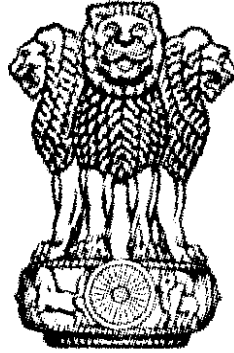


PROJECT IMPLEMENTATION UNIT GANDHINAGAR



सत्यमेव जयते

TECHNICAL SPECIFICATION FOR PLUMBING WORKS

Name of Work: -New Construction of 30 Bedded Community Health Center at.Thangadh, Ta.Thangadh, Dist.Surendranagar.

**Project Implementation Unit
4th Floor, PIU/RDD/NHM Building,
Civil Hospital Compound, Sector-12,
Gandhinagar – 382 012.**

GENERAL SPECIFICATIONS

These General Specification are to be read in conjunction with other documents issued along with tender. In case of any discrepancy between Design drawings, General conditions or Bill of quantity, more stringent of the same shall be applicable.

The contractor shall refer the following drawings while bidding and will read them in conjunction with specifications as well as bill of quantity. A part list of applicable codes & standards is mentioned as Annexure – I and the compliance will be ensured.

1. WORK DESCRIPTION

The work shall be strictly carried out as per the scope listed in this document and in accordance with the specifications. The equipment & material supplied at site will also be selected out of the list of approved makes. Bill of quantity provided with the document is for contractor guidance. It is expected that after award of work, contractor shall prepare shop drawings for approval by the Consultant & PMC's representative and also submit Technical documentation duly identifying shortlisted make of material/equipment along with its data sheets. Actual ordering shall be based on approved shop drawings & documents.

The work at site shall comply with the approved shop drawings and will meet the satisfaction of PMC's representative. The contractor shall be required to demonstrate satisfactory operation of entire system (including client supplied equipment installed by contractor) and furnish the required labour, material & tools to install & commission the system.

The broad scope of work for proposed plumbing and firefighting system covered under this contract shall include supply, installation, testing & commissioning of the following:

Sanitary fixtures and accessories.

C.P. bathroom fittings and accessories.

Soil, waste and vent pipes with fittings

Rain water disposal pipes with fittings

Water supply pipes with fittings

External sewerage system

External Drainage system

External water supply system

Connection to and from municipal mains in case of water, sewer and drain connection including coordination with all other agencies

Fire pumping system, Fire Hydrant including fire extinguishers. The scope also includes electrical panel as applicable.

Other Miscellaneous Items.

Wiring & earthing from MCC panels to various firefighting system, control wiring & interlocking.

Any chasing/chipping/civil masonry.

Balancing, testing & commissioning of the entire plumbing system.

Besides above, contractor shall also be required to undertake following:

Obtain approval from Local Authorities prior & post installation for operation of system.
All civil works which include making openings in walls & slabs and making good of the same.
Commissioning of the plant including test reports to demonstrate satisfactory working prior to handing over.
Provide as-built drawings and handing over document Test reports, list of recommended spares, operation & maintenance manual for the entire plumbing system.
Training of Client's staff.

2. SITE MANAGEMENT

The Contractor shall be required to provide following staffing for the project:

- a. Design Engineer who will work with Consultant for getting shop drawings, technical submittal and variation in quantity statement approved.
- b. Procurement team as per tender document.
- c. Full time dedicated Engineer & supervisor posted at site as per tender document.

The contractor shall submit organization chart and CV prior to starting work at site.

The Contractor shall have required stores, tools & plant, security and facility to transport materials to place of installation for speedy execution of work.

3. REGULATIONS & PERMITS

Prior to starting work at site, the contractor shall obtain required permits/ licenses required for satisfactory execution and operation of the installation.

The executed work shall strictly confirm to applicable laws, regulations and Indian Standards which become applicable. In case the specifications and drawings contained in this document call for higher standard than those required by prevailing regulations, then these specifications & drawings shall become applicable. However, in case of any conflict or violation between the document/drawings and prevailing laws, then the applicable laws & regulations shall be governing & binding.

4. SHOP DRAWINGS

A set of design drawings listed in this document are available at Consultant office and may be issued with the tender document. These design drawings are for reference of the contractor and indicate proposed arrangement and the extent of work covered in the contract. The data given in the drawings and specifications is as exact as could be procured, but its accuracy is not guaranteed. The contractor cannot execute work or scale these drawings for reference.

Following shall be the procedure followed by contractor while preparation of shop drawings:

The contractor shall refer the design drawings for understanding the scope and proposed routes to be followed during execution.

Collate latest architectural backgrounds from the PMC's representative/Architect/Consultant.

Examine all related services drawings but not limited to structural, plumbing, electrical, HVAC, Interior, landscape and others including as-built works before starting the work. Any discrepancy must be report to the PMC's site representative in writing and obtain approval for go-ahead.

Within one week of award of work, the Contractor shall prepare a list of shop drawing along with submission schedule for approval of PMC's representative/Consultant. The list of drawings must include layouts for Plant room, Pump room, Typical drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.

Maximum headroom shall be maintained at all points and in case the same is inadequate, then written approval from PMC's representative must be obtained prior to execution at site.

These shop drawings shall depict information required to complete the Project as per specifications and as required by the Consultant/PMC's representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Where the work under this contract is proposed to be installed in close proximity or is interfering with other trades, then based on PMC's representative/consultant directions, the contractor shall prepare all services coordinated working drawings and sections at a suitable scale (not less than 1:50), clearly showing proposed installed in relation to the work of other trades.

The contractor shall thereafter furnish six sets of detailed shop drawings to PMC's representative/Consultant for obtaining comments/approval. The Contractor will make unlimited number of re-submissions of shop drawings unless PMC's representative/Consultant/Architect approval is obtained.

The Contractor will thereafter submit six sets of final shop drawings to the PMC's representative for their exclusive use and all other agencies.

No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

In case installation is carried out without following above process or obtaining a waiver to follow the procedure from PMC's representative, the work shall be rejected and contractor shall rectify the same at their own cost.

Shop drawings shall be submitted for approval minimum four weeks in advance of planned delivery and installation of any material to allow PMC's representative/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

5. TECHNICAL DOCUMENTATION

The contractor prior to supplying material at site, will submit the following documentation to Consultant/PMC's representative for approval:

Manufacturers drawings, catalogues, pamphlets and other documents in triplicate. Each item shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

Samples of all materials shall be submitted to the PMC's site representative prior to procurement. These will be submitted in two sets for approval and retention by PMC's representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed, a mockup or sample installation shall be carried out for approval before proceeding for further installation.

Where the contractor proposes to use an alternate make or model of equipment other than that specified, all new drawings and detailing required thereafter shall be prepared by the contractor at his own expense including any re-design required for other discipline/trade. Any delay on such account shall also be at the cost of and consequence of the Contractor.

Contractor to refer list of approved makes & materials for this project.

6. QUALITY ASSURANCE

The contractor to ensure that all materials and equipment supplied shall be new and of best available quality conforming to the relevant Indian Standard Specifications and to these specifications. Makes shall be strictly in conformity with list of approved manufacturers. PMC reserve the right to reject any item which in their assessment is second hand

Any deviations from above shall be clearly highlighted prior to supply and shall be brought to the notice of the PMC's representative/Consultant for further instructions in the matter.

