valve. Flush pipe/bend shall be connected to the W.C. by means of a suitable rubber adapter.

2.5. EUROPEAN W.C.

- 2.5.1 European W.C. shall be wash down, single or double siphonic type, floor or wall mounted set, flushed by means of porcelain low level flushing cistern, or an exposed or concealed type flush valve, as specified in schedule of quantities. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung w.c. shall be supported by C.I. floor mounted chair.
- 2.5.2 Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

2.6 URINALS

- 2.6.1 Urinals shall be lipid type half shall white glazed vitreous China of approx. size 630x420x380mm size or as specified in bill of quantities.
- 2.6.2 Half stall Urinals shall be provided with 15mm dia C.P. spreader, 32mm dia C.P domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete as directed by Architect.
- 2.6.3 Half stall urinals shall be fixed with C.P. brass screws and shall be provided with 32mm dia domical waste leading to urinals trap.
- 2.6.4 Urinals shall be flushed by means of automatic porcelain flushing cistern or exposed or concealed type urinal flush valve, as specified in schedule of quantities.

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2.6.5 Flushing cistern for urinals shall be automatic type cast iron or vitreous china as given in the schedule of quantities. Each flushing cistern shall have a copper siphon and inlet noose cock to control the flow. Flushing cistern shall be fixed to wall with R.S. or C.I. brackets. Cast iron cistern and brackets shall be painted with two coats of white enamel paint. Cistern may be concealed in pipe shafts or false ceilings where required as directed by Architect.

2.6.6 Flush pipes of flushing cistern with sizes of main and branch flush pipes shall be as follows:

No. of Urinals in range	Capacity of cistern litres	Size of main flush pipe	Size of branch flush pipe	Size of Connection to urinal
One	5	--	--	15
Two	10	20	--	15
Three	10	25	--	15

2.6.7 Alternatively, urinals may be flush with flush valves, exposed or concealed type.

2.6.8 Waste pipes for urinals shall be any one of the following:

- a). G.I. pipes
- b). Rigid P.V.C.
- c). Lead pipes.

Waste pipes may be exposed on wall or concealed in chase as directed by the Architect. Specifications for waste pipes shall be same as given in sub-section 8.0 to 10.0 section-II of Volume-II.

2.7 LAVATORY BASIN

2.7.1 Lavatory basins shall be white glazed vitreous china or polymarble of size, shape and type specified in the bill of quantities.

2.7.2 Each basin shall be provided with R.S. or C.I. brackets and clips and the basin securely fixed to wall. Placing of basins over the brackets without secure fixing shall not be accepted.

2.7.3 Each basin shall be provided with 32mm dia C.P. waste with overflow, pop-up waste or rubber plug and chain as given in the bill of quantities, 32mm dia C.P.Brass bottle trap with C.P. pipe to wall and flange.

2.7.4 Each basin shall be provided with fittings or mixing fitting as specified in the bill of quantities.

2.7.5 Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms above the floor or as directed by Architect.

2.8 SINKS

2.8.1 Sinks shall be of precast Terrazzo marble, or white glazed fireclay or vitreous china or stainless steel or any other material as specified in the schedule of quantities.

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2.8.2 Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40mm dia C.P. waste with chain and plug or P.V.C. waste. Fixing shall be done as directed by Architect.

2.8.3 Supply fittings for sinks shall be mixing fittings or C.P. taps as specified in the bill of quantities.

2.9 MIRRORS

2.9.1 Mirrors shall be electro coated copper 5.5mm thick of guaranteed reputed make. The size shall be as specified in the bill of quantities or shown on the drawings. The image shall be clear and without waviness at all angles of vision.

2.9.2 Mirrors shall be provided with backing of 12mm thick marine plywood sheet fixed with C.P. brass semi-round headed screws and cup washers or C.P. brass clamps as specified or instructed by Architect.

2.10 SHOWER SET

2.10.1 Shower set shall comprise of one/two C.P.Brass concealed stop cocks with two long body brass/C.P. brass bib cock, or bath spout or as given in the bill of quantities.

2.10.2 Each shower set shall also be provided with C.P. Shower arm with wall flange and shower head of approved quality as specified in the bill of quantities.

2.10.3 Concealed stop cocks shall be so fixed as to keep the wall flange clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

2.11 ACCESSORIES

2.11.1 Contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by Architect, and given in the bill of quantities.

2.11.2 All C.P. accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by Architect.

2.11.3 Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.

2.12 URINAL PARTITIONS

2.12.1 Urinal partitions shall be white glazed vitreous china or 25mm thick marble of size specified in the schedule of quantities.

2.12.2 Porcelain partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. clips as recommended by the manufacturer and directed by Architect.

2.13 MEASUREMENT

2.13.1 Rate for providing and fixing of sanitary fixtures accessories, urinal partitions shall include all items and operations stated in the respective specifications and bill of quantities and nothing extra is payable.

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- 2.13.2 Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

SECTION III

SOIL, WASTE, VENT & RAINWATER PIPES & FITTINGS

3. SOIL, WASTE, VENT & RAINWATER PIPES & FITTINGS

3.1 Scope of Work

3.1.1 Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the Schedule of Quantities.

3.1.2 Without restricting to the generally of the foregoing, the soil, waste, vent pipes system shall include the followings:-

1. Vertical and horizontal soil, waste and vent Pipes, and fittings, joints, clamps, connections to fixtures.
2. Connection of pipes to sewer lines as shown on the drawings at ground floor levels.
3. Basement drainage, channels, gratings and floor drains.
4. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads /Khurras.
5. Testing of all pipe lines.

3.2. General Requirements

3.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Project Manager.

3.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

3.2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

3.2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

3.2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance. Any access panel required in the Civil structure, false ceiling or marble cladding etc. shall be clearly reported to the Owner in the form of shop drawings so that other agencies are instructed to provide the same.

3.3 Piping System

3.3.1 Soil, Waste and Vent Pipes

- a) The soil and waste pipe system above ground has been planned as a "Two pipe system" having separate pipes for waste for kitchen sinks, wash basins, AHU's, condensate drains and floor drains and soil from the WCs and Urinals.
- b) All waste water from AHU's plant and pump rooms, floor channels in basements (if any) will be provided with a deep seal trap before connecting to the main drain or vertical stack.
- c) Vertical soil and waste stacks shall be connected to a separate horizontal drain / single horizontal drain at basement ceiling generally as shown on the drawings.

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- d) Toilet layouts have been so arranged that the W.C outlets shall be with “P” trap above ground level.
- e) All soil/waste from areas in basement areas will be collected in sumps and pumped into sewer lines or as specifically designed.
- f) Head (Starting point) of drains and sewage/waste water sumps (as and where applicable) having a length of greater than 4m upto connection to the main drain or manhole shall be provided with a 80/100mm vent pipe terminating above roof / a Maxi-Filtra with an ACF cartridge shall be provided close to the MH as directed by the Project Manager.

3.4 Rainwater Pipes

- a) All open terraces shall be drained by rain water down takes.
- b) Rainwater down takes are separate and independent of the soil and waste system and will discharge into the underground storm water drainage system of the complex.
- c) Rainwater in open courtyards shall be collected in catch basins and connected to the storm water drains.
- d) Any dry weather flow from waste appliances e.g. AHU's, Parking and Drainage Sumps shall connected to the Storm Water Network and Sewerage Sumps will be connected to the Sewerage System.

3.5 Balcony/Planter Drainage

Wherever required, all balconies, terraces, planters and other formal landscape areas will be drained by vertical down takes or other type of drainage system shown on the drawings and directed by the Project Manager.

3.6 Soil Waste and Vent Pipes and Fittings above Ground

3.6.1 Soil, waste, vent, anti-syphonage and rain water pipes shall be cast iron pipes.

3.6.2 All pipes shall be straight and smooth and inside free from irregular bore, blow holes cracks and other manufacturing defects. Pipes shall be centrifugally spun iron so pipes conforming to IS 3989-1979 and fittings shall be conform to IS 3989-1979.

3.6.3 Fittings

3.6.3.1 Fitting shall conform to the Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specifications.

3.6.3.2 Fittings shall be of the required degree of curvature with without access door.

3.6.3.3 Access door shall be up with 3MM thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal. The fixing shall be air and water tight.

3.6.4 Floor Traps & Urinal Traps

Floor traps shall be cast iron, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 Cement: 2 Coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor levels. Contractor shall provide all necessary shuttering and centering for the block. Size of the block shall be 30 x 30 cms of the required depth.

3.6.5 CLEANOUT PLUGS

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Contractor shall provide cast brass cleanout plugs as required. Cleanout plugs shall be thread and provided with key holes for openings. Cleanout plugs shall be fixed the pipes by a G.I. socket drip seal caulked. (Detail with sketch).

3.6.6 Jointing (CI Soil Pipes & Fittings)

Joints for cast iron soil, waste vent, anti syphonage and rainwater pipes shall be made with drip seal / pipe seal compound and sufficient skein of jute rope dipped in coal tar shall be caulked to leave a minimum space for the sealant compound.

3.6.7 Cleanout Plugs

Floor Clean Out Plug

Clean out plug for soil, waste or rain water pipes laid under floors shall be provided near pipe junctions bends, tees, "Yes" and on straight runs at such intervals as required as per site conditions. Clean out plugs shall terminate flush with the floor levels. They shall be cast brass suitable for the pipe dia. With screwed to a G.I socket. The socket shall be joined to the pipe with drip seal/pipe seal.

3.7 Waste Pipe from Appliances

3.7.1 Waste pipe from appliances e.g. washbasins, sinks, urinals shall be of galvanized steel in toilets, kitchens, pantries and service areas where so required, and as given in the Schedule of Quantities or as shown on the drawings.

3.7.2 All pipes shall be fixed in gradient towards the connection to stack or drains. Pipes inside all toilets room shall be in chase unless otherwise shown on drawings. Where so required and shown on drawings or directed by the Project Manager.

3.7.3 (a) Galvanized Pipes (Where specified or required at site for sump drainage only)

Pipes shall be galvanized steel tubes conforming to IS: 1239 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, Plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes in chase shall be painted with two coats of black bitumen paint and exposed pipes with one coat of red oxide primer and two or more coats of synthetic enamel paint or as given in the Schedule of Quantities. G.I. waste pipes buried in ground or sunken slab shall be protected with multi layer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. "Pykote" or equivalent.

3.7.3 (b) uPVC Pipes (Where specified or required at site for waste only)

Pipes shall be uPVC confirming to IS: 4985-2000 (quick fit type) and quality certificates shall be furnished as required. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, and Plugs. All waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

3.8 Drainage under floor/above floor (service floors, basement ceiling etc.)

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3.8.1 All drainage lines passing under building, in exposed position above ground e.g. service floors, basement ceiling etc. shall be Multilayered as per details given in sub-clause 3.10 above or shall be as per details given below. Position of such pipes shall generally be shown on the drawings.

3.8.1 (a) SOCKET PIPES

3-layered reinforced polypropylene (PP) sewage pipes, halogen and lead free, with integral push-fit socket and factory-fitted lip ring, tested and monitored according to the Product Standard EN 1852 – 1, having internal layer of PP in light grey color, intermediate layer of PP in grey/titanium-grey color, external layer of PP in copper brown color.

3.8.2 Fittings

3-layered reinforced polypropylene (PP) sewage pipes, halogen and lead free, with integral push-fit socket and factory-fitted lip ring, tested and monitored according to the Product Standard EN 1852 – 1. Fittings upto dimension DN/OD 200 are manufactured by injection molding (1-layer), above DN/OD 200 (250 and above)

the fittings are butt or extrusion welded by the manufacturer. Fabrication of fittings at site shall not be permitted.

3.8.4 Cleanout on Drainage Pipes (CO Plugs)

a) Cleanout plugs shall be provided on head of each drain and in between at locations indicated on plans or directed by. Cleanout plugs shall be of size matching the full bore of the pipe but not exceeding 150mm dia. CO plugs on drains of greater diameters shall be 150mm dia. Fixed with a suitable reducing adapter.

b) Floor cleanout plugs shall be cast brass as given in para 3.10.6 above.

c) PP plugs of material as in item 3.12 above provided at ceiling level pipe shall be fixed to a socketed end piece.

3.8.5 Pipe Joints

Field-proven push-fit connection with improved and modified lip ring of high ageing-resistant shall be provided with the pipes and fittings for easy push-fit installation, installation procedure as given in clause 3.10 above shall be followed.

3.9 Encasing in Cement Concrete

3.9.1 Encasing of pipes is required to provide stability to the line and prevent its damage during construction.

3.9.2 Soil and waste pipes under floor

Pipes laid in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 12mm size) 75mm in bed and all round. When pipes are running

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well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8m. All drainage pipes except when fixed above ground or in exposed locations shall be encased in cement concrete as specified above for soil and waste pipes. The bed and encasing thickness shall however be 150mm in bed and all round as shown on the drawing/specified in the BOQ.

3.10 Painting

3.10.1 Paints used shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe color code.

3.10.3 G.I waste pipes buried in ground or fixed in chase shall be protected with 2mm thick bitumen membrane tape with a final coat of hot or cold applied bitumen. Exposed waste pipes shall be painted with two or more coats of synthetic enamel paint.

3.11 Cutting and Making Good

3.11.1 Contractor shall provide all holes cut outs and chases in structural members necessary and required for the pipe work as building work proceeds. Wherever cut outs, holes are left in the original construction, they shall be made good with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20mm nominal size) or cement mortar 1:2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

3.12 Sleeves/Cutouts

3.12.1 Contractor shall utilize all cutout and sleeves provided during construction to prevent breaking. The annular space between the pipe and the sleeve shall be filled up with approved type of fire hydrant sealant. When sleeves are misplaced or inaccurately located contractor shall make the holes in the wall or structural members at his own cost but only with the prior permission of the Project Manager.

3.13 Testing

3.13.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including Multilayered PP pipes laid in basement ceiling.

3.13.2 Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests.

3.13.3 All materials obtained and used on site must have manufacturers hydraulic test certificate for each batch of materials used on the site.

3.14 Measurements

3.14.1 General

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- a) Rates quoted for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities
 - b) Rates are applicable for the work in basements, under the ground, floors, in shafts at ceiling level area for all depths and building upto 45m in height.
- 3.14.2 Rates are inclusive of cutting holes and chases in masonry work and making good the same.
- 3.14.3 Rates are inclusive of pre testing and on site testing of the installations, materials and commissioning of the works.
- 3.14.4 Pipes (unit of measurement. Linear meter to the nearest centimeter)
- 3.14.5 Soil, waste, vent, anti syphonage, rain water pipes, and drainage pipes shall be measured net when fixed correct to a centimeter including all fittings along its finished length.
- 3.14.6 G.I. pipes/uPVC shall be measured per running meter correct to a centimeter for the finished work, which shall include fittings e.g. Bends, Tees, Elbows, Reducers, Crosses, Sockets, Nipples and Nuts. The length shall be taken along center line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality and finish. The diameter shall be diameter of internal bore.
- 3.14.7 Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any Masonry Supports, Shuttering and Centering Cutting complete as described in the relevant specifications.
- 3.14.8 Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts and nuts embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.
- 3.14.9 Fittings (excluding pipe fittings) (Unit of measurement by numbers)
- Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.
- 3.14.10 **Painting**
- Painting of pipes and fittings shall be measured per running meter.
- 3.14.11 **Excavation for soil pipes:**
- No extra payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for pipes laid below ground, in sunken slabs or over basement rafts.
- 3.15 **Air Admittance Valves (AAV)**
- Air admittance valves shall be made in ABS/PVC capable of operating at temperatures between 0 degree c and 60 degree c. The AAV shall be of suitable for

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flow rate and installed in main discharge stacks and / or branches. Design based on air flow capacity required in proportion to the discharge unit capacities. The vendor is to supply data sheet showing relevant calculations and drawings indicating location and type of AAV as required.

AAV's to have following performance parameter:

- Temperature range: -20 degree Celsius to 60 degree Celsius.
- Open pressure: -70 pa (-0.010 psi)
- Max. Pressure rating tightness: 10,000 pa (1 m/40" h2o) at 0 pa or higher

3.16 Maxi Filtra:

Maxi Filtra shall be in black ABS to be installed at the outlet of the vent pipe discharging gases in the atmosphere. They are fitted with active carbon filters with iodine being 1050mg/g. The replaceable carbon filters must be changed regularly as per manufacturer's specifications.

SECTION IV

4. WATER SUPPLY SYSTEM

4.1 Scope of Work

4.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

4.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- a) Distribution system from main supply headers to all fixtures and appliances for cold/hot water.
- b) Cold water supply lines from tube-wells and city water connections to fire and underground water tanks.
- c) Municipal water and Bore-well connections to U.G. water tanks.
- d) Garden Irrigation system
- e) Excavation and refilling of pipes trenches.
- f) Pipe protection and painting.
- g) Control valves, masonry chambers and other appurtenances.
- h) Connections to all plumbing fixtures, tanks, appliances and Municipal mains
- i) Inserts for RCC tank.

4.2 General Requirements

4.2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

4.2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

4.2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections.

4.2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

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- 4.2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 4.2.6 Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.
- 4.2.7 All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.
- 4.2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- 4.3 **Water Supply System**
- 4.3.1 Contractor should study the site plan and water supply system diagram for an overview of the system.
- 4.3.2 Source
- Water supply will be acquired from Municipal Corporation water mains to a service connection and captive tube-wells within the site and collected in water storage tanks located in basement.
- 4.4 **G.I. Pipes, Fittings & Valves (In Plant rooms and for Equipments)**
- 4.4.1 All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes conforming to I.S. 1239 of medium/ heavy class as specified in the BOQ.
- 4.4.2 Fittings shall be malleable iron with a reinforcing ring over the threaded ends upto 50mm dia and without reinforcing rings for sizes 65mm dia and above. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include Couplings, Bends, Tees, Reducers, Nipples, Unions, and Bushes. Fittings shall conform to I.S:1879 (Part I to X).
- 4.4.3 Pipes and fittings shall be jointed with screwed joints. Care shall be taken to remove burr from the end of the pipe after reaming with a proper time.
- 4.4.4 Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply.
- 4.4.5 All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other as shown on drawings.
- 4.5 **Pipe Supports**
- 4.5.1 All pipes clamps, supports, hangers, rods, pipe supports, nuts and washers shall be factory made galvanized MS steel or alternatively galvanized after fabrication to suit site requirements.

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4.5.2 G.I pipes in shafts and other locations shall be supported by galvanized M.S clamps of design approved by pipes in wall chases shall be anchored by G.I hooks, pipes at ceiling level shall be supported on structural clamps fabricated from M.S structural steel. Pipes in typical shafts shall be supported on Galvanised slotted angles/channels as specified elsewhere.

4.6 Clamps

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by iron hooks, Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural steel as described above. Pipes in typical shafts shall be supported on slotted angles/channels as specified.

4.7 Anchor Fasteners

4.7.1 All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

4.8 Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

4.9 Flanges

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by connections shall be made by the correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S.780. and C.I. butterfly valve to IS: 3095.

4.10 CPVC and UPVC Pipes and Fittings:

Chlorinated Poly Vinyl Chloride (CPVC) compound shall meet cell class 23447 B as defined by ASTM D 1784 and have a design stress of 2000 psi and a maximum service temperature upto 93 degree Celsius. Pipes shall be as per SD 11, material as per ASTM 1784, specifications as per ASTM D2846 and cpvc jointing solvent shall be as per ASTM F493. SCHEDULE PIPES 40 and 80 shall be as per ASTM F441. (for Hot water and Cold water applications)

Clamping for cpvc pipe shall be as per manufacturer's recommendations only.

4.11 Trenches

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows

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<u>Dia of pipe</u>	<u>Width of Trench</u>	<u>Depth of Trench</u>
15mm to 50mm	30 cms	75cms
65mm to 100mm	45 cms	100 cms

4.12 Sand filling

Pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

4.13 Painting

All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard color code given in this document or specified by Project Manager.

4.14 Pipe protection

4.14.1 All GI pipes in wall chase and below floor in toilets (where so fixed) shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

4.14.1 G.I. water supply pipes, if buried in ground or sunken slab, shall be protected with multi layer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. "Pypkote" or equivalent.

4.15 Valves

4.15.1 Ball Valves

Valves upto 50 mm dia. shall be screwed type Ball Valves with stainless steel balls spindle teflon seating and gland packing tested to a hydraulic pressure of 20 kg/sq.cm., and accompanying couplings and steel handles.(to BIS 5351)

4.16 Butterfly Valves – Slim Seal Type

4.16.1 Valves 65 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

4.16.2 Butterfly valve shall be of best quality conforming to IS: 13095.

4.17 Non Return Valve (Dual Slim Type)

Where specified, non return valve shall be provided through which flow shall occur in one direction only.

Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of nuts, bolts and washers of correct length.

4.18 Storage tanks Underground & Overhead Tank. (Accessories & Connections)

4.18.1 Storage tanks for water supply shall be in reinforced cement concrete built by the building contractor.

4.18.2 Each tank shall be provided with a 560mm Dia Heavy Duty Cast Iron manhole frame and cover.

4.19 Storage Tanks

4.19.1 Underground

Underground storage tanks for water supply shall be reinforced cement concrete built by the building contractor.

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Each tank shall be provided with a 560mm Dia Heavy Duty Cast Iron manhole frame and cover or as approved by local municipal authority.

4.20 Outlets and overflow

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities, further connections and accessories shall be provided under this contract.

4.21 Testing

All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7 kg / sq.cm whichever is higher. Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes' or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves, which do not effectively operate, shall be replaced by new ones at no extra cost and the same shall be tested as above.

Hot water pipes chased into the walls shall be provided with a 6mm thick insulation with elastic flexible material having hermetic closed cell structure of expanded synthetic material rated for 60°C hot water supply.

4.22 Measurement

- a) Pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.
- b) Jointing with teflon tape, white lead, solvent, crimping and insertion gasket of appropriate temperature grade.
- c) Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.
- d) Excavation, backfilling, disposal of surplus earth and restoring the ground & floor in original condition.

4.23 Pipe Supports

Fabricated and / or galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structurals and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.

4.24 Rate quoted for supports & hangers shall be inclusive of :

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- a) Expandable anchor fastens.
- b) Galvanising of all supports & hangers.
- c) Cutting holes in walls, ceilings on floors and making good where permitted.
- d) Nuts, bolts and washers for fixing and assembling.
- e) Wooden / PVC pipe saddles for vertical or horizontal runs.

4.25 Valves

Gunmetal, cast iron, butterfly and non return valves and puddle flanges shall measured by numbers and shall include wheels I caps, GI nuts, bolts, washers, insertion gasket.

4.26 Painting/pipe protection/insulation

Painting/pipe protection /insulation for pipes shall be measured per linear meter over finished surface and shall include all valves and fittings for which no deduction shall be made. No extra payment shall be made for fittings, valves or flanges.

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SECTION V

DRAINAGE

5. DRAINAGE (Sewers & Storm Water Drains)

5.1 Scope of work

5.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

5.1.2 Without restricting to the generality of the foregoing, the drainage system shall include:-

5.1.2.1 Sewer lines including excavations, pipelines, manholes, drop connections and connections to the existing sewer.

5.1.2.2 Storm water drainage, excavation, pipelines, manholes, catch basins, drain channels and connections to the existing storm water drain.

5.2 General requirements

5.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Project Manager.

5.2.2 Drainage lines and open drains shall be laid to the required gradients and profiles.

5.2.3 All drainage work shall be done in accordance with the local municipal bye-laws.

5.2.4 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

5.2.5 Location of all manholes, etc. shall be got confirmed by the Contractor from the Architect / Landscape Architect. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager.

5.3 Excavation

5.3.1 Alignment and grade

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Project Manager. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Project Manager.

5.3.2 Excavation in tunnels

The excavation for sewer works shall be open cutting only, unless the permission of the Project Manager is obtained for laying pipes in tunnel where sewers have to be constructed along narrow passages or difficult ground.

5.3.3 Opening out trenches

In excavating the trenches, etc. the solid road metalling, pavement, kerbing, etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Project Manager.

The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Project Manager.

5.3.4 Obstruction of roads

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The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Project Manager.

5.3.5 Removal of filth

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and remove to a suitable place to be provided by the Contractor.

5.3.6 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating thereto and so that the inverts may be at the levels given in the sections.

5.3.7 Refilling

After the sewer or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15cms layers with materials taken from the excavation, each layer is being watered to assist in the consolidation unless the Project Manager.

5.3.8 Contractor to restore settlement and damages

The contractor shall, at his own costs and charges make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be reliable for any accidents caused thereby. He shall also at his own cost and expenses and charges, repair any make of any damage done to the buildings and other property.

5.3.9 Disposal of Surplus Earth

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

5.3.10 Timbering of sewer and trenches

- a) The contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose of sandy strata and below the surface of the sub soil water level.
- b) All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall be take place.

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- c) The contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

5.3.11 Shoring of Buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

5.3.12 Removal of water from sewer, trench etc

- a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.
- b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the Contractor at his own expenses.

5.3.13 Width of trench

5.3.14 Recommended width of trenches at the bottom shall be as follows:-

100 mm dia pipe	55 cms
150 mm dia pipe	55 cms
225-250 mm dia pipe	60 cms
300 mm dia pipe	75 cms

Maximum width of the bed concrete shall also be as above. No additional payment is admissible for widths greater than specified.

5.4 Salt glazed stoneware pipes (Where applicable)

5.4.1 Stoneware pipes shall be of first class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall have the manufacturers name marked on it and shall comply to I.S. 65.1

5.4.2 Laying and jointing of stoneware salt glazed pipes

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- Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at the site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.
- The pipes shall be laid with sockets leading uphill and rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.
- Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete at the Contractor's cost and charges.
- If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed to ensure even bearing.