Prior to starting execution work at site, the Contractor shall verify the sufficiency of the size of the shaft openings, clearances and ceiling spaces for proper installation. Failure to communicate insufficiency of any of the above, shall constitute Contractor acceptance of the same. The Contractor shall locate all equipment in fully accessible locations which can be easily serviced, operated or maintained. Valve or other devices requiring attendance shall be finalized and communicated in sufficient time. Failing this, the Contractor shall make all the necessary repairs and changes at own expense. Access panel shall be marked.

7. INTEGRATION WITH BUILDING AUTOMATION SYSTEM

The scope of Plumbing and Firefighting Contractor shall include the following for the interface to Building Automation System and no additional cost shall be paid for providing the interface feasibility.

Stop/Manual/ Auto switches along with potential free contacts for monitoring the manual operation status, to be provided for those equipment whose start / stop is controlled by Building Automation System.

Potential free 'NO' contacts for monitoring 'Run' status of equipment wherever required.

Necessary contactor with potential free contacts and Stop/Manual/ Auto switches to be provided for all equipment wherever the starter is not provided and which requires starting / stopping through Building Automation System.

Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe lines.

The space provision in all the equipment panel (MCC) for mounting Current/ Potential transformers & transducers and power supply to the transducer shall be provided by the Plumbing and Firefighting contractor. Separate current transformers shall be provided by Plumbing and Firefighting contractor for monitoring current / KWH (wherever required) through BAS.

The installation of current transformer & Transducer along with wiring between Current Transformer & Transducer up to the terminal block shall be provided by the Plumbing and Firefighting contractor. All transducers shall be supplied by BAS contractor.

The low voltage BAS Cables shall be brought up to the electric panel by BAS contractor and all terminations into the electrical panels shall be made by Plumbing and Firefighting contractor after satisfying himself of the wiring system. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Plumbing and Firefighting system, lies solely with the contractor.

All necessary Hardware/ Software shall be made available by the Plumbing and Firefighting Contractor on the Microprocessor based panel for the integration of such panel to Building Automation System for remote monitoring / controlling of marking / equipment thru BAS.

8. TESTING, ADJUSTING AND BALANCING

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, equipment, panels etc. at factory with two personnel from Owners / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of

the representatives of the Architect / Consultant and Owner's site representative.

9. COMPLETION CERTIFICATE

On completion of the installation, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire installation duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

10. AS-BUILT DRAWINGS

Contractor shall submit following as-built drawings as and when work is completed:

Six set of hard copies of all as-built drawings duly corrected and incorporating any modifications during execution.

Two set of pen drive containing the drawings.

- Position of all sanitary fixtures.
 - Runs of all water lines with diameters on all floors and vertical risers / drops.
 - Runs of all soil, waste, vent & rain water piping with diameters on all floors and vertical stacks.
 - Position and sizes of all type of control valves and all other plant and equipment.
 - Position of cleaning eye / access doors and opening panels in soil/waste disposal system.
 - Original installation and Maintenance manual of all types of equipment.
 - Location of all mechanical equipment with layout and piping connections.
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11. MAINTENANCE MANUAL

Upon completion and commissioning of works, the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and PMC's site representative and two for Clients Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment. The manuals shall include:

- i. Description of the work carried out / installed.
- ii. Operating instructions.
- iii. Maintenance instructions including procedures for preventive maintenance.
- iv. Manufacturers catalogues.
- v. Spare parts list.
- vi. Trouble shooting charts.
- vii. Drawings
- viii. Type and routine test certificates of major items.

Details of all the bought out item should be part of this maintenance manual.

12. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labor and helpers for operating the entire installation for such periods so as to enable the Client's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Client's personnel in the operation, adjustment and maintenance of all equipment installed.

13. DEFECTS LIABILITY PERIOD

Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Client.

14. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall and no reimbursement shall be made for the extended period.

ANNEXURE – I

PART LIST OF CODES & STANDARDS

LIST OF BUREAU OF INDIAN STANDARDS AND OTHER INTERNATIONAL CODES

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below. All equipment and material being supplied by the contractor shall meet the requirements of IS and other specified.

Tariff advisory committee's regulation (fire insurance), electrical inspectorate and Indian Electricity rules and other Codes / Publications as given below:

1.	<u>Pipes and Fittings</u>	
	IS : 458	Specification for precast concrete pipes (with and without reinforcement)
	IS : 651	Salat glazed stone ware pipes and fittings.
	IS : 1239 (Part 1)	Mild steel, tubes, tubulars and other wrought steel fittings : Part 1Mild Steel tubes.
	IS : 1239 (Part 2)	Mild Steel tubes, tubulars and other wrought steel fittings : Part 2Mild Steel tubulars and other wrought steel pipe fittings.
	IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
	IS : 1538	Cast Iron fittings for pressure pipes for water, gas and sewage.
	IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
	IS : 1879	Malleable cast iron pipe fittings.
	IS : 1978	Line pipe
	IS : 1979	High test line pipe.
	IS : 2501	Copper tubes for general PMing purposes
	IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and dimensions.
	IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes : Part 2Tolerances.
	IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes : Part 3 Limits of sizes.
	IS : 3468	Pipe nuts.

	IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage(168.3 mm to 2032 mm outside diameter).
	IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste And ventilating pipes, fittings and accessories.
	IS : 4346	Specifications for washers for use with fittings for water services.
	IS : 4711	Methods for sampling steel pipes, tubes and fittings.
	IS : 6392	Steel pipe flanges
	IS : 6418	Cast iron and malleable cast iron flanges for general PMCing purposes.
	IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.
	IS:782	Specification for caulking lead (3 rd rev.)
	IS:6163	Cast Iron Low Pressure Pipes
	IS:13592	PVC Pipes
	IS:4989	HDPE Pipes for Potable water supply, Sewage and Ind. Effluent
	I.S:985	UPVC Pipes for Potable water supply
	IS:110221	Code of Practice for coating and wrapping of U.G M.S Pipelines
	IS:3114	Code of Practice for laying C.I Pipes (2 nd rev.) (Amendment 2)
2.	<u>Valves</u>	
	IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
	IS : 780	Specification for sluice valves for water works purposes (50 mm to300 mm size).
	IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
	IS : 2906	Specification for sluice valves for water works purposes (350 mm to1200 mm size)
	IS : 3950	Specification for surface boxes for sluice valves.
	IS : 5312 (Part 1)	Specification for swing check type reflux (non-return) valves : part 2Multi door pattern.
	IS : 5312 (Part 2)	Specification for swing check type reflux (non-return) valves : part 2Multi door pattern.
	IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
	IS : 13095	Butterfly valves for general purposes.