5.4.3 Jointing of pipes

- Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.
- The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be mixed as needed for immediate use and no mortar shall be beaten up and used after it has begun to set.
- After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper of "badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all round the pipes for inspection by the inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

5.5 uPVC Pipes & Fittings.

- a) Upvc pipes shall be straight and smooth conforming to IS 4985-1983 of class as specified in Schedule of Quantities.
- b) Joints shall be done as per the manufacturer's recommendations. The pipes and fittings must have matching dimension for perfect joints in the system shall be with solvent cement as per manufacturers requirements.

5.6 Testing

- All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

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- Sewer lines shall be tested for straightness by: (i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end. (ii) means of a mirror at one and a lamp at the other end. If the pipeline is straight the full circle of light will be seen otherwise obstruction or deviation will be apparent.
- The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Project Manager.
A test register shall be maintained which shall be signed and dated by Contractor.

5.7 Gully traps

Gully traps shall be of the same quality as described for stoneware pipes in clause 5.4.1 above and used where shown on drawings.

Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40 mm nominal size) and a brick masonry chamber 30x30 cms inside plastered with cement mortar 1:5 with 15x 15 cms grating inside and 30x30 cms C.I. sealed cover and frame weighing not less than 7.3 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

5.8 Reinforced cement concrete pipes

- All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun S & S RCC pipes of specified class. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.
- **Laying**
R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Project Manager.
- **Jointing**
After setting out the pipes the socket shall be centered over the spigot and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 Cement: 2 fine sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 degrees to the longitudinal axis of the pipe on both sides of the collar neatly.
- **Testing**
All pipes shall be tested to a hydraulic test of 1.5 m head for at least 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above. The smoke test shall be carried out by the contractor, if directed by the Project Manager and a test register shall be maintained which shall be signed and dated by the Contractor/Project Manager.

5.9 Cement Concrete and masonry works (For Manholes and Chambers)

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5.9.1 Materials

a) **Water**

Water used for all the construction purposes shall be clear and free from Oil, Acid, Alkali, Organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered good enough for construction purpose.

b) **Aggregate for Concrete**

The aggregate for concrete shall be in accordance with I.S. 383 and I.S. 515 in general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Project Manager. The size of the coarse aggregate shall be done as per I.S.383.

c) **Sand**

Sand for various constructional purposes shall comply in all respects with I.S 650 and I.S. 2116. It shall be clean, coarse hard and strong, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities which may be considered by the Project Manager.

d) **Cement**

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to I.S. 269.

e) **Mild Steel Reinforcement**

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of I.S. 432 (Grade I).

f) **Bricks**

Bricks shall have uniform color, thoroughly burnt but not over burnt, shall have plan rectangular faces with parallel sides and sharp right angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the Project Manager.

g) **Other Materials**

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the Project Manager before use.

5.9.2 Cement concrete (plain or reinforced)

- a) Cement concrete pipes bedding, cradles, foundations and R.C.C. slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

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- b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.
- c) All concrete work shall be cured for a period or at least 7 days. Such work shall be kept moist by means of gunny bags at all times. All pipes trenches and foundations shall be kept dry during the curing period.

5.9.3 Masonry

Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed from 1st class bricks or 2nd class as specified in the Schedule of quantities in cement mortar 1:5 mix (1 cement: 5 coarse sand). All joints shall be properly raked to receive plaster.

5.9.4 Cement concrete for pipe support

Wherever specified or shown on the drawing, all pipes shall be supported in bed all round or haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Width of the bedding shall be as per para 5.3.1.4.

Unless otherwise directed by the Project Engineer, cement concrete for bed, all-round or in haunches shall be laid as follows: -

	upto 1.5 m depth	upto 3 m depth	beyond 3 m depth
Stoneware pipes	All round	Haunches	All round
In open ground (no sub soil water)	(1:4:8)	(1:4:8)	(1:4:8)
R.C.C or SW (In sub soil water)	All round (1:3:6)	Haunches (13:6)	Haunches (1:3:6)
C.I Pipes (In all conditions)	All round (1:3:6)	Haunches (13:6)	Haunches (1:3:6)
R.C.C Pipes Or C.I Pipes	All round (1:3:6)	All round (13:6)	All round (1:3:6)
Under or building			
(Ratio refer to cement: coarse sand: stone aggregate 40 mm nominal size)			

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R.C.C pipes or C.I. pipes may be supported on brick masonry or precast R.C.C or in situ cradles. Cradles shall be shown on the drawings. Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

5.10 Manholes and chambers

5.10.1 All manholes, chambers and other such works as specified shall be constructed on brick masonry in cement mortar 1:5(1 cement: 5 coarse sand) as specified in the Schedule of Quantities.

All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as given in the Schedule or Quantities or shown in the drawings.

Where not specified, manholes shall be constructed as follows:- (all dimensions internal clear in cms)

Size of manhole type	90x80 Rect.	120x90 Rect.	91 dia Conical	122 dia Conical
Maximum depth	120	240	167	168
Average thickness				
Of R.C.C slab	15	15	-	-
Size of cover and frame cms	60x45	50 dia	50 dia	50 dia
Weight of Cover and frame	38 kg	116 or 208 kg	116 or 208 kg	116 or 208 kg

5.10.2 All manholes shall be provided with cement concrete benching in 1:2:4 mix. The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement. (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nom. Size) as per standard details.

5.10.3 All manholes shall be plastered with 12mm thick cement mortar 1: 3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster mixed with water proofing compound.

5.10.4 All manholes with depths greater than 1 m. shall be provided with 20 mm square or 25 mm round rods plastic coated catch rings set in cement concrete blocks 25x10x10 cms in 1:2:4 mix 30 cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.

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5.10.5 All manholes shall be provided with cast iron/steel fiber reinforced plastic (SFRC) covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or given above.

5.10.6 Road gullies, ramp drains, gratings in basement shall be cast iron with M.S. frame or Steel Fiber Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities.

5.11 Making connections

5.11.1 Contractor shall connect the sewer line of the building to the main manhole by providing making holes and channels etc.

5.12 Measurement

5.12.1 Excavation

5.12.1.1 Measurement for excavation of pipe trenches shall be made per linear meter under the respective category of soil classification encountered at site and specified in the tender.

- A) Ordinary soil
- B) Hard soil (hard moorum & soft rock)
- C) Hard rock requiring chiseling
- D) Hard rock requiring blasting

5.12.1.2 Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth up to 1.5 m or as given in the Schedule of Quantities.

5.12.1.3 Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the schedule of quantities and above the rate for depth up to 1.5 m.

5.12.1.4 Timbering and Shoring Timbering and shoring as described above shall be measured per sq m and paid for as per the type of timbering of shoring done at site and as per the relevant item in the Schedule of Quantities. Rate for timbering and shoring shall be for all depths and types of soil classifications including saturated soil.

5.12.1.5 Saturated Soil

No extra payment for pumping and bailing out water shall be made for excavation with an average depth of 1.5 m in saturated soil, surface water from rain falls or broken pipes lines, or sieves and other similar sources. An extra rate as quoted in the schedule of quantities shall be paid for excavation in saturated soil for pipe trenches above average depth of 1.5 m. No payment is admissible for water collected from surface sources and broken pipelines or sewers.

5.12.1.6 Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation of trenches shall be inclusive of refilling, consolidation and disposal of surplus earth within a lead of 200 m.

5.12.2 Stoneware Pipes/RCC/C.I. pipes

Stoneware/R.C.C./C.I. pipes shall be measured for the finished length of the pipeline per linear meter i.e.

- (a) Lengths between manholes shall be recorded from inside of one manhole to inside of other manhole

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- (b) Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole. Rate shall include all items given in the schedule of quantities and specifications.

5.12.3 Gully Traps

Gully traps shall be measured by the number and rate shall include all excavation, foundation, concrete brick masonry, cement plaster inside and outside, C.I. grating and sealed cover and frame.

5.12.4 Cement Concrete for Pipes

Cement concrete in bed and all-round or in haunches shall be paid per running meter between the outside walls of manholes at bottom of the trench. No additional payment is admissible in respect of concreting done for widths greater than specified, for shuttering or centering and concreting in sub soil water conditions.

5.12.5 Manholes, Catch basins & Ramp drains

- a) All manholes and catch basins shall be measured by numbers and shall include all items specified above and necessary excavation, refilling & disposal of surplus earth.
- b) Manholes with depths greater than specified under the main item shall be paid for under "extra depth" and shall include all items as given for manholes. Measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.
- a) Ramp drains shall be measured per meter length.

5.12.6 Making Connections

Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Schedule of Quantities and specifications.

SECTION VI

GARDEN IRRIGATION

6.0 Garden Irrigation System

6.1 Scope of Work

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to install garden hydrants and sprinklers and drip

Irrigation water supplies system as required by the drawings, specified hereinafter and as given in the Schedule of Quantities (BOQ).

6.1.1 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- a) Connections from the water supply system to all hydrants, sprinklers and drip irrigation points.
- b) Garden hydrants, surface sprinklers & pipe emitters.
- c) Excavation and refilling of pipes trenches.
- d) Control valves, masonry chambers and other appurtenances.
- e) Connections to all pumps & appliances.

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6.2 The System

6.2.1 The garden hydrant and sprinkler irrigation system will be new and fully working system in the complex.

6.4.1 System components shall be pipes, valves, controllers, various types of sprinklers and drip irrigation lines with emitters as approved by the Project Manager.

6.5 General requirements

6.3.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

6.5.1 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

6.5.2 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

6.5.3 Pipes shall be laid in a manner as to provide as far as possible easy accessibility for repair and maintenance. Pipes under roads shall be laid in RCC pipe sleeves.

6.5.4 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

6.6 HDPE Pipes and Fittings.

6.6.1 Garden hydrant mains shall be HDPE pipes conforming to IS: 4984 of class specified. If class is not mentioned in the schedule of quantities the same shall be Material Grade PF100, unless other materials like uPVC schedule 40 or uPVC as per IS 4985 in accordance to specifications given above are specified in the BOQ.

6.6.2 Fittings for HDPE pipes shall be injection molded fitting suitable for thermal weld joints. Fittings must have suitable provision for expansion and shall be rated for the same working pressure as the pipeline, unless other materials like uPVC schedule 40 or uPVC as per IS 4985 in accordance to specifications given above are specified in the BOQ.

6.6.3 Thermal Joints shall be made in an approved manner as recommended by the manufacturer.

6.6.4 Provide flanges at intervals of 20-25 m. for all pipes 65 mm dia and above.

6.6.5 Provide suitable adapters for connection between pipes & valves.

6.6.6 Provide cement concrete supports and anchor blocks at all bends, tees and other locations as directed by the Project Manager. Connections at garden hydrant outlet, near valves must also be anchored.

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6.6.7 Drip Irrigation Pipes

Pipes shall be LLDPE pipes of UC 7510 resin conforming to ASAE S-435 standard.

6.6.8 G.I. Pipes & Fittings

Vertical connection for garden hydrant points shall be galvanised steel tubes to IS12:1239 (medium class) with matching malleable iron fitting of approved make.

6.6.9 Sprinklers

Pop-up Sprinklers Pop-up sprinklers shall be underground with rugged plastic high impact case with precision jet spray guide arm control with brass head, Sprinklers shall be suitable for pressure and coverage given in the schedule of quantities.

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SECTION VII

PUMPING AND WATER TREATMENT PLANT SYSTEM

7.0 SCOPE OF WORK

- a) Work under this section shall consist of furnishing all labour, materials equipment and appliances necessary and required to completely install all works described hereinafter and shown on the drawings.
- b) Without restricting to the generality of the foregoing the system shall include the following:
 - a. Raw water, Treated water, Soft water and drainage pumps.
 - b. Water filtration plant with pressure filter and chlorination plant.
 - c. Water Softening plant.

7.1 GENERAL REQUIREMENT

- 7.1.1 All materials shall be new as per approved makes complying with the appropriate Indian Standards.

All equipment other than specified in approved makes shall be of the best available make manufactured by reputed firms to the entire satisfaction of Resident Engineer.

- 7.1.2 The sample of the items shall be provided on the request of engineer-in-charge.
- 7.1.3 All equipment shall be so installed on suitable existing foundations, true to level and in a neat work- man like manner.
- 7.1.4 Equipment shall be installed so as to provide sufficient clearance between the end walls & between equipment to equipment.
- 7.1.5 Shop drawings for equipment layout with associated piping, control panels and wiring of equipment showing the route of conduit / cable from equipment to control panel shall be submitted by the Contractor for approval to engineer-in-charge before starting the fabrication of panel and starting the work. On completion of the works, four sets of "As-installed" drawings incorporating all details like equipment layout, piping routes, location of panels etc. shall be furnished by the contractor.