3.	<u>Sanitary Fittings</u>	
	IS : 771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances.
	IS : 774	Specification for flushing cistern for water closets and urinals (other than plastic cistern)
	IS : 775	Specification for cast iron brackets and supports for wash basins and sinks
	IS : 781	Specification for cast copper alloy screw down bib taps and stop valves for water services.
	IS : 1700	Specification for drinking fountains.
	IS : 2548 (Part 2)	Specification for plastic seats and covers for water closets : Part 1Thermoset seats and covers.
	IS : 2556 (Part 1)	Specification for vitreous sanitary appliances (Vitreous china) : Part 1 General requirement.
	IS : 2556 (Part 2)	Specification for vitreous sanitary appliances (vitreous china) : Part2 Specific requirements of wash-down water closets.
	IS : 2556 (Part 3)	Specification for vitreous sanitary appliances (vitreous china) : Part3 Specific requirements of squatting pans.
	IS : 2556 (Part 4)	Specification for vitreous sanitary appliances (vitreous china) : part 4specific requirements of wash basins.
	IS : 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china) : part 6Specific requirements of urinals, section 2 half stall urinals.
	IS : 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china) : Part6 specific requirements of urinals, section 4 partition slabs.
	IS : 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china) : Part6 Specific requirements of urinals, section 5 waste fittings.
	IS : 2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china) : Part6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
	IS : 2556 (Part 7)	Specification for vitreous sanitary appliances (vitreous china) : Part7 Specific requirements of half round channels.
	IS : 2556 (Part 8)	Specification for vitreous sanitary appliances (vitreous china) : Part8 Specific requirements of siphoning wash down water closets.
	IS : 2556 (Part 11)	Specification for vitreous sanitary appliances (vitreous china):Part11 Specific requirements for shower rose.

	IS : 2556 (Part 12)	Specification for vitreous sanitary appliances (vitreous china) : Part12 Specific requirements of floor traps.
	IS : 2556 (Part 15)	Specification for vitreous sanitary appliances (vitreous china) : Part

		15 Specific requirements of universal water closets.
	IS : 2692	Specification for ferrule for water services
	IS : 2717	Glossary of terms relating to vitreous enamelware and ceramic metal systems
	IS : 2963	Specifications for waste plug and its accessories for sinks and washbasins.
	IS : 3311	Specification for waste plug and its accessories for sinks and washbasins.
	IS : 5961	Specification for cast iron gratings for drainage purposes.
	IS : 6249	Specification for gel-coated glass fiber reinforced polyester resin bath tubs.
	IS : 6411	Specification for gel-coated glass fiber reinforced polyester resin bath tubes.
	IS : 8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
	IS : 9758	Specification for flush valves and fitting for water closets And urinals.
4.	Water Quality Tolerance	
	IS : 3025 (Parts 1 to 44)	Method of sampling and test (physical and chemical) for water and waste water.
	IS : 4764	Tolerance limits for sewage effluents discharged into inland surface waters.
	IS : 10500	Drinking Water
5.	Pumps & Vessels	
	IS : 1520	Specification for horizontal centrifugal pumps for clear cold freshwater.
	IS : 2002	Steel plates for pressure vessels for intermediate and High temperature service including boilers.
	IS : 2825	Code for unfired pressure vessels.
	IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for Chemical processes Part 1 : Rubber lining.
	IS : 5600	Specification for sewage and drainage pumps

	IS : 8034	Specification for submersible pump sets for clear, cold, fresh water.
	IS : 8418	Specification for horizontal centrifugal self-priming pumps.

6.	<u>General</u>	
	National Building Code of India 2005 Part IV and Part IX	
	Uniform Plumbing Code of India 2008	
	SP : 6 (1)	Structural Steel Sections
	IS : 325	Three Phase Induction Motors
	IS: 456	Code of practice for plain and reinforced concrete (3 rd rev.) (Amendment 2)
	IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
	IS : 694	PVC insulated cables for working voltages upto & including 1100 V.
	IS : 779	Specification for water meters (domestic type).
	IS : 782	Specification for caulking load.
	IS : 800	Code of practice for general construction in steel
	IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
	IS : 1172	Code of Basic requirements for water supply drainage and sanitation
	IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners : Part 1 introduction and general information.
	IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners : Part 2 product grades and tolerances.
	IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables : Part 1 for working voltages upto and including 1100 V.
	IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables : Part 2 for working voltages from 3.3 KV upto and including 11 KV.
	IS : 1726	Specification for cast iron manhole covers and frames.
	IS : 1742	Code of practice for building drainage.
	IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
	IS : 2065	Code of practice for water supply in buildings.

	IS : 2104	Specification for water meter for boxes (domestic type)
	IS : 2373	Specification for eater meter (bulk type)
	IS : 2379	Colour code for identification of pipe lines.

	IS : 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
	IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
	IS : 3114	Code of practice for laying of cast iron pipes
	IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1manholes.
	IS : 4127	Code of practice for laying glazed stoneware pipes.
	IS : 4853	Recommended practice for radiographic inspection of Fusion welded butt joints in steel pipes.
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
	IS : 5455	Cast iron steps for manholes.
	IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
	IS : 7558	Code of practice for domestic hot water installations.
	IS : 8321	Glossary of terms applicable to plumbing work.
	IS : 8419 (Part 1)	Requirements for water filtration equipment : Part 1 Filtration medium sand and gravel.
	IS : 8419 (Part 2)	Requirements for water filtration equipment : Part 2 under drainage system.
	IS : 9668	Code of practice for provision and maintenance of water supplies and firefighting.
	IS : 9842	Preformed fibrous pipe insulation.
	IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
	IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
	IS : 10446	Glossary of terms relating to water supply and sanitation.
	IS : 11149	Rubber Gaskets
	IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings..

	IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings : Part 1 water supply.
	IS : 12251	Code of practice for drainage of building basements.

	IS : 5572	Code of practice for sanitary pipe work.
	BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
	BS : 8301	Code of practice for building drainage.
	BSEN : 274	Sanitary tap ware, waste fittings for basins, bidets and baths. General technical specifications.

7	Fire Fighting	
	IS-8757	Glossary of terms associated with fire safety
	IS-884.	Specification for first-aid hose reel for fire fighting
	IS-901.	Specification for couplings, double male and double female instantaneous pattern for firefighting.
	IS-902.	Specification for fire hose delivery couplings, branch pipe, nozzle and nozzle spanner.
	IS-903.	Specification for fire hose delivery couplings, branch pipe, nozzle and nozzle spanner.
	IS-904.	Specification for two way and three – way suction collecting heads for firefighting purposes.
	IS-907.	Specification for suction strainers, cylindrical type for firefighting purpose.
	IS-908.	Specification for fire hydrant, stand post type.
	IS-909.	Specification for underground fire hydrant.
	IS-636.	Non percolating flexible firefighting delivery hose.
	IS-7637.	Glossary of terms for firefighting equipment.
	IS-937.	Specification for washers for water fittings for firefighting purposes.
	IS-1641.	Code of practice for fire safety of buildings (general): General principles.
	IS-1642.	Code of practice for fire safety of buildings (general): Details of Construction.
	IS-1643.	Code of practice for fire safety of buildings (general): Exposure hazard.
	IS-1644.	Code of practice for fire safety of buildings (general): Exit requirements and personal hazard.
	IS-1646.	Code of practice for fire safety of buildings (general): Electrical installations
	IS-2871.	Specification for branch pipe, universal for firefighting purposes.
	IS-2930.	Functional requirements for hose laying tender for fire

		brigade use.
	IS-5290.	Specification for landing valves.
	IS-8090.	Specification for couplings, branch pipe, nozzle, used in hose reel tubing for firefighting.
	IS-8442.	Specification for stand post type water monitor for firefighting.

	IS-9972.	Specification for automatic sprinkler heads.
	IS-11101.	Specification for extended branch pipe for fire brigade use.
	IS-12349.	Fire protection-Safety sign.
	IS-12407.	Graphic symbols for fire protection plan.
	IS-9668.	Code of practice for provision and maintenance of water supplies and firefighting.
	IS-3844.	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.
	IS-12585.	Specification for thermoplastic hose (Textile Reinforced)
	IS-10221.	Code of practice coating and wrapping of underground mild steel pipe lines.
	IS-15105.	Design and installation of fixed automatic sprinkler fire extinguisher system-code of Practice.
	IS-325.	Three phase induction motors.
	IS-1822.	Motor starter for voltage not exceeding 1000 volts.
	IS-3624.	Bourdon tube pressure and vacuum gauges.
	IS-1520.	Horizontal centrifugal pumps for clear, cold, fresh water.
	IS-1239.	Mild steel tubes, tubular and other wrought steel fittings.
	IS-3589.	Electrically welded steel pipes for water, gas and sewage.
	IS-6392.	Steel pipe flanges.
	IS-778.	Gun metal gate, globe and check valves for general purpose.
	IS-2592.	Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles.
	IS-732.	Code practice for electrical wiring and fittings of building.
	IS-900.	Code of practice for installation and maintenance of induction motor.
	IS-1248.	Direct acting electrical indicating instruments.
	IS-2516.	A.C.circuit breakers for voltages not exceeding 1000 volts.
	IS-4047.	Heavy duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts.
	IS-2208.	HRC cartridge fuse links upto 650 volts.
	IS-1554. (Part - I).	PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.
	IS-780.	Sluice valve for water works purposes (50 to 300 mm. size).
	IS-13095.	Butterfly valves.

	IS-1992.	Selection of Fire Extinguisher
	IS-694 - 1990	PVC insulated wires / cables for working voltage up to and including 1100V.

WATER SUPPLY

GENERAL REQUIREMENTS

- (a) Any damage caused to the building, or to electric, sanitary water supply or other installations etc. therein either due to negligence on the part of the contractor, or due to actual requirements of the work, shall be made good and the building or the installations shall be restored to its original condition by the contractor.

Nothing extra shall be paid for it, except where otherwise specified.

- (b) All water supply installation work shall be carried out through licensed plumbers.
- (c) It is most important to ensure that wholesome water supply provided for drinking and culinary purposes, is in no way liable to contamination from any less satisfactory water. There shall, therefore, be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for conveying or containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose. The provision of reflux or non-return valves or closed and sealed valves shall not be construed a permissible substitute for complete absence of cross-connection.
- (d) No piping shall be laid or fixed so as to pass into, through or adjoining any sewer, scour outlet or drain or any manhole connected therewith nor through any ashpit or manure-pit or any material of such nature that would be likely to cause undue deterioration of the pipe.
- (e) Where the laying of any pipe through fouled soil or previous material is unavoidable, the piping shall be properly protected from contact with such soil or material by being carried through an exterior cast iron tube or by some other suitable means. Any piping or fitting laid or fixed, which does not comply with the above requirements, shall be removed and re-laid in conformity with the above requirements.
- (f) All pipes shall be so laid and fixed and maintained as to be and to remain completely water tight, thereby avoiding waste of water, damage to the property and the risk of contamination of the water conveyed.
- (g) The change in diameter and in direction shall preferably be gradual rather than abrupt to avoid undue loss of head. No bend or curve in piping shall be made so as to alter the cross section.
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LAYING AND JOINTING OF WATER SUPPLY PIPES AND FITTINGS**GENERAL**

SPECIFICATIONS of UNDER GROUND WORKS

1. UNLOADING :

- (a) The pipes shall be unloaded where they are required.
- (b) Unloading (except where mechanical handling facilities are available) – pipes weighing upto 60 kg shall be handled by two persons by hand passing. Heavier pipes shall be unloaded from the lorry or wagon by holding them in loops, formed with ropes and sliding over planks set not steeper than 45 degree. The planks shall be sufficiently rigid and two ropes shall always be used to roll the pipes down the planks. The ropes should be tied on the side opposite the unloading. Only one pipe shall be unloaded at a time.
- (c) Under no circumstances shall the pipes be thrown down from the carriers or be dragged or rolled along hard surfaces.
- (d) The pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded.

2. STORING :

- (a) The pipes and specials shall be handled with sufficient care to avoid damage to them. These shall be lined up on one side of the alignment of the trench socket facing up grade when line runs uphill and upstream when lines run on level ground.
- (b) Each stack shall contain pipes of same class and size, consignment or batch number and particulars of the suppliers, wherever possible, shall be marked on the stack.
- (c) Storage shall be done on firm, level and clean ground. Wedges shall be provided at the bottom layer to keep the stack stable.

3. CUTTING :

- (a) Cutting of pipes may be necessary when pipes are to be laid in lengths shorter than the lengths supplied, such as while replacing accessories like tees, bends, etc. at fixed position in the pipe lines.
- (b) A line shall be marked around the pipe with a chalk piece at the point where it is to be cut. The line shall be so marked that the cut is truly at right angle to the longitudinal axis of the pipe.

4. TRENCHES :

- (a) The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.
 - (b) Cover shall be measured from top of pipe to the surface of the ground. In general
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the cover should be 1000 mm unless specified in drawings.

- (c) The minimum width of the trench should be “D + 400 mm”, where, D is outer diameter of the pipe
- (d) For pipes with diameter less than 1200 mm, the bed of the trench shall be excavated to the pipe grades so that uniform support is assured for the full length of the pipe.
- (e) The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layer.
- (f) If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe or provide lean cement concrete as required and specified..
- (g) After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.
- (h) Roots of trees within a distance of about 0.5 meter from the side of the pipe line shall be removed or killed.
- (i) The excavated materials shall not be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling that may be re-laid and compacted in the same order to the satisfaction of the PMC-in-charge.
- (j) The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after dewatering the trenches.
- (k) Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water main cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the PMC-in-charge.
- (l) When pipes are laid under road and pavements, subjected to heavy traffic loads, the trench may be covered with RCC slabs of suitable dimensions.

5. LAYING :

- (a) The pipes shall be lowered into the trench by means of suitably pulley blocks, sheer legs
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chains ropes etc. In no case the pipes shall be rolled and dropped into the trench. One end of each rope may be tied to a wooden or steel peg driven into the ground and the other end held by men which when slowly released will lower the pipe into the trench. After lowering, the pipes shall be arranged so that the spigot of one pipe is carefully centered into the socket of the next pipe, and pushed to the full distance that it can go. The pipe line shall be laid to the levels required. Specials shall also be laid in their proper position as stated above.

(b) Where so directed, the pipes and specials may be laid on masonry or concrete pillars. The pipe laid on the level ground, shall be laid with socket facing the direction of flow of water.

(c) In unstable soils, such as soft soils and dry lumpy soils it shall be checked whether the soils can support the pipe lines and if required suitable special foundation shall be provided.

6. THRUST BLOCKS :

(a) Thrust blocks are required to transfer the resulting hydraulic thrust from the fitting of pipe on to a larger load bearing soil section.