7.2 WATER SUPPLY PUMPS

7.2.1 HYDROPNEUMATIC SYSTEM – Fresh Water Supply

- 7.2.1.1 Hydro pneumatic system pumps shall be multistage stage, vertical stainless steel pumps, having stainless steel casing, stainless steel pump foot and diffusers, stainless impeller, stainless steel shaft, ceramic bearings, tungsten carbide shaft protection bushes and hydro pneumatic pump make to mechanical seal driven by 6.0 kw, 2900 RPM, 220 Volts, 50 Cycles, AC 3 –phase TEFC vertical flange motor. Each pump shall be capable of operating within a performance pressure characteristics range sufficient below and above the required working pressure.
- 7.1.1.2 200 lits diaphragm tank fabricated from prime quality steel for long life the tanks are long lasting epoxy paint treatment for greater protection against atmospheric elements.
- 7.1.1.3 Pumps and motors shall be mounts on a common MS structural base plate.
- 7.1.1.4 Each pump shall be provides with a totally enclosed fan cooled induction motor of H.P and R.P.M specified in schedule of quantities.

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- 7.1.1.5 Each pumping set shall be provides with a Gun Metal “Bourden” type pressure gauge with gunmetal isolation cock and connecting piping and also with pressure switch for its operation controlling.
- 7.1.1.6 Appropriate vibration eliminating pads shall be provides with each pump.
- 7.1.1.7 The pump set shall be provided with gun metal gate valve of appropriate sizes on delivery. a non-return valve of appropriate size and a pressure gauge with cock shall be provided on the delivery line.
- 7.1.1.8 Suction and delivery lines of the pumps shall be provided with double flanged reinforced Neoprene flexible pipe connectors. Connectors shall be suitable for a working pressure of each pump as specified in Schedule of Quantities.

- 7.1.1.9 Mega Control Device with one number variable frequency drive.

7.3 WATER TREATMENT PLANT FEED PUMPS

- 7.3.1 Treatment plant feed pumps shall be single stage, vertical stainless steel pumps, having stainless steel casing, stainless steel pump foot and diffusers, stainless impeller, stainless steel shaft, ceramic bearings, tungsten carbide shaft protection bushes and mechanical seal driven by 1.5 kw (Approx), 2900 RPM, 220 Volts, 50 Cycles, AC 3 –phase TEFC vertical flange motor. Each pump shall be capable of operating within a performance pressure characteristics range sufficient below and above the required working pressure.
- 7.3.2 Pumps and motors shall be mounts on a common MS structural base plate.
- 7.3.3 Each pump shall be provides with a totally enclosed fan cooled induction motor of H.P and R.P.M specified in schedule of quantities.
- 7.3.4 Each pump shall be provides with a Gun Metal “Bourden” type pressure gauge with gunmetal isolation cock and connecting piping.
- 7.3.5 Appropriate vibration eliminating pads shall be provides with each pump.
- 7.3.6 The pump set shall be provided with gun metal gate valve of appropriate sizes on delivery. a non-return valve of appropriate size and a pressure gauge with cock shall be provided on the delivery line along with suitable size of Y- strainer at suction side.
- 7.3.7 Suction and delivery lines of the pumps shall be provided with double flanged reinforced Neoprene flexible pipe connectors. Connectors shall be suitable for a working pressure of each pump as specified in Schedule of Quantities.

7.4 SUMP PUMPS

- 7.4.1 Pumps shall be submersible type as indicated in data sheet.
- 7.4.2 Pump shall be integral with submersible motor on a common shaft. The pumps shall have 2900 rpm synchronous speed unless stated otherwise in the data sheets.
- 7.4.3 The pump set shall be installed in vertical position in sumps with level controller cum operated float switches.

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7.4.4 Pump casings shall be aluminum and impellers of SS. All pumps shall have combination ball and roller bearings and shaft seals should be mechanical. Motor shall be submersible and shall be rated for minimum hp specified or the BHP absorbed in the operating range of the pump.

7.5 DOSING PUMP

Dosing Pump shall be provided for the working pressure of System where the solution is to be dosed.

Metering Pump shall be provided for operation on 220 V, 50 Hz., AC Power Supply.

Piping from the Main Water Supply Line to the doser shall be PVC flexible pipe branded.

All parts of the metering/dosing pump coming in contact with solution shall be of stainless steel of grade SS-304.

7.6 LEVEL CONTROLLER

Contractor shall provide and install low voltage transistorised level controllers as specified in Schedule of Quantities. Each level controller shall be provided with required number of PVC sheathed stainless steel probes with necessary wiring and conducting.

7.6.1 FOR FILTER FEED PUMPS

To cut off water treatment plant feed pumps on low water level in raw water tanks and high water level in ground floor treated water tank. To start pumps on low water level in treated water tanks.

7.6.2 FOR SOFTENER FEED PUMPS

To cut off water treatment plant feed pumps on low water level in Treated water tanks and high water level in ground floor Soft water tank. To start pumps on low water level in soft water tanks.

7.6.3 TREATED WATER TRANSFER PUMPS

To cut off treated water transfer pumps on low water level in treated water tank and high water level in overhead treated water tank and start sump on low water level in overhead treated water tank.

7.6.4 IRRIGATION WATER TRANSFER PUMPS

To cut off soft water transfer pumps on low water level in soft water tank and high water level in overhead soft water tank and start sump on low water level in overhead soft water tank.

7.6.5 FOR HYDROPNEUMATIC SYSTEM

To cut off hydro-pneumatic system pumps on low water level in ground level treated water tanks. To start pumps on opening of any taps.

7.7 WATER FILTRATION & SOFTENING PLANT

The water treatment equipment shall be based on the raw water criteria as mentioned.

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S.No.	Parameters	Raw Water (Inlet) Properties of water	Unit	Desirable Limits Drinking Water as per IS 10500	Extended Limits Drinking Water as per IS 10500
1	Colour	< 1	Max	5	
2	Turbidity	0.2	NTU	5	
3	PH Value	7.6	Range	6.5 – 8.5	
4	Total Dissolved Solid	800	Mg/l		2000
5	Chlorides (as Cl)	180	Mg/l	250	1000
6	Sulphate as SO ₄	190	Mg/l		400
7	Fluorides(as F)	0.2	Mg/l	1	1
8	Magnesium as Mg	3.1	Mg/l		
9	Total Hardness, CaCO ₃	267	Mg/l		

7.7.1 WATER FILTERS

Water filters shall be sand / gravel pressure filters downward or upward flow type suitable for a rate of filtration given in schedule of quantities.

Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure given in schedule of quantities. The minimum thickness of shall will be 8 mm and dished ends shall be 10 mm. The filter shall have at least one pressure tight manhole cover. Each filter shall be provide with screwed or flanged connections for inlet, outlet individual drain connections and all other connections necessary and required. Filter shall be painted inside with two or more coats of non- toxic corrosion resistant paint and one coat of red oxide primer outside.

UNDER DRAIN SYSTEM: Each filter shall be provides with an efficient under drain system comprising of collecting pipes, gunmetal / poly pr=opylene nozzles of manufacturer's design. The entire under drain system shall be provides on M.S. plate cement concrete supports.

FACE PIPING: Each filter shall be provides with interconnecting face piping comprising of inlet, outlet, and backwash complete with valves. Piping shall be cast iron double flanged to I.S.1536-1967 and C.I. Double flanged fittings to I.S. 1537-1967. Sluice valves 65 mm dia. and above shall be cast iron Double flanged sluice valves to I.S. 780. Valves 50 mm and below shall be screwed type gunmetal full way gate valves. Water softener must be of multiport valve.

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ACCESSORIES: Each filter shall be provided with following accessories:

Air release valve with connecting piping.

100 mm diameter dial Bourden type gunmetal pressure gauges with gunmetal isolation cock and connecting pipes.

Sampling cocks on raw water inlet and filtered water outlet.

Individual drain connection with gunmetal full way valve.

Connection with valve for air scouring.

Flow meter or water meter (if required).

FILTER MEDIA

Each filter shall be provided with clean and washed filter media. Following is recommended :

Pebbles	13.6mm size	(100mm deep)
Gravel	6-2.5mm size	(100mm deep)
Coarse sand	2.5-.25mm size	(100 mm deep)
Fine sand	1.25-.08mm size	(650-750mm deep)
Activated		600mm

The above filter media arrangement may be altered to suit contractor's own design for the most efficient performance.

7.7.2 CHEMICAL DOSER (Alum Doser, chlorinator)

Chemical doser shall be displacement type complete with rubber bag in vessel duly painted of 50 liters capacity or as mentioned in the schedule of quantities.

Doser shall be suitable for working pressure mentioned in the schedule quantities.

Each doser shall be provided with orifice plate assembly injection and corrosion proof piping. Piping from the main water supply line to the doser shall be G. I. pipes to IS : 1239 (heavy class).

7.7.3 WATER SOFTNER

Softener vessel shall be designed in accordance with the code of unfired pressure vessel conforming to BIS.

Softeners shall be designed to give 'Soft Water' of quality of Commercial Zero i.e. hardness less than 5 ppm for soft water tanks and less than 150 ppm for treated water tank. Softener shall provide with suitable grade of CATION exchange resin in quantity to be considered by the Contractor at the time of quoting.

Softener shall be fabricated out of mild steel and suitable for self-supporting arrangement.

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Softener shall have a set of face piping for inlet, outlet brine injection with all valves. Suitable drain shall be provided (with multiport valve preferably).

One set of hydraulic injector with control valve and brine delivery pipes.

One cylindrical PVC/HDPE brine saturator and mixing tank, provided with brine delivery piping with adjustable level indicating clamp and control valves complete. The tank shall be of capacity as given in the schedule of quantities.

The first charge of resin, chemicals, media & consumables shall be included in the cost of water softening plant.

7.8 INSTALLATION AND TESTING

All pumps, water treatment equipments, R.O. plants and solar heater shall be laid out generally in accordance with the shop drawings (submitted by contractor and approved by engineer-in-charge / consultant / architect) achieving economy of space and piping.

All pumps, water treatment equipments, R.O. plants and solar heater shall be tested for the rated performance in the presence of the employer's representative and got approved.

7.9 Mode of measurement

Pumps for water supply with valves on suction & delivery side, non-return valve on delivery, pressure gauge on delivery, set of high/low control including wiring, foundation bolts, nuts etc. shall be measured as one unit and paid.

Sump pumps with motor, water proof cable, gun metal valve, and non return valve in delivery all installed in position will be measured as one unit and paid.

Level controllers shall be measured by numbers.

Water filter, Softener, Chemical dosers shall be measured by number and shall include all items given in schedule of quantities.

7.10 CATALOGUES & MANUAL

The Contractor shall furnish the operation & maintenance manual/ technical literatures in duplicate to engineer-in-charge.

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SECTION VIII

FIRE HYDRANT SYSTEM

1.0 Scope of work

- 1.1 The scope of work shall cover supply, fabrication, installation, testing and commissioning of the fire hydrant system covering the following but not limited to:
 - 1.1.1 Fire Hydrant pumps, electric and diesel driven as shown in the equipment schedule, drawings and as required.
 - 1.1.2 Jockey pump, electric driven as shown in the equipment schedule, drawings and as required.
 - 1.1.3 Engine Control Panel.
 - 1.1.4 Hydrant mains, external ring and yard hydrants.
 - 1.1.5 Wet risers in the building as specified and shown on drawings.
 - 1.1.6 Landing valves, hose reels, hose cabinets etc.
 - 1.1.7 Fire brigade breaching, siamese connections and connections to pumps and appliances.
 - 1.1.8 The contractor shall get the Fire Fighting System approved by the Chief Fire Officer of Delhi Fire Service.

2.0 Standards

- 2.1 The fire hydrant installation shall conform to and meet with the requirements set out by the following:
 - 2.1.1 As relevant IS Code of practice for the safety of buildings (General) firefighting equipment and its maintenance.
 - 2.1.2 As relevant IS Code of practice for installation of internal fire hydrant in multi-storied building.
 - 2.1.3 Compliance with the local fire brigade and the fire enforcing authorities as specifically laid down by them.

3.0 Fire pump

- 3.1 The fire pump shall be single stage / double stage suction centrifugal type with split casing type and direct driven by electric motor or diesel engine as specified. The pump rating and performance shall conform to the equipment schedule and meet the TAC duty requirements.
- 3.2 Pump casing shall be of close grained cast iron with bronze impeller. The shaft sleeve shall be brass or SS 304 and the trim shall be brass or bronze.
- 3.3 Pump shall be capable of delivering 150% of the rated capacity at 65% of the rated head and the no-delivery head shall be not more than 140% (150% in case of end suction type) of the rated delivery head. The pump casing shall withstand 1.5 times the no-delivery pressure or 2 times of the duty pressure whichever is higher.
- 3.4 The pump shall be either electrically driven or diesel driven with direct flexible coupling.
- 3.5 The electric drive motor shall be squirrel cage induction conforming to IS 325 - 1978 and rated for continuous duty (S1). Motor shall have not less than class F insulation and minimum enclosure of IP22. The starter shall be air cooled fully automatic star delta or auto transformer type. Starters shall conform to IS 8544 and rated for AC-3 duty conditions.
- 3.6 Drive rating shall be based on the largest of the following:
 - a) Rated pump discharge at rated head
 - b) 150% of rated discharge @ 65% of rated head

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- c) Maximum power absorbed by the pump in its operating range i.e. no-delivery to free discharge.
- 3.7 The diesel engine shall be naturally aspirated (non-turbocharged) and electrically started. The engine shall be complete with starting batteries full-wave selenium rectifier charger, isolator, leads, mounting frame etc. Engine rating shall be same as for the electric motor. The detailed specifications of the engine are at Clause no 6.0.