(b) Thrust blocks shall be installed wherever there is a change in the direction / size of the pipe line or the pressure line diagram, or when the pipe line ends at a dead end. If necessary, thrust blocks may be constructed at valves also.

(c) Thrust blocks shall be constructed taking into account the pipe size, water pressure, type of fitting, gravity component when laid on slopes and the type of soil.

7. BACK FILLING AND TAMPING :

(a) Back filling shall follow pipe installation as closely as possible to protect pipe from falling boulders, eliminating possibility of lifting of the pipe due to flooding of open trench and shifting pipe out of line by caved in soil.

(b) The initial back fill material used shall be free of large stones and dry lumps.

(c) The initial back fill shall be placed evenly in a layer of about 100 mm thick. This shall be properly consolidated and this shall be continued till there is a cushion of at least 300 mm of cover over the pipe.

(d) If it is desired to observe the joint or coupling during the testing of mains they shall be left exposed. Sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing.

8. HYDROSTATIC TESTS :

(a) After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests :

(i) **Pressure test :** At a pressure of at least 1.5 times the maximum working pressure-pipe and joints shall be absolutely water tight under the test.

- (ii) **Leakage test :** (To be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for a duration of two hours.
- (b) **Hydrostatic Tests :** The portions of the line shall be tested by subjecting to pressure test as the laying progresses before the entire line is completed. In this way any error of workmanship will be found immediately and can be corrected at a minimum cost. Usually the length of the section to be tested shall not exceed 500m.
- (c) Where any section of a main is provided with concrete thrust blocks or anchorages, the pressure test shall not be made until at least five days have elapsed after the concrete is cast. If rapid hardening cement has been used in these blocks or anchorages, test shall not be made until at least two days have elapsed.
- (d) Prior to testing, enough back fill shall be placed over the pipe line to resist upward thrust. All thrust blocks forming part of the finished line shall have been sufficiently cured and no temporary bracing shall be used.
- (e) The open end of the section shall be sealed temporarily with an end cap having an outlet which can serve as an air relief vent or for filling the line, as may be required. The blind face of the end cap shall be properly braced during testing by screw jacks and wooden planks or steel plate.
- (f) The section of the line to be tested shall be filled with water manually or by a low pressure pump. Air shall be vented from all high spots in the pipe line before making the pressure strength test because entrapped air gets compressed and caused difficulty in raising the required pressure for the pressure strength test.

PROCEDURE FOR PRESSURE TEST :

1. Each valve section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants and blow offs. If these are not available at high places, necessary tapping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.
 2. If the trench has been partially back-filled the specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the PMC-in-charge. The duration of the test shall not be less than 5 minutes.
 3. **Examination under Pressure :** All exposed pipes, fittings, valves, hydrants and joints should be carefully examined during the open-trench test. When the joints are made with lead, all such joints showing visible leaks shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the authority. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until satisfactory to the PMC-in-charge.
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4. If the trench has been back-filled to the top, the section shall be first subjected to water pressure normal to the area and the exposed parts shall be carefully examined. If any defects are found, they shall be repaired and the pressure test repeated until no defects are found. The duration of the final pressure tests shall be at least one hour.

PROCEDURE FOR LEAKAGE TEST :

1. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled the water and the air expelled.

No pipe installation shall be accepted until the leakage is less than the number of cm³/h determined by the formula :

$$ql = ND P / 3.3$$

Where
ql = the allowable leakage in cm³/h.

N = number of joints in the length of the pipe line.
D = diameter in mm, and
P = the average test pressure during the leakage testing
kg/cm².

2. **Variation from Permissible Leakage :** Should any test of pipe laid in position discloses leakage greater than the specified in para 5 the defective joints shall be repaired until the leakage is within the specified allowance.

CPVC PIPES FOR WATER SUPPLY DISTRIBUTION NETWORK

The scope of this specifications cover pipes & fittings using CPVC Compound. The CPVC compound shall confirm to NSF certification for use in drinking / portable water. It also covers general & technical properties of the CPVC pipes, fittings, the basic compound, installation procedures, cement solvent details, special fittings, Concealed & external plumbing etc.

STANDARDS & SPECIFICATIONS

IS : 15778 : 2007- Specification for Chlorinated Poly Vinyl Chloride (CPVC) Pipes for Potable Hot & Cold water distribution systems.

ASTM D1784 -Standard Specification for Rigid Poly Vinyl Chloride (PVC) and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.

ASTM D2846 - Specification for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Hot & Cold water distribution systems.

ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe & Fittings.

Technical Details of CPVC

{Abbreviations: **OD** Outer Dia., **ID** Inner Dia., **WT** Wall Thickness.}

General Properties:

Specific Gravity	ASTM D 792	23°C	1.55
Specific Volume	ASTM D 570	23°C	0.645cm ³ /g
Water Absorption	ASTM D 785	23°C	+0.03%
		100°C	+0.55%

MECHANICAL

Izod Impact	ASTM D 256	23°C	80J/mo.n
Tensile Strength	ASTM D 638	23°C	55N/mm ²
Flexural Strength	ASTM D 790	23°C	104N/mm ²
Compressive Strength	ASTM D 695	23°C	70N/mm ²

TECHNICAL DETAILS

Outside Diameter and Wall Thickness for CPVC SDR 11 as per ASTM D-2846 Plastic Pipe

Nominal Size (MM)	Avg. OD MM (SDR II)	Tolerance (MM)	Min. Wall Thickness MM(SDR II)	Tolerance (MM)
15	15.90	+/- 0.08	1.70	+ 0.51
20	22.20	+/- 0.08	2.00	+ 0.51
25	28.60	+/- 0.08	2.59	+ 0.51
32	34.90	+/- 0.08	3.18	+ 0.51
40	41.30	+/- 0.10	3.76	+ 0.51
50	54.00	+/- 0.10	4.90	+ 0.58

CPVC SDR 11 Pipe Pressure Rating vs Temperature Table

Operating Temperature	Working Pressure Rating (kg/cm ²)
	SDR II
	15 TO 50 MM DIA
23°C	28.10
27°C	28.10
32°C	25.57
38°C	23.05
43°C	21.64
49°C	18.27
54°C	17.42
60°C	14.05
66°C	13.21
71°C	11.24

77°C	8.99
82°C	7.03
93°C	5.62

Outside Diameter and Wall Thickness for CPVC Schedule 80 as per ASTM F 441 Plastic Pipe

Nominal Size (MM)	Avg. OD MM (Sch 80)	Tolerance (MM)	Min. Wall Thickness MM(Sch 80)	Tolerance (MM)
65	73.0	+/- 0.18	7.01	+ 0.84
80	88.9	+/- 0.20	7.62	+ 0.91
100	114.3	+/- 0.23	8.56	+ 1.02
150	168.3	+/- 0.28	10.97	+ 1.32
200	219.1	+/- 0.38	12.70	+ 1.52
250	273.1	+/- 0.38	15.06	+ 1.80

CPVC Sch 80 Pipe Pressure Rating vs Temperature Table

Nominal Size (mm)	Working Pressure Rating (kg/cm ²)
	Sch 80
	(23°C)
65	29.53
80	26.01
100	22.50
150	19.69
200	17.57
250	16.17

JOINING CPVC PIPES & FITTINGS

CUTTING –

In order to make a proper and neat joint, measure the pipe length accurately and make a small mark. Ensure that the pipe and fittings are size compatible. Cut the pipe with a plastic pipe cutter or hacksaw blade. Cutting tubing as squarely as possible provides optimal bonding area within a joint.

All Domestic pipes within the shaft and toilets for domestic, flushing and hot water distribution systems (in chases or under the floor) shall be with CPVC Pipes & Fittings confirming to IS:15778.

DEBURRING / BEVELING –

Burrs and fillings can prevent proper contact between tube and fitting during assembly and should be removed from the outside and inside of the pipe. Debarking tool, pocket knife or file is suitable for this. A slight bevel on the end of the tubing will ease entry of the tubing into the fitting socket.

FITTING PREPARATION -

Using a clean, dry rag, wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

SOLVENT CEMENT APPLICATION –

Use only CPVC cement or an all – purpose cement conforming to ASTM F 493 or joint failure may result. When making a joint, apply a heavy, even coat of coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged water ways.

ASSEMBLY –

Immediately insert the tubing into the fitting socket, rotate the tube ¼ to ½ turn while inserting. This motion ensures and even distribution of cement within the joint. Properly align the fittings. Hold the assembly for approximately 10 seconds, allowing the joint to set-up.

SET AND CURE TIMES –

Solvent cement set and cure times are a function of pipe size, temperature and relative humidity. Curing time is shorter for drier environments, smaller sizes and higher temperatures. It requires 10 to 20 minutes for perfect joint.

MINIMUM CURE TIME PRIOR TO PRESSURE TESTING AT 150 PSI (10 BAR)		
Ambient Temperature During Cure Period	Pipe Sizes	
	15 to 25 mm dia.	32 to 50 mm dia.
Above 15°C	1 Hour	2 Hours
4 - 15°C	2 Hours	4 Hours
Below 4°C	4 Hours	8 Hours

TESTING

Once an installation is completed and cured as per these recommendations. The system should be hydrostatically pressure tested at 1.25 times the working pressure or 10 bar for one hour

(whichever is more) is recommended. When pressure testing, the system should be filled with water and all air bled from the highest and farthest points in the run. If a leak is found, the joint must be cut out and discarded. A new section can be installed using couplings. During sub- freezing temperatures, water should be blown out of the lines after testing to eliminate potential damage from freezing. Air testing is not recommended.

HANDLING AND STORAGE

Reasonable care should be exercised in handling CPVC tubing and fittings. They should not be dropped, stepped on, or have objects thrown on them. If improper handling or heavy impact results in cracks, splits or gouges, the damaged section should be discarded. CPVC tubing should be covered with a non-transparent material when stored outdoors for long periods of time. When installing CPVC pipe and fitting in an area that is exposed to direct sunlight for an extended period of time, protect the pipe with insulation or an acrylic water based white paint.

HANGER AND SUPPORTS

For vertical / horizontal runs, support at maximum of 1.5 meter intervals for all diameter is desired. Piping should not be anchored tightly to supports, but rather secured with smooth straps or hangers that allow for movement caused by expansion and contraction.

SAFE HANDLING OF SOLVENT CEMENT

When using solvent cements, primers and cleaners there are some basic safety measures all users should keep in mind.

Avoid prolonged breathing of solvent vapors. When pipe and fittings are being joined in enclosed areas, the uses of ventilating devices are advised.

Keep cements, primers and cleaners away from all sources of ignition, heat, sparks and open flame.

Keep containers of cements, primers and cleaners tightly closed except when the product is being used.

Dispose of all rags used with solvents in a proper outdoor waste receptacle.

Avoid eye and skin contact. In case of eye contact, flush with plenty of water for 15 minutes and call a physician.

PEX PIPES & FITTINGS

The flexible non-corrosive pipe-in pipe solution with manifold for controlling open/shut operation of individual fixture/fitting with very impressive pressure performance graph ($\frac{1}{2}$ " pipe: at 23 degree C 33.1 bar: at 82.2 degree C 14.8 bar: at 93.3 degree 12.8 bar, $\frac{3}{4}$ " pipe: at 23 degree C 32.7 bar: at 82.2 degree C 14.5 bar: at 93.3 degree 12.4 bar). Installation requires no skilled laborers, reduces water hammer effect, prevents lime build-up due to smooth internal surface and eliminates electrolysis, no deterioration from PH levels. The system requires less fittings and joints, reducing potential for leakages, requires no threading, no cement solution and no electro/butt fusion/welding, the system is user friendly and can be installed in much lesser time as compared to other solutions available.

Tolerances

Acceptable tolerance for pipes shall be as given in the relevant Indian standard.

Fittings

Fittings shall conform to the same Indian Standard as for pipes. Pipes and fittings must be of matching I.S.Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

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

SS PIPES & FITTINGS

All drinking water supply pipes systems shall be Stainless steel pipes of grade AISI 304/316L as per JIS standard 3448 complete The fitting shall also be of stainless steel press fit design of grade AISI 304/ 316 L.

The fixing technique used press fitting with simple cold mounting. The fitting is quick, solid and permanent. This involves clamping the fittings around an integral polymeric seal using an electro- mechanical tool. This technique takes less time and less manpower for a large installation than other jointing methods. As this method is also flame free, quick-to-joint and low weight, the installation cost can be substantially reduced.No pipes shall be run inside as sunken floor as far as possible. Pipes may be run under the ceilings or floors and other areas as shown in drawings. Specialized workmen to be provided for SS piping.

D.I PIPES & FITTINGS

The Ductile Iron Pipes with internal cement mortar lining and external Zinc coating with finishing layer of Bitumen; manufactured, tested and duly marked in strict accordance with and confirming to IS: 8329/2000 (as per latest amendment); suitable for push-on Jointing, along-with one number Rubber Gaskets for each length of pipe (EPDM Gasket as per IS: 5382/1985).

G.I PIPES & FITTINGS

The pipes shall be galvanised mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS: 1239. The Galvanising shall conform to IS:4736, the zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly, and square with the axis of the pipe.

The fittings shall be malleable iron and comply with all the requirements of the pipes. The sizes of pipes and fitting is specified in the schedule of quantities.

Laying and Jointing of GI Pipes

The galvanised pipes and fittings shall run in wall chase or ceiling or as specified. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 cm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted for pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be painted with anticorrosive bitumastic paints of approved quality. Under the floors the pipe shall be laid in layer of sand filling.

Galvanised iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes after threading. Teflon tape, White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer's instructions, with a grommet of a few strands of fine yarn while tightening. Compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion.

PIPING INSTALLATION SUPPORT (VALID FOR GI PIPING ONLY)

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanised steel sections.

Pipe hangers shall be provided at the following maximum spacings:

Pipe Dia(mm)	Hanger Rod Dia (mm)	Spacing between Supports(m)
Up to 25	6	2
32 to 50	10	2.7
80 to 100	12	2.7
125 to 150	16	3.6
200 to 300	19	5.3

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge metal sheet shall be provided between the insulation and the clamp, saddle or roller, extending atleast 15 cm. on both sides of the clamps, saddles or roller.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

All buried pipes for CWS shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet coating.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size isolation ball valve. Automatic air valves shall also be provided on hot water risers.

Discharge from the air valves shall be piped through a galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings and include in Bill of Quantities. Care shall be taken to protect pressure gauges during pressure testing.