4.0 Accessories

- 4.1 The Fire Pumps shall be complete with the following accessories:
 - a) Suction and discharge eccentric reducers
 - b) Pump coupling guard
 - c) Common base frame, fabricated mild steel or cast iron.
- 4.2 Each pump shall have independent set of pressure switches. The pressure switch shall be snap action SP DT switch rated 10A @ 220 V operated through a stainless steel diaphragm. The switch shall have a pointer for manual adjustment of set point, and all electrical connections shall be terminated in a screwed terminal connector. The entire unit shall be encased in a cold drawn steel (heavy gauge) enclosure. The diaphragm shall be designed for a maximum operating pressure of the system. Each pressure switch shall be provided with a pressure gauge in parallel as shown on the drawings and all gauges and pressure switches shall be mounted in an instrument panel with necessary control piping and drainage facility.

5.0 System operation and control panels

- 5.1 The fire pump shall be started automatically on loss of pressure and the operation sequence of the booster and fire pumps shall be as follows:
 - 5.1.1 Jockey Pump shall start when the system pressure drops by 0.35 kg/cm² and stop when the system pressure is re-established.
 - 5.1.2 The Fire Pump shall start when the system pressure drops by 1.0 kg/cm² and shall continue to run till manually switched off.
 - 5.1.3 Jockey and fire pump starting shall be indicated on the panel with a red indication lamp.
- 5.2 The motor starters (direct on line or star-delta) shall consist of electrically actuated contactors. The starter shall be complete with ON-OFF push buttons, timers and auxiliary contacts and shall be fully automatic. There shall be an indicating lamp with each of the pumps and an ammeter and selector switch with the fire pumps. Fire pump starting shall be annunciated through an electric siren.
- 5.3 The starter along with isolator shall be housed in a 14 SWG MS box duly rust inhibited through a process of degreasing and phosphating.
- 5.4 All cabling to and from the pumps to starter and control switch shall be carried out through armoured PVC cables of approved makes. Cables shall be laid in accordance with section "M V CABLING". The pump motors and panels shall be double earthed in accordance with IS 3043-1966 or as shown on drawings and as approved.

6.0 Fire hydrants and hose reels

- 6.1 Hydrants shall be provided internally and externally as shown on the drawings. Internal hydrants shall be provided at each landing of and escape staircase and additionally depending on the floor area as shown on drawings. Landing valve shall be single headed gunmetal valve with 63 mm dia outlets and 80mm inlet conforming to IS 5290-1969. Landing valve shall have flanged inlet and instantaneous type outlets and mounted at 1.0m above the floor level. Instantaneous outlets for the hydrants shall be of standard pattern approved and

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- suitable for 63mm dia fire brigade hoses. Wherever necessary, pressure reducing orifices plate and shall be provided so as to limit the pressure to 3.5 kg/sqcm or any other rating as required by the Local Fire Authority.
- 6.2 Each landing valve shall have a hose reel cabinet as shown on drawings.
- a) Landing valve with single 63 mm dia outlet and 80 mm dia inlet.
 - b) First-aid hose reel with 30 m long 25 mm dia high pressure double braided rubber hose (IS:444 marked) with 25 m dia Ball Valve.
 - c) 2 Nos. 15.0 Meter long 63 mm dia Reinforced Rubber Lined (RRL) hoses with gun metal I.S. marked instantaneous couplings.
 - d) One gun metal branch pipe.
- 6.3 The First Aid Hose shall conform to IS 884-1969 and be wound on a heavy duty circular hose reel with a bracket. The hose shall be permanently connected on one end to the Wet Riser through a 25m Ball Valve with necessary hose adapter and a gun metal nozzle at the other end.
- 6.4 Hoses shall be in two lengths of 15.0 m each, of RRL type with instantaneous couplings, neatly rolled into bundles and held in position with steel brackets. Hoses shall be tested and certified by the manufacturer, to withstand an internal water pressure of not less than 35 kg/sqcm without bursting. The hose shall also withstand a working pressure of 7 kg/sqcm without leakage.
- 6.5 The hose cabinet shall be fabricated from 2mm mild steel sheet duly rust inhibited through a process of degreasing and phosphating. The cabinet shall have double flap hinged doors with 4mm clear glass and shall have necessary openings for riser main and brackets for all internals. The cabinet shall receive two coats of red oxide primer both inside and outside before two after coats of final paint of approved colour shade.
- 6.6 External hydrants shall be as per IS:5490 with hand wheel control and a 80 mm dia pipe stand post. Hydrants shall be located at least 2m away from and within 15m from the building wall.
- 6.7 Each hydrant shall be provided with a hose cabinet containing 2x15m 63 dia RRL hoses with couplings. The cabinet shall contain a branch pipe and nozzle. The cabinet shall be 900 x 600 x 400 fabricated out of 2 m mild steel sheet duly rust inhibited through a process of degreasing, phosphating etc. The cabinet shall receive two coats of red oxide primer, inside and outside, before 2 coats of final painting of approved shade. The cabinet shall be wall-mounted or free standing with its own steel legs depending on the site conditions and as shown on drawings and as approved.
- 6.8 The fire brigade connection shall consist of two / three/four headed as specified in BOQ 63mm dia gun metal outlets with built-in check valve and drain plugs connected to a 150mm dia outlet connection to the water reservoir or to the hydrant main. The fire brigade collecting head shall conform to IS 904-1965.

7.0 Test & commissioning

- 7.1 The fire pump starting and stopping shall be tested by opening the test valve and record the following and the valves should be as furnished below:

System pressure at start-up	:	2.0 kg/sqcm
System pressure at stop	:	3.5 kg/sqcm
Time elapsed from start to stop	:	2 Seconds

8.0 Mode of measurement

- 8.1 Hydrant pump with mounting frame, excluding concrete foundation shall be measured per unit.
- 8.2 Jockey pump same as hydrant pump.
- 8.3 Instrument panel with pressure gauges, pressure switches, control piping etc. shall be measured as one unit.

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- 8.4 Control cabling from pressure gauge panel to the respective starters shall be measured in running meter and paid at unit rates.

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SECTION – IX

PIPING FOR FIRE FIGHTING SYSTEM

1.0 Scope

- 1.1 The scope of work covers, supply, fabrication, laying, testing, painting and commissioning of the entire piping system for the fire fighting installation i.e. fire hydrant and sprinkler systems.

2.0 Piping

2.1 External

- 2.1.1 All External pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 using wrought GI steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwed type. Flanges shall be rated for 2.0 N/sqmm.
- 2.1.2 Black mild steel pipes, when laid underground, shall be protected against corrosion by two coats of hot bitumen and 2mm thick wrapping of pykote. Fittings shall be weld able wrought iron, suitable for butt welding and 10% of the welded joints shall be radio graphically tested and found in order. The welded joints shall be random selected for testing in consultation with the Engineer-in-charge. All flanges shall be slip-on welded type to IS 6392 with a 3mm fibre-reinforced teflon gasket and rated for 2.0 N/sq. mm.
- 2.1.3 Underground mains shall be laid not less than 750 mm below the ground level and shall be at least 2m away from the building face and supported on concrete pedestals at every 3.5m and held on with galvanised iron clamps. Concrete thrust anchors shall be provided at all bends and tees as shown on drawing and as directed. All excavation for pipe laying shall be carried out with sufficient width for making proper joints. Backfilling shall be done only after the piping is hydro-statically pressure tested. Piping shall be constantly kept clean till tested.
- 2.1.4 All valves shall be housed in brick masonry chambers over 150mm cement concrete (1:3:6) foundation. The brick walls of the chamber shall be plastered inside and outside with 20mm cement sand plaster 1:4 with a floating coat of neat cement. Chambers shall be 650 x 650 mm clear for depths upto 1200 mm and 1000 x 1000 mm for depths beyond. Each chamber shall have a cast iron surface box approved by the Engineer in-charge.
- 2.1.5 Piping laid above ground shall be supported on cement concrete (1:2:4) pedestals raising the bottom of the pipe at least 150mm over the ground level and held to the pedestals with galvanised clamps. Pedestals shall be made at 3.0m centre to centre and as shown on drawings. Cement concrete 1:2:4 thrust anchors shall be provided at all tee-off points and change of direction as shown on drawings and as required. Pipes laid on walls and ceiling shall have galvanised steel brackets.

2.2 Internal

- 2.2.1 All internal pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 using wrought steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwed type. Flanges shall be rated for 2.0 N/sqmm.
- 2.2.2 Valves shall be suitable for external piping.
- 2.2.3 All pipes shall be of approved make and best quality without rust marks. Pipes and fittings shall be fixed in a manner as to provide easy accessibility for repair, maintenance and shall not cause obstruction in shafts, passages etc. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanship manner. Pipes shall be securely fixed to walls and ceilings by suitable supports at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceiling and walls.
- 2.2.4 All pipes shall be adequately supported from ceiling or walls through structural supports fabricated from mild steel structural e.g. rods, channels, angels and flats generally as shown on drawings. Fasteners shall be shear type anchor fasteners in concrete walls and ceilings and wrought steel spikes of at least 75mm long in brick walls. All pipes supports shall be painted with 1 coats of red oxide primer and two coats of black enamel paint.

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- 2.2.5 All low point loops in the piping shall be provided with 25mm Ball Valves with rising spindle for draining the system. All valves shall have screwed brass caps. Likewise 25mm gun metal air vents shall be provided at all high point loops to prevent air-locking.
- 2.2.6 All piping shall have flanged joints at about 25m intervals to facilitate easy maintenance.

3.0 Pipe Jointing

- 3.1 All pipes shall be provided with threaded joints up to 50mm diameter and welded joints for pipe above 50mm diameters. Hold tite shall be used for sealing.
- 3.2 All welded joints shall be tested by radiography test.
- 3.3 Joints between CI and GI pipes shall be made by providing a suitable flanged tail or socket piece and MS flange on the GI pipe. Flanges shall have appropriate number of holes and shall be fastened with nuts, bolts and 1.5mm thick compressed asbestos gasket.

4.0 Valves and other accessories

4.1 Gate Valves

- 4.1.1 Sluice / Gate valves shall be used for isolation of flow in pipe lines For sizes upto 65 mm, gate valves shall be outside screw rising spindle type and shall be as per IS: 778 Class-I and Class-II, as applicable. For sizes 80 mm to 300 mm, gate valve shall be as per IS: 780, PN=1.0 and shall be of inside screw and non rising type and cast iron double flanged.
- 4.1.2 Gate valves shall be provided with a hand wheel, draining arrangement of seat valve and locking facility (as required). Gate valves shall have back setting bush to facilitate gland renewal during full open condition.
- 4.1.3 The Body, bonnet, Stuffing Box, cap and hand wheel shall be of cast iron to IS:210/70, grade FG 200 / 260. The non rising spindle shall be of solid forged high tensile brass or carbon steel to AISI 304 construction. The Body seating and wedge ring shall be of solid leaded gun metal. The Bonnet gasket shall be of high quality rubber.
- 4.1.4 The Valve shall be PN 1.0 rated but shall withstand tests of upto 20 kg / cm². The ends shall be flanged. The batch number of the valve shall be punched on the top of the flange. The spindle shall be removable type, and shall be easily rotated.

4.2 Pressure Switch

- 4.2.1 The Pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. It shall be suitable for line pressures upto 15 kg / cm². The scale range for cut in and cut out shall be from 0 to 10 kg / cm².
- 4.2.2 The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:66 water and environment protection.
- 4.2.3 The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel. The switch shall be snap acting type with 1 number N O / N C contact.

4.3 Air Vessel

- 4.3.1 Air vessel shall be fabricated from 6 mm thick, 300mm x 1000mm MS plate suitable for 7kg/cm² working pressure complete with air release valve, safety valve, pressure gauge etc. as required. The air vessel shall be continuous welded construction and painted with two coats of Postal red enamel outside over a coat of primer and epoxy paint inside.

4.4 Pressure Vessel

- 4.4.1 The Pressure Vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water, the remaining being filled with air which will be under compression when the system is in normal operation.
- 4.4.2 Pressure vessel shall be fabricated from 8-10 mm thick MS plate with dished ends and suitable supporting legs. It shall be provided with a 50 mm dia flanged connections from pump, one 25 mm drain with ball valve, one water level gauge and 25 mm sockets for pressure switches. The pressure vessel shall be hydraulically tested as required.

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4.4.3 The Pressure Vessel shall be for Hydrant Systems. The Pressure Switches shall be mounted on the drain end of each Vessel. The Vessel shall also be provided with an air release valve mounted at the top.

4.5 Pressure Gauge

4.5.1 The Pressure Gauge shall be constructed of die cast aluminium and stove enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourden tube type Pressure Gauge with a scale range from 0 to 16 Kg / CM² and shall be constructed as per IS: 3624. Each Pressure Gauge shall have a siphon tube connection. The Shut off arrangement shall be by Ball Valve.

4.6 Ball Valve

4.6.1 The Ball Valve shall be made from die cast brass and tested to 14 Kg/cm² pressure.

4.6.2 The valve shall be internally threaded to receive pipe connections.

4.6.3 The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body- bonnet gasket and gland packing shall be of Teflon.

4.6.4 The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm² pressure.

4.6.5 The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree. The lever shall be operated smoothly and without application of any unnecessary force.

4.7 Non Return Valve

4.7.1 Non-return valves shall be cast iron spring action swing check type. An arrow mark in the direction of flow shall be marked on the body of the valve. The valve shall bear IS:531 certification.

4.7.2 The Valve shall be of cast iron body and cover. The internal flap in the direction of water shall be of cast iron and hinged by a hinge pin of high tensile brass or stainless steel. Cast iron parts shall be conform to IS:210 / 70, grade 200 / 260 type.

4.7.3 The gasket shall be of high quality rubber and flap seat ring of leaded gun metal to BS 1400 LG 2C. At high pressure of water flow the flapper shall seat tightly to the seat. The Valve shall be capable of handling pressure upto 15 kg / cm².

4.8 Butterfly Valve

4.8.1 The Butterfly Valve shall be suitable for waterworks and tested to minimum of 16 kg / sq cm pressure. The Valves shall fulfil the requirements of AWWA (American Water Works Association) C 504, API 609 and MSS-SP-67.

4.8.2 The body shall be of cast iron to IS:210 in circular shape and of high strength to take the minimum water pressure of 10 kg / cm². The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

4.8.3 The valve seat shall be of high grade elastomer or nitrile rubber. The Valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be of EN 8 grade carbon steel.

4.8.4 The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakage.

4.8.5 The Valves shall be supplied with manual gear operated opening / closing system by lever.

5.0 Pipe supports

All pipes whether horizontal or vertical shall be suitably supported using galvanized mild steel clamps/clevis hanger manufactured by M/s Hitech Support (India) Pvt Ltd or equivalent product of good quality as approved by engineer in-charge.

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5.1 Vertical Pipes

- 5.1.1 The pipes running vertical shaft shall be supported by galvanised mild steel rigid clamps fixed to wall with anchor bolts and studs.
- 5.1.2 When the horizontal distance between the centre line of two adjacent pipes is less than 300 mm a powder coated HITECH/or equivalent rail shall be fixed to wall the pipes independently clamped to the rail with 'U' bolt clamps.

5.2 Horizontal Pipes

- 5.2.1 Pipes running horizontal shall be supported from structural beam/slab by using appropriate galvanised m.s. pipe clevis hangers.
- 5.2.2 The spacing of supports shall be as follows:

GI Pipes/MS Pipes		CI Spun Pipes	
Internal Dia (mm)	Spacing (mm)	Internal dia (mm)	Spacing (mm)
15	1800	75-150	2700
20,25	2400	200-250	3000
32	2700	300	3600
40-50	3000		
65-80	3600		
100	4000		
150	4500		

- 5.2.3 Supports for horizontal piping longer than 15m in a stretch shall be provided with swivel clamps. Otherwise, the clamps shall be universal clamps or rigid clamps as required by the project engineer.

5.3 Fixing of clamps/rails etc.

All clamps, rails and accessories shall be fixed to the structure (beam, slab, walls etc.) by using approved good quality anchor fasteners of appropriate size.

6.0 Painting

- 6.1 All exposed piping for fire fighting shall be distinctly painted 'Fire red' shade 536 to IS:5-1978. Pipes shall first receive two coats of red oxide primer uniformly applied and two coats of oil paint applied thereafter. All pipes supports shall be painted black as specified for support & clamps.

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6.2 Painting Schedule

6.2.1 All equipment and piping shall be painted in accordance with the following colour code:

Equipment	Colour	Distinguishing Mark
a) Pump motors	Fire Red Shade	
	No.536 to IS: 5 -1978	
b) Internal piping	"	
c) Landing valves & Hose reel cabinets	"	
d) External Hydrants	"	
e) Fire brigade connection	"	
f) Priming tank	"	
g) Air vessel	"	
h) Electric panels	Black & Red	
i) Fire Alarm Panel	Black & Red	
j) Repeater panel	Black & Red	
k) Break Glass Unit	Fire Red	
l) Hooters/Speakers	Fire Red	
m) Sprinkler pipes	Fire Red	

6.2.2 All surfaces to be painted shall be thoroughly cleaned with wire brush to remove completely rust and other extraneous substances. Over the cleaned surfaces one coat of red oxide primer shall be applied completely covering the exposed surfaces. Finishing coat of enamel paint shall be applied one day after the prime coat, after ensuring that the paint is dry. The second coat shall be done before the installation is handed over and after approval to do so from the Engineer-in-charge.

7.0 Testing & commissioning

All piping after installation shall be tested for a hydrostatic test pressure of 10.5 kg/sqcm or 1.5 times the working pressure (whichever is less) maintained for 24 hours. All joints and valves shall be checked for leaks and rectified and retested. During testing all valves except drain & air valves shall be kept fully open.

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8.0 Makes of materials

For makes of materials refer to list of approved makes of material.

9.0 Mode of measurement

9.1 All external piping shall be measured along the centre line of the pipe and paid per unit length and shall include:

9.1.1 All pipes & fittings

9.1.2 Bituminous coating

9.2 All internal piping shall be measured similarly but shall include for the pipe supports and clamps.

9.3 All valves, air valves, drain valves together with flanges or tail pieces shall be measured per unit.

9.4 All excavation and concrete supports and thrust blocks shall be measured as per drawing and paid for per cum.

9.5 The cost of pipe supports described above form part of the rate quoted for piping and no extra shall be payable on the account.

All painting shall form part of the cost of equipment piping etc. No separate payment shall be admissible.

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SECTION - X SPRINKLER SYSTEM

1.0 Pendant type Sprinkler Head

- 1.1 Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal dia outlets.
- 1.2 The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches at 68° C / 79° C.
- 1.3 The nominal bore shall be 15 mm dia and colour of liquid shall be Red / Yellow.
- 1.4 The Sprinkler head shall be approved by UL / FM.

2.0 Upright type Sprinkler Head

- 2.1 Upright sprinkler heads shall be similar to Pendant type in material construction and performance but designed to throw water Droplets upwards in umbrella fashion, to cool the underside of ceiling and extinguish any fire involving combustibles on the floor below.
- 2.2 The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm dia and the colour of liquid shall be red.
- 2.3 Upright Sprinkler heads shall be use in lower and upper basement parking areas and above the false ceiling.

3.0 Side Wall type Sprinkler Head

- 3.1 Side wall sprinkler heads shall be similar to Pendant type in material construction and performance but designed to throw water Droplets horizontally.
- 3.2 The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm diameter and the colour of liquid shall be red.
- 3.3 Side wall sprinkler heads shall be use in staircase landing and along the ramp.

4.0 Powder coated Sprinkler with Powder coated Twin plate Rosette.

- 4.1 Most areas below false ceiling shall be provided with powder coated pendant sprinkler with twin plate sliding rosette. The sprinkler head shall be same as Pendant type above but powder coated white. The sprinkler head shall be provided with a double plate powder coated rosette that shall seal the gap between the false ceiling and the sprinkler head.
- 4.2 The adjustment allowable shall be 12 mm. The lower part shall have flared ends that shall fit tightly into the upper piece.

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4.3 The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm diameter and the colour of liquid shall be red.

5.0 Installation Control Valve for Sprinkler

4.1 The Installation Control Valve shall be double seated clapper type check valve. The Body and cover shall be made from Cast Iron to IS:210 Grade FG 200. The seat and seat clamp shall be made from bronze to IS: 318, LTB II grade. The sealing to the seat shall be neoprene gasket. The hinges pin and ball shall be from stainless steel.

4.2 It shall be vertically mounted and the direction of water travel shall be indicated on the surface. It shall be rated to 12 Kg / cm² and tested to 25 Kg / cm² pressure.

4.3 A By-pass check valve shall be fitted to adjust minor and slow variations in water pressure for balancing so as to avoid any false alarm.

4.4 The valve shall also be provided with a Test Control Box. The Box shall house a lever to test and operate the ICV. A brass strainer shall also be provided at the point of water supply to the Alarm gong. A Retarding Chamber shall also be provided.

4.5 The Chamber shall be able to balance the water pressure in case of water line surges.

4.6 Each Installation Control Valve shall have two sets of Pressure Gauges with brass ball valve type shut off.

4.7 A Water Motor Alarm. shall also be provided. This shall be mechanically operated by discharge of water through an impeller. The drive bearing shall be weather resistant. A strainer shall be provided on line before the nozzle. The Gong piece shall be constructed from bronze to IS 318, 2 TB II Grade, and base of cast iron. The Motor Housing, Rotor and Housing Cover shall be pressure die cast aluminium.

6.0 Flow Switch

6.1 Flow switch shall have a paddle made of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The seat shall be of stainless steel. The Flow Switch shall have IP:55 protection.

6.2 The Flow Switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

7.0 Makes of materials

For makes of materials refer to list of approved makes of material.

8.0 Mode of measurement

8.1 Sprinkler head including supports and clamps for fixing shall be measured as unit.

8.2 All alarm control valves including drain valves, butterfly valve and all other accessories together with flanges or tail pieces shall be measured per unit.

8.3 All floor control valves including drain valves, butterfly valve, sight glass and all other accessories together with flanges or tail pieces shall be measured per unit.

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SECTION - XI

PORTABLE FIRE EXTINGUISHERS & EXIT SIGNAGES

1.0 Scope

1.1 The scope of work covers the supply and installation of portable fire extinguishers. The following types are envisaged in these specifications and provided as shown in the schedule of portable fire extinguishers.

- 1.0.1 Dry powder extinguisher
- 1.0.2 Carbon-dioxide extinguisher
- 1.0.3 Mono ammonia phosphate extinguisher
- 1.0.4 Water expelling type.

2.0 Standards

2.1 The following standards and rules and regulations shall be applicable:

- 2.1.1 Fire protection manual of the tariff advisory committee, Fire Insurance Association of India
 - 2.1.2 IS:2176 :Portable fire extinguisher Dry power type
 - 2.1.3 IS:2878 :Portable fire extinguisher carbon-dioxide type
 - 2.1.4 Local Fire Brigade/Authority
- 2.2 All standards mean the latest.

3.0 Extinguishers

3.1 Dry powder type

3.1.1 The extinguishers shall be 2, 5, 10 kg capacity and cartridge type unless specified otherwise.

3.1.2 The body shall be of cold rolled carbon steel grade D and 1.5mm thick upto 5 kg and 2mm for 10 kg. The construction shall be similar to 'Soda Acid type' but of the following dimensions.

Capacity (kg)	Outside dia (mm)	Filler opening (mm)
2.00	100	45
5.00	150	45
10.00	175	45

3.1.3 The discharge fitting shall be with 500mm 10mm dia hose upto 5 kg and 750 mm 12.5 mm dia for 10 kg with a trigger controlled nozzle capable of discharging 85% of the contents as follows:

Capacity (kg)	Time (sec)	Throw (m)
2.00	8 - 10	2

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5.00	15 - 20	4
10.00	23 - 30	6

3.1.4 A carbon dioxide cartridge conforming to IS:4947 shall be fitted in a cartridge holder with an inner shell. A spring loaded piercing device shall be provided in the cap for piercing the seal of the gas cartridge. A syphon tube of copper or PVC shall be provided for upright operation. The cap and neck ring shall be similar to Soda Acid type extinguisher.

3.1.5 All internal and external components and surfaces shall receive anti-corrosive coating of not less than 12 microns shall be applied uniformly as indicated below:

- | | | | |
|----|--------------------|--------------|-------------------------------------|
| a) | Body | Mild steel | Tin alloy |
| b) | Cage for acid | Brass sheets | Lead or tin alloy bottle and spring |
| c) | Discharge fittings | Leaded - Tin | Tin alloy |
| | | Bronze | |
| d) | Strainer | Brass sheets | Lead or Tin alloy |

3.2 Carbon dioxide type

3.2.1 The extinguishers shall be rated for 2.0 and 4.5 kg by weight or carbon dioxide, unless stated otherwise. The contents shall be with a filling ratio not exceeding 0.667.

3.2.2 The body shall be steel cylinder made according to IS:2872 and approved by the chief controller of explosives.

3.2.3 The discharge head shall be simple and safe to operate conforming to IS:3224 with a safety release to IS:5903 set to 18.0 to 20.0 N/sqmm. A syphon tube of copper or PVC shall be fitted. A non-conducting discharge horn and a high pressure hose (27.5 N/sqmm pressure) shall be fitted with each extinguisher.