Temperature gauge as specified shall be provided at the hot water supply and return and as shown on drawings and included in Bill of Quantities.

FERRULES

The ferrules for connection with main shall generally conform to IS:2692. It shall be of non-ferrous materials with a bell mouth cover and shall be of nominal bore as specified. The ferrule shall be fitted with a screw and plug or valve capable of completely shutting off the water supply to the communication pipe, as and when required.

Fixing Ferrules

For fixing ferrule in cast iron mains, the empty main shall be drilled and tapped at 45 deg to the vertical and the ferrule screwed in. The ferrule must be so fitted that no portion of the shank shall be left projecting within the main into which it is fitted.

VALVE CHAMBERS

Provision of suitable brick masonry chambers in cement mortar 1:5 (1 cement : 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement:5 fine sand : 10 graded stone aggregate 20 mm nominal size) with 15 mm thick cement plaster inside and outside finished with a plaster inside and outside finished with a floated coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back-filling complete shall be made.

VALVES

All valves (gate, globe, check, safety) shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard IS:776 and non-return valves and swing check type reflux to IS:5312.

Sluice valves

Sluice valves, where specified shall be flanged sluice valves of cast iron body. The spindle, valve seat and wedge nuts shall be gunmetal. They shall generally have non-rising spindle and shall be of the particular duty and design as specified. The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian standard IS:780 and IS:2906.

Butterfly valve

The butterfly valve shall be suitable for waterworks and rated Pressure requirement as mentioned in the Schedule of quantities.

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

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 EN 8 grade carbon steel.

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 leakages.

Ball valve

The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

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.

The handle shall be provided 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.

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

Ball float valve

Ball valves with floats to be fixed in storage tanks shall consist of cast brass lever arm having copper balls (26 SWG) screwed to the arm integrally. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers. The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system. Where called for brass valves

shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe.

Globe valves on Hot-water line shall be union bonnet with stem/disc and body seat ring of SS. Suitable for temperature upto 80° C.

S.No	Type of Valve	Size	Construction	Ends
a.	Isolating Valve	15 mm to 50 mm 65 mm and above	Gun Metal Gun Metal	Screwed Flanged
b.	Sluice Valve & Butterfly Valve	65 mm and above	Cast Iron	Flanged
c.	G.M. non return valve	15 mm to 50 mm 65 mm above	Gun Metal Gun Metal	Screwed Flanged
d.	Flap Type – Non return valve	65 mm and above	Cast Iron	Flanged

All valves shall be suitable for the working pressure involved.

Gun metal valve

Gun metal Valves shall be used for smaller dia pipes, and for threaded connections. The Valves shall bear certification as per IS : 778.

The body and bonnet shall be of gun metal to IS : 318. The stem gland and gland nut shall be of forged brass to IS : 6912. The hand wheel shall be of cast iron to IS : 210.

The Hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non rising type.

Non-return valve

Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS : 5312.

Pressure Reducing Valve Set

Each pressure reducing valve set shall be complete with pressure reducing or pressure regulating valve, isolating valves, pressure gauges (fix with symphonic check) on inlet and outlet, pressure relief valve on outlet and filter on inlet.

Each pressure reducing valve shall contain loading neoprene diaphragm and a full floating, self aligning, ignition resistant seat and shall be of the single stage, pressure reduction type with provision for manually adjusting the delivery pressure. The valve shall fail safe to the low pressure.

Valves shall be capable of operating at the maintaining automatically the respective delivery pressure and flow rates as indicated and shall not be liable to creep. Valves shall also be capable of maintaining the pre-set down stream pressure under static condition.

The filter on each inlet to a pressure reducing valve shall be of replaceable porous sintered metal

type.

Pressure Relief Valves

Each pressure relief valve shall be of the fully enclosed type and fitted with hand easing gear.

Each pressure relief valve in a pressure reducing station shall have a flow capacity equal to that of the pressure reducing valve.

Pressure relief valves in locations other than reducing stations shall have flow capacities equal to that of the associated equipment.

Pressure Gauge

The pressure gauge shall be constructed of die cast aluminium and stove enamelled. 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 / cm square and shall be constructed as per IS:3524. Each pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by Ball Valve.

Calibration certificate shall be obtained and submitted for each pressure gauge.

WATER FITTINGS

Unless otherwise specified all Gunmetal fittings such as gate, globe, check & safety valves shall be fitted in pipe line in workman like manner. Necessary unions shall be provided on both ends of the valves for easy replacement. The joints between fittings and pipes shall be leak-proof when tested to desired pressure rating. The defective fittings and joints shall be replaced or redone.

PAINT:

Used paints and coatings that comply with the following limits for VOC content and the following chemical restrictions:

Non-Flat Paints and Coatings: VOC not more than 150 g/L.

Anti-Corrosive Coatings VOC not more than 250 g/L.

Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

Paints and coatings shall not contain any of the following: Acrolien

AcrylontrileAntimony

Benzene

Buty benzyl phthalateCadmium

Di (2-ethylheyl) phthalateDi-n-butyl
phthalate

Di-n-octy phthalate 1,2-
dichlorobenzeneDiethy phthalate
Dimenthyl phthalateEthyl

benzene

Painting:

Water supply pipes in exposed, in shafts shall be painted with two or more coats of ready mix Low-VOC oil paint to give an even shade before painting all dust and extraneous matter shall be removed.

Paint shall be of approved quality and shade. Where directed by the Owner's site representative pipes shall be painted in accordance with approved pipe colour code.

Pipe in chase shall be painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with synthetic enamel paint after removing dust and extraneous matter.

Water supply pipes below ground and covered in cement concrete shall not be painted.

CONNECTIONS TO VARIOUS MECHANICAL EQUIPMENT SUPPLIED BY OTHER AGENCIES

All inlets, outlets, valves, piping and other incidental work connected with installation of mechanical equipment supplied by other agencies all be carried out by the contractor in accordance with the drawings, requirements for proper performance of equipment, manufacturers instructions and the directions of the Owner's site representative / Architect. The equipments to be supplied by the other agencies consist mainly for Kitchen, Back-of-the- House area and other similar areas. The work of connections to the various equipments shall be effected through proper unions and isolating valves. The work of effecting connections shall be executed in consultation with and according to the requirement of equipment suppliers, under the directions of the Owner's site representative / Architect. The various aspects of connection work shall be executed in a similar way to the work of respective trade mentioned elsewhere in these specifications.

CONNECTIONS TO RCC WATER TANKS

The contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator to water storage tanks as called for. All pipes crossing through RCC work shall have puddle flanges fabricated from MS/GI pipes of required size and length and welded to 6/8 mm thick MS plate. All puddle flanges must be fixed in true alignment and level to ensure further connection in proper order. Full way gate valves of a approved make shall be provided as near the tank as practicable on every outlet pipe from the storage tank except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof grating.

The overflow pipe shall be so placed to allow the discharge of water being readily seen. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be emptied for cleaning. The floor and the walls of the tank shall be tiled with glazed tiles up to the overflow level. Alternatively food grade epoxy to be applied.

Tiling of Walls

The floor and the walls of the tanks shall be tiled with glazed tiles up to the overflow level. Alternatively food grade epoxy to be applied to the floor and the walls of the tanks.