3.2.4 The discharge system shall be designed to expel 95% of the contents in continuous discharge as follows:

Capacity (kg)	Time (Sec.)
2.0	8 - 18
3.0	10 - 20
4.5	10 - 24

3.3 Mono ammonium phosphate type

3.3.1 The capacities envisaged are 2 kg & 5 kg. The filling pressure shall be 0.95 +/- 0.055 N/sqmm.

3.3.2 The body shall be cylindrical in shape and made of cold rolled carbon steel grade D/DD or hot rolled steel plate with radiographically tested welded construction. Plate thickness shall conform to IS:11108.

3.3.3 Discharge valve mechanism shall be a simple and safe squeeze grip valve. 4.5 kg and above capacity shall have a high pressure (0.5 N/sqmm) hose and non-conducting horn and shall also be provided with a pressure gauge. 95% of the contents shall be discharged as follows:

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Capacity (kg)	Time (sec)	Throw (m)
2.00	8 - 16	2
5.00	15 - 24	4

3.3.4 The internal and external components and surface shall be treated for anti-corrosion as for dry powder type extinguishers.

3.4 Water CO2 Fire Extinguisher

3.4.1 The extinguishing medium shall be primarily water stored under normal pressure, the discharge being effected by release of carbon dioxide gas from a 60 gms cylinder.

3.4.2 The capacity of the cylinder when filled shall be 9 litres +/- 5 %.

3.4.3 The cylinder shall be fabricated from MS sheet, welded at seams, with dish and dome, being of same thickness and of size not exceeding the diameter of the body. The neck shall be externally threaded with leaded tin bronze.

3.4.4 The cap shall be of leaded tin bronze. The siphon tube shall be of brass or GI. The cartridge holder, knob, discharge fittings and plunger shall be of leaded tin bronze and plunger of stainless steel with spring also of stainless steel. The discharge tube shall be of braided nylon, of 10 mm dia and 600 mm length with a brass nozzle.

3.4.5 The extinguisher shall be treated for anti corrosion internally and externally and painted fire red externally. The cartridge shall be IS marked. The Extinguisher body shall be tested to 25 bar pressure for 2 minutes. The Extinguisher shall be IS:940 marked.

3.5 General requirements

3.5.1 All extinguishers shall be standard products approved by the Tariff Advisory Committee and Local Fire Authority and manufactured and tested strictly in accordance with the relevant Indian Standard. All markings and test results shall be stamped in the appropriate colour markings accordingly to the Indian Standards.

3.5.2 All extinguishers shall have a structurally designed galvanised steel handle and also a suitable wall mounting bracket.

4.0 Illumination signs/EXIT signage

The illuminated signs shall have the letters 'FIRE EXIT' or 'NO FIRE EXIT' painted in red on a 6mm thick white perspex sheet as the front face of a sheet steel enclosure constructed with minimum 1.5mm thick sheet. The MS box shall be powder coated finished in white colour. The perspex sheet shall be back lit with a rechargeable maintenance free sealed battery integral with a battery charging circuit. The battery backup facility shall operate independent of the mains supply in the event of a mains failure. The batteries shall be of adequate rating so as to support the illumination of the signage for a minimum period of 1 hour without mains power. The preferred dimensions of the illuminated signs shall be 450 mm length and 225mm height with 100 mm high lettering. They shall be suitable for surface or recessed mounting or ceiling hung type as required including all arrangements for suspension, cutting/chasing and making good the defects etc. complete as approved.

5.0 Mode of measurement

5.1 Each extinguisher with its mounting bracket shall be measured per unit and paid for.

5.2 Exit signages with mounting plate shall be measured per sq.inch and paid for.

6.0 Makes of Equipment and materials

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Refer to list of approved makes.

SECTION - XII

ELECTRICAL WORK

1.0 Scope

- 1.1 The scope of this section comprises of fabrication, supply, erection, testing and commissioning of electric panels, wiring and earthing of all equipment components and accessories, including supply, installation and wiring of remote mounted push button stations.
- 1.2 All the electrical cables, termination, wires and accessories are also including in the Scope of Work. The main cable from the main distribution board will be supplied and erected by other Agency.

2.0 General

- 2.1 Work shall be carried out in accordance with the specifications of CPWD specifications, Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date.

3.0 Construction Features

- 3.1 The control panel shall be metal enclosed sheet steel cubical, indoor type, floor mounting/wall mounting type as per BS 5486 Part 1, 190 & IEC 439-1. The control panel shall be totally enclosed, completely dust and vermin proof, Gaskets between all adjacent units and beneath, covers shall be provided to render the joints dust proof. Control panels shall be arranged in multitier formations. All doors and covers shall also have sealing & pad locking arrangement. All mild steel sheets used in the construction of control panels shall be minimum 2mm. thick or as specified and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all slag grounded off and welding pits wiped smooth with plumber metal.
- 3.2 All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal provided with hank nuts. Self threading screws shall not be used in the construction of control panels. Base channel shall be of 75mm x 40mm x 5mm thick shall be provided at the bottom. Minimum clear space of 250 mm between top of channel of control panel and bottom most unit shall be provided.
- 3.3 The control panels shall be of adequate size with a provision of 10% spare space to accommodate possible future additional switchgear. Knockout holes of appropriate size and number of cables shall be provided in the control panels in conformity with the location of incoming and outgoing conduits/cables. All equipment such as meters and indicating lamps, etc shall be located adjacent to the unit with which it is associated and care shall be taken to achieve a neat and symmetrical arrangement. Facility shall be provided for termination of cables from both above and below the control panel. Where cables enter below, cables boxes shall be fitted at the rear and arranged in tiers to facilitate making connections to the upper and lower units. Clamps shall be provided to support the weight of the cables. All incoming and outgoing feeders shall be brought out to a terminal block of adequate size at suitable location inside the control panel. All wiring inside the control

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panel shall be color coded and labeled with approved plastic beads for identification. Circuit diagrams showing the arrangement of circuits shall be pasted on the inside of the panel door and covered with transparent plastic sheet and all labeling shall be provided on the front face of the panel board.

4.0 Circuit Compartments

4.1 Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the 'ON' position. Safety interlocks shall be provided to prevent the breaker or Contactor from being drawn out when the breaker is in the draw out position of the panel. Instruments and indicating lamps shall not be mounted on the panel compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.

5.0 Instrument Accommodation

5.1 Separate and adequate compartments shall be provided to accommodate instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accident contact with live parts of the circuit breaker and bus bar.

6.0 Bus Bars and Bus bar Connection

6.1 The bus bar and interconnections shall be of aluminum and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The bars and interconnections shall be insulated with PVC heat shrinkable sleeve and color coded. All bus bars shall be supported on unbreakable, non-hygroscopic insulated SMC/DMC type supports at regular intervals not more than 400 mm, to withstand the forces arising in case of short circuit in the system. Bus bars shall be provided in separate chamber of main control panels shall be connected by clamping, no holes shall be drilled in bus bars. If holes have to be drilled for making connections, extra cross section of bus bars shall be provided.

6.2 All bus bar connections in smaller control panels shall be done by drilling hole and connecting by brass bolts and nuts. Additional cross section of bus bars shall be provided in small control panels to cover up the holes drilled in the bus bars.

6.3 All connections between the bus bar and breaker and between breaker and contactor shall be through copper strips of proper size to carry full rated current and shall be insulated with coloured PVC heat shrinkable sleeve.

7.0 Terminals

7.1 The outgoing terminals and neutral links shall be brought out to a terminal block suitably located in the control panels. The current transformer for instruments, metering and for protection shall be mounted on the terminal blocks. Separate cable compartment shall be provided for incoming and outgoing cables.

8.0 Wire ways

8.1 A horizontal wire way screwed covers shall be provided at the top to take in the connecting control wiring of different vertical sections.

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9.0 Cable Compartments

9.1 Cable compartments/alley of adequate size shall be provided in the control panels for easy termination of all incoming and outgoing cables entering from bottom or top using detachable gland plates with proper knockouts. Adequate and proper DMC supports shall be provided in cable compartments to support cables. All incoming and outgoing terminals shall be brought out on terminal blocks in the cable compartment.

10.0 Materials

a) Rotary Switches

Switches up to 60 amps shall be rotary type with compact and robust construction, built up from one or more stacks with contacts and a positioning mechanism, with stop as required. The terminals shall be shrouded with insulation to prevent accidental contact with live parts. Rotary switches shall be backed up with moulded type HRC fuse fittings of appropriate rating.

b) Selector Switch

When called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

c) Molded Case Circuit Breakers (MCCB)

MCCBs shall be quick make, quick break, and preferably double break contact system, arc extinguishing device, independent manual type with trip free feature with mechanical ON, OFF, and TRIP indications as called for in BOQ. A trip button shall be provided for tripping the breaker.

MCCB shall be a compact high strength, heat resistant, flame retardant; insulating molded case with high withstands capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment

d) Switches

Switches beyond 60 amps shall be panel mounted double break type and suitable for load break duty, quick make and break action. Switch contacts shall be silver plated and shall be back-up with HRC fuses of appropriate rating. The switch handles shall be located at the front.

e) HRC Fuses

Fuses shall be high rupturing capacity of not less than 20 MVA at 415 volts. The backup fuse rating of each motor/heater/equipment shall be so chosen that the fuse does not operate on starting of motor/heater/equipment. Fuses shall be of the same make as the switches.

f) Starters

Each motor shall be provided with a starter of suitable rating. Direct on line starters shall be provided for motors up to 10 HP.

Operating coils of contactors shall be suitable for 220/415 +/- 10% volts AC, 50 cycles supply system. The contactor shall drip out when voltage drops to 90% of the rated voltage.

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g) Over Load Relays

Contactors shall be provided with a three element, positive acting ambient temperature compensated time lagged hand-reset type thermal over load relay with adjustable setting.

h) Current Transformers

Current Transformer shall be of accuracy class - I and suitable VA burden for operation for the connected meters and relays.

i) Single Phase Preventor

Single phase preventor shall be provided for all the starters. Single phase preventor shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

j) Indicating Lamp and Metering

The meters shall be flush mounted and draw-out type. The indicating lamp shall be neon type and of low burden. Each phase indicating lamp shall be backed up with 2 amps fuse.

k) Push Button Stations

Push button station shall be for manual starting and stopping of motors/equipment as called for. Red and Green colour push buttons shall be provided for starting and stopping operations. Push buttons shall be suitable for panel mounting and accessible from front without opening door.

m) Cables

M.V. cables shall be PVC insulated aluminium conductor armoured cables suitable for laying in trenches, duct, and on cable trays as required.

n) Wires

650/1100 volts grade PVC insulated copper conductor wires in conduit shall be used.

11.0 Cable Laying

11.1 Easy access to all cables shall be provided to allow cable withdrawal/replacement in the future. Where more than one cable is running, proper spacing shall be provided to minimize the loss in current carrying capacity with necessary saddling/clamps.

12.0 Earthing

12.1 The earthing of MCC and equipment shall be as per BIS Specification and considered in the main electrical panel. The loop earthing shall be carried out with G.I/Copper Strips/wires.

13.0 Painting for Panel

13.1 All sheet steel work shall undergo a process of seven tank treatment and painting with powder coating paint of approved shade.

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14.0 CABLE WORK

This section covers detailed requirements for supply, laying, testing and commissioning of cables.

14.1 GENERAL

MV cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

14.2 MATERIAL

14.2.1 The MV power cable of 660/1100 V. grade shall be PVC insulated Aluminium conductor armoured cable conforming to IS : 1554 (part - I). MV cable shall be 3.5/4 core of size and type as specified.

14.2.2 The MV control cables shall be PVC insulated copper conductor armoured cable.

14.3 STORAGE AND HANDLING

14.3.1 All cables shall be inspected upon receipt at site and checked for any damage during transit.

14.3.2 Cable drums shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in the ground causing rot and damage to the cable drums.

14.3.3 During storage periodical rolling of drums once in 3 months through 90° shall be done. Rolling shall be done in the direction of the arrow marked on the drum.

14.3.4 It should be ensured that both ends of the cable are properly sealed to prevent ingress/absorption of moisture by the insulation.

14.3.5 Protection from rain and sun shall be ensured. Sufficient ventilation between cable drums, should be ensured during storage.

14.3.6 The drums shall always be rested on the flanges and not on the flat sides.

14.3.7 Damaged battens of drums etc. should be replaced, if necessary.

14.3.8 When cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum.

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- 14.3.9 For transportation over long distances, the drum should be mounted on cable drum wheels strong enough to carry the weight of the drum and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.
- 14.3.10 When unloading cable drums from vehicles, a crane shall preferably be used. Otherwise the drum shall be rolled down carefully on a suitable ramp or rails, where necessary.
- 14.3.11 While transferring cable from one drum to another, the barrel of the new drum shall have a diameter not less than that of the original drum.
- 14.3.12 The cables shall not be bent sharp to a small radius. The minimum safe bending radius for all types of PVC cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multi core cable shall not be less than 15 times its overall diameter.
- 14.3.13 Cable with kinks and straightened kinks or with similar apparent defects like defective armouring etc. shall be rejected.
- 14.3.14 Cables from the stores shall be supplied by the contractor as per the site requirement in pieces cut in the stores.

14.4 INSTALLATION

14.4.1 GENERAL

The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S.:1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the contractor & approved by Engineer-in-Charge.

14.4.2 ROUTE

- 14.4.2.1 Before the cable laying work is undertaken, the route of the cable shall be decided by the Architect in consultation with Owner representative.
- 14.4.2.2 While shortest practicable route shall be preferred, cable runs shall generally follow fixed developments such as roads, foot-paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run to shorten the route length is not desirable as it would lead to route identification and maintenance problems, besides posing difficulties during later development of open areas etc.
- 14.4.2.3 While selecting cable routes, corrosive soils, ground surrounding sewage and effluent etc. shall be avoided. Where this is not feasible, special precautions as approved by the Architect shall be taken.

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14.4.2.4 As far as possible, the alignment of the cable route shall be decided taking into consideration the present and future requirements of other agencies and utility services affected by it, the existence of any cable in the vicinity as may be indicated by cable markers or cable schedules or drawing maintained for that area, possibilities of widening of roads/lanes, storm water drains etc. Cable routes shall be planned away from the drains and should be within the property.

14.4.2.5 Whenever cables are laid along well demarcated or established roads, the MV cables shall be laid further from the kerb line than HV cables.

14.4.2.6 Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, MV cables shall be laid above HV cables.

14.4.2.7 Where cables cross one another the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

14.5 WAY LEAVE

14.5.1 It may be necessary to obtain way leave for the cable route from the appropriate authorities some of whom are listed below:

- a) Drainage, Public Health and Water Works.
- b) Telephones and Telegraphs.
- c) Gas works.
- d) Other Undertakings.
- e) Owners of properties.

14.5.2 Where necessary, joint inspection with representatives of other authorities may be arranged so that mutual interests are safeguarded. In case of private property, Section 12/51 of the Indian Electricity Act shall be complied with.

14.6 PROXIMITY TO COMMUNICATION CABLES

Power and communication cables shall as far possible cross at right angles. Where power cables are laid in proximity communication cables the horizontal and vertical clearances shall not normally be less than 60 cms.

14.6.1 LAYING METHODS

14.6.1.1 Cables shall be laid direct in ground or in pipes/closed ducts, in open ducts or on cable trays suspended from slab depending on site conditions.

14.6.2 Laying in Pipes/Closed ducts :

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- 14.6.2.1 In location such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.
- 14.6.2.2 GI or Hume Pipes (spun reinforced concrete pipes) shall be used for such purposes. In the case of new construction, pipes as required shall be laid along with the Civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the electrical drawings. GI pipe shall be laid directly in ground without any special bed. Hume pipe (Spun reinforced concrete pipe) shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40mm nominal size) bed, after which it shall be completely embedded in concrete. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1mtr. from the ground level when laid under roads, pavement etc.
- 14.6.2.3 Where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of polyphase system.
- 14.6.2.4 The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.
- 14.6.2.5 Manholes of adequate size as decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall be covered by suitable manhole covers with frame of proper design. The construction of manholes and providing the cover is not in the scope of this Contract and shall be got executed and paid for by the Engineer-in-Charge through another agency.
- 14.6.2.6 Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothed to prevent injury to cable insulation or sheathing.
- 14.6.2.7 Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water. This seal in addition to being waterproof shall also be fireproof.
- 14.6.2.8 All chases and passages necessary for lying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer-in-Charge.
- 14.6.2.9 Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.
- 14.6.3 Laying on Cable Trays**
- 14.6.3.1 Cables, where indicated in approved shop drawings, shall be laid on overhead cable trays which are suspended from ceiling or supported from wall, by anchor fasteners as required.

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14.6.3.2 The Contractor shall provided for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trifoil clamps and structural steel members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.

14.6.4 Termination

Brass single compression glands shall be provided for MV cables termination

14.6.5 Testing

14.6.5.1 All 650/1100 Volt grade cables before laying shall be tested with a 500 V megger or with a 2,500/5,000 V megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.

14.6.5.2 All cables shall be subject to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

15.0 CABLE TRAYS

15.1 Prefabricated Cable trays of ladder type and associated accessories, tees, bends, elbows & reducers shall be fabricated from 12 gauge (2.6 mm thick) mild steel. Perforated cable trays and associated accessories tees, elbows, and reducers shall be fabricated from 14 guage (2 mm thick) MS steel.

15.2 Cable trays and accessories and covers shall be painted with one shop coat of red oxide zinc chromate primer and two coats of Aluminium alkyd paint.

15.3 The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trifoil clamps and structural steel members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.

16.0 EARTHING

This section covers detailed requirements for earthing.

16.1 GENERAL

16.1.1 The non-current carrying metal parts of electrical installation shall be earthed properly. All metallic structure, enclosures, junction boxes, outlet boxes, cabinets, machine frame, portable equipments, metal conduits, trunking, cable armour, switchgear, distribution boards, lighting fittings and all other parts made of metal in close proximity with electrical circuits shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing will be in conformity with the

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relevant Indian Electricity Rules 1956 and Indian Standard Specification IS : 3043. Every item of equipment served by the electrical system shall be bonded to earthing system.

- 16.1.2 Every switch, lighting fixture and 5 Amp outlets shall be provided with insulated copper conductor of 1.5 sq. mm for earthing. The computer workstations shall be earthed with 2.5 sq.mm. insulated copper conductor wire.
- 16.1.3 Separate copper earth pits shall be provided for UPS, EPABX & Networking equipment.
- 16.1.4 The raceways shall not be used as a grounding conductor.

16.2 CONNECTION OF EARTHING CONDUCTORS

- 16.2.1 Main earthing conductor shall be taken from the earth connections at the PDB to the earthing pit. Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution boards or to an earth leakage circuit breaker. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of equipment shall be earthed with 2 no. G.I. strips/wires and non-current carrying metallic parts with, 1 no. G.I. strips/wires.
- 16.2.2 Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures cables and conductors, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in earthing system. The Electrical resistance of metallic enclosures for cables and conductors measured between earth connections at the main switch boards and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate circuit breakers and shall not exceed 1 OHM.

16.3 EARTH CONNECTIONS

All metal clad switches and other equipment carrying single phase circuit, shall be connected to earth by a single connection. All metal clad switches carrying 3 phase shall be connected with earth by two separate and distinct connections. The earthing conductor inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size. The earthing conductor shall be painted to protect it against corrosion. Earthing conductor outside the building shall be laid 600 mm below finished ground level. The over lapping in G.I. strips in joints shall be welded. Lugs of adequate capacity and size shall be used for all termination of conductor wires. Lugs shall be bolted to the equipment body to be earthed after the metal is cleaned of paint and other oily substance and properly tinned.

16.4 PROTECTION FROM CORROSION

Connection between copper and galvanized equipment shall be made on vertical face and protected with paint and grease. Galvanized fixing clamps shall not be used for fixing earth conductors. Only copper fixing clamp shall be used for fixing earth conductors. When there is evidence that the soil is aggressive to copper, buried earthing conductors shall be protected by suitable serving and sheathing.

16.5 EARTHING STATION

16.5.1 PLATE ELECTRODE EARTHING

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- 16.5.1.1 Earthing electrode shall consist of a Copper plate of 600 mm X 600 mm X 3 mm or G.I. plate of 600mm x 600mm x 6.3 mm as called for in the Schedule of Quantity. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 meters below ground level. Wherever possible, earth electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrode shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer surface of the wall.
- 16.5.1.2 The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 20 mm dia GI pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through the pipe. The funnel over the GI pipe shall be housed in a masonry chamber approximately 300 mm x 300 mm x 300 mm deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame. Test facility shall be provided with test links for the earthing station.

16.5.2 PIPE ELECTRODE EARTHING

Earthing Electrode shall consist of G.I. medium class. 40 mm dia 4.5 m long pipe (without any joint) G.I. pipe Electrode shall be cut, tapered at the bottom and provided with holes of 12 mm dia drilled not, less than 7.5 cm from each other upto 2 M of length from the bottom. Pipe electrode shall be buried in the ground vertically with its top at not less than 200 mm below the ground level. When more than one pipe is to be installed a separation of not less than 2 M shall be maintained between two adjacent electrodes as called for in the drawings. Wherever possible, earth electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrode shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer surface of the walls. The pipe electrode shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 40 mm x 20 mm reducer shall be used for fixing of funnel with mesh. The funnel and mesh have been provided for watering the earth through the pipe. The funnel over the G.I. Pipe shall be housed in a masonry chamber 300mm x 300mm x 300mm. deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame. The breaked earth pit will be provided with test links in suitable enclosures.

16.5.3 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, as specified in Clause no. 7 then the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, Calcium chloride, sodium carbonate, copper sulphate, salt and soft coke or charcoal in suitable proportions.

16.5.4 RESISTANCE TO EARTH

The resistance to each earthing system shall not exceed 1.0 ohm.

5..1.1.1.1

5..1.1.1.2

5..1.1.1.3

COMMISSIONING & GUARANTEE

1. SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

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Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

All tests shall be made in the presence of the Architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rotameters. Contractor shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Consultant / Project Manager.

Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

2 PRECOMMISSIONING

On completion of the installation of all pumps, piping, valves, pipe connections, insulation etc. the Contractor shall proceed as follows:

2.1 Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fittings and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

- a) All strainers shall be inspected and cleaned out or replaced.
- b) Check all clamps, supports and hangers provided for the pipes.
- c) Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. Thereafter conduct & hydro test of the system as for (b) above.
- d) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

3 FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Architect.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify

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and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

4 REJECTION OF INSTALLATION / PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Architect either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority/Architect.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Employer.

5. WARRANTY AND HANDOVER

The Contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

6. HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Owner's site representative and all testing and commissioning documents shall be handed over to the Owner's site representative.

The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Owner's site representative.

8. PIPE COLOUR CODE:

S.No.	Pipe Lines	Ground / Base Color	First Color Band	Second Color Band
1	Drinking Water (All cold water lines after filter)	Sea Green	French Blue	Single Red
2	Treated Water (Soft Water)	Sea Green	Light Orange	
3	Domestic Hot Water	Sea Green	Light Grey	
4	Drainage	Black		

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Color code to confirm to IS: 2379:1990

5..2 LIST OF STANDARD CODES

S.No.	IS Code No.	5..2.1 Description
1.	IS:1729:1979	Specification for sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories (1st rev.) (Amendment 4)
2.	IS:651:1992	Specification for salt glazed stoneware pipes and fittings (5th rev.) (Amendment 1)
3.	IS:456:1978	Code of practice for plain and reinforced concrete (3rd rev.) (Amendment 2)
4.	IS:3114:1994	Code of practice for laying of CI pipes (2nd rev.) (Amendment 2)
5.	IS:782:1978	Specification for caulking lead (3rd rev.)
6.	IS:783:1985	Code of practice for laying of concrete pipes (1st rev.)(amendment 1)
7.	IS:4127:1983	Code of practice for laying of glazed stoneware pipes (1st rev.)
8.	IS:780:1984	Specification for sluice valve for water works purposes (6th rev.) (50 to 300 mm size) (amendment 3)
9.	IS:1172:1993	Code of basic requirements for water supply, drainage & sanitation (4th rev.)
10.	IS:1200 (Part-16):1979	Code of practice for methods of measurements of building and civil engineering works: Part 16 laying of water and sewer lines including appurtenant items (3rd rev.)
11.	IS:1200(PART-19):1981	Code of practice for methods of measurements of building and civil engineering works: part 19 water supply, plumbing and drains (3 rd rev.)
12.	IS:1742:1983	Code of practice for building drainage (2nd rev.)
13.	IS:13095:1991	Butterfly valves for general purposes
14.	IS:5312 (part 1) :1984	Swing heck type reflux valves (non-return valve): part 1 single door pattern (1 st rev.)(amendment 1)
15.	IS:1726:1991	CI manhole covers & frames (3rd rev.)

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S.No.	IS Code No.	5..2.1 Description
16.	IS:884:1985	Fire aid hose reel for fire fighting
17.	IS:901:1988	Coupling double male and female instantaneous pattern for fire fighting
18.	IS:903:1984	Fire hose delivery coupling, branch pipe, nozzles and nozzles spanner
19.	NBC-SP-7-1983 Part IV	National building code of India 1983, amendment No. 3
20.		Central public works division (CPWD) Part-V, wet riser system for fire fighting 1985, Govt. of India
21.	IS:3844-1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises
22.	IS:2190:1992	Code of practice for selection and maintenance of first-aid fire extinguisher
23.	IS:6382:1984	Code of practice for design and installation of fixed system carbon dioxide fire extinguishing system
24.	SP:35 (s&t)-1987	Hand book on water supply & drainage by bureau of Indian standards
25.		National Building code (sec-ix)
26.	IS:2065:1983	Code of practice for water supply in buildings
27.	IS:933-1989	Specifications for portable chemical from fire extinguisher
28.	IS:2171-1985	Specifications for portable fire extinguishers, dry power

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