MEASUREMENTS

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include pipe and fittings such as coupling, bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions. Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Tender.

All pipes below ground shall be measured per linear meters (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, deduction for valves shall be made rate quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chase and making good all item mentioned in Tender.

LAWN HYDRANTS

Lawn hydrants shall be of 25mm size unless otherwise indicated. All hydrants shall be provided with gate valves and threaded nipple to receive hose pipes. Lawn hydrant valves shall be of approved make and design. Where called for lawn hydrants shall be located in masonry chambers of appropriate size.

PIPE PROTECTION (FOR COLD WATER PIPES BURIED IN TRENCHES / GROUND / EARTH)

All buried pipes shall be cleaned with zinc chromate primer and bitumen paint, wrapped with three layers of fiber glass tissue, each layer laid in bitumen and placed on concrete blocks with PUF saddles dipped in bitumen at every 2 meters. The pipes where laid under floor shall be encased with 100 mm thick good quality, river sand all around in addition to protective coating as described above. Alternatively pypcoat / coated insulation for protection of pipe would also be acceptable as per final approval of project PMC / consultant.

THRUST BLOCKS

In case of bigger pipes (80 mm dia and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Owner's site representative.

MASONRY CHAMBER

- i. All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per supplied drawings.
 - ii. The excavation for chambers shall be done true to dimension and level indicated on plans or as directed by the Owner's site representative.
 - iii. Concrete shall be having cement concrete 1:3:6 (1 cement: 3 coarse sand: 6
-

graded stone aggregate 40 mm nominal size.

- iv. Brick shall be of class designation 75 in cement mortar 1:5 (1 cement: 5 fine sand)
- v. Inside Plastering not less than 12 mm thick shall be done in cement mortar 1:3 (1 cement : 3 fine sand) finished with a floating coat of neat cement.

SHIFTING OF EXCAVATED SURPLUS MATERIAL

Contractor shall make his own arrangement to shift the surplus excavated material within the site limits as directed by PMC's site representative at free of cost within time limit.

SOIL, WASTE, VENT AND RAIN WATER PIPES AND FITTINGS (REINFORCED POLYPROPYLENE PIPES)

1 SCOPE OF WORK

The scope of this section comprises the supply, installation, testing and commissioning of internal soil, waste, and vent pipes.

2 BASIC PIPING SYSTEM

PP is a sound-absorbing, hot water resistant pipe system that is suitable for all pressure less sewage pipes according to DIN EN 12056 and DIN 1986-100. The pipes and molded parts are made of PP mineral reinforced Polypropylene, so that general sound protection is guaranteed from the extraction positions to the manifold. Although it is conceived as a sound-absorbing sewage pipe, PP mineral filled is also permitted as main pipe up to the building's connection duct. Low noise can be delivered in the DN 50 to DN 200 dimensions with the density of 1.9 gm/cm³. Low noise has long life, and like all plastic materials, it is corrosion-resistant and resistant to aggressive effluents. No crust formation takes place due to the smooth surface. The lesser weight in comparison with metallic pipes and the quick, safe plug-in fittings of the system make it easy to lay.

PP mineral filled is resistant to hot water and fulfills the requirements of DIN 1986, which means 95°C short term and 90°C long term temperature loading. It can be used for the drainage of wastewater between pH 2 and pH 12, eg. in professional kitchens up to the building's connection duct.

3 SOUND PROTECTION PROPERTIES

The excellent sound protection properties of PP mineral filled can be attributed primarily to its thick-walled design as well as special molecular structure and the high density of 1.9 gm/cm³ of the pipe and moulded parts. This property enables Low noise to absorb air as well as mechanical vibrations. A contribution to sound protection is also made by the compensator socket that functions as the control connector between low noise pipes. At a maximum of every 3m it isolates the sewage pipe from the following system (mechanical vibration isolation).

4 TECHNICAL DATA

Polypropylene, mineral reinforced, DIN 4102 B1.

Low noise is UV stabilize and can be used exposed to sun.

Low noise has all door fittings ranges from 75 mm to 160 mm. Door fittings are also available with inner cap which makes inner surface of door much smoother.

Material properties:		
Property	Unit	Value
Density	g/cm ³	1.9
Elongation@ break	%	29
Tensile Strength	N/mm ²	13
Modulus of elasticity	N/mm ²	3800
Coefficient of linear expansion	mm/mk	0.09
Fire resistancy	DIN 4102, B1	
Life Expectancy	More than 50 years	
Chemical Resistance	Ph2- Ph12	

Pipe dimensions (mm)		
S.No	Outer diameter (mm)	(s) W. Thickness(mm)
1.	50	4.0
2.	75	4.5
3.	110	5.3
4.	160	5.3
5.	200	6.2

5 JOINTING

- (a) Make sure the spigot end and inside of socket is clean and the sealing ring is placed evenly in the socket.
- (b) When cutting pipes, make sure they are cut square. Chamfer the end cut to angle of 15° with a medium file.
- (c) A correct depth of entry of the spigot into the socket is required to allow thermal movement. To achieve this, push spigot fully into the socket (remove sealing ring at this time) and make a mark on the spigot. This bold mark indicates the correct depth of entry to allow the necessary expansion gap.
- (d) Smear rubber lubricant evenly on the chamfered spigot and the sealing ring. Then insert the spigot into socket with light twisting motion. Pull out the pipe to allow 10 mm expansion gap.
- (e) The joint is now complete and required no additional mastics, tape or cement or any other jointing sealants.

6 CUTTING AND MAKING GOOD

Pipes shall be fixed and tested as building proceeds. The contractor shall provide all necessary holes, cutouts and chases in structural members as building work proceeds.

Since, the toilets are not sunken, hence, all pipes will be suspended from the toilet floor and will be taken out to the plumbing shaft below the beam. The cut out in toilet floor will be made through core cutting after marking exact dimensions of fixtures and type of WC. The core cutting is suggested to be done at a later stage during plumbing works. Or, the necessary cutouts should be left in RCC slab during the casting.

7 PIPE PROTECTION

Where pipes are embedded in floors, slabs, columns, beams etc., they shall be given a protection by encasing them with 75 mm thick 1:2:4 cement concrete all-round the pipes and fittings as specified.

1 SCOPE OF WORK

(PVC PIPES)

The scope of this section comprises the supply, installation, testing and commissioning of internal soil, waste, vent and rain water disposal pipes.

2 BASIC PIPING SYSTEM

Soil, waste, vent and rain water pipes of 75 / 90 / 110 / 160/200 mm dia in shafts, ducts, suspended and in concealed areas i.e. sunken slab etc. shall consist of UV stabilized uPVC SWR pipes as per type B of IS:13592 & fittings as per IS:14735. The pipes and fittings shall be suitable for rubber ring joint for vertical pipes and solvent cement joint for horizontal pipe work in toilets. All fittings shall be of injection moulded type. The rubber rings shall conform to IS : 5382. The waste pipes of 65 mm and smaller dia shall be of rigid uPVC as per IS:4985 of min 6 kg / sq cm, suitable for solvent cement joints.

The wall thickness of Pipes shall be as follows –

75 mm diameter	-	wall thickness 3.2 to
3.8 mm90 mm diameter	-	wall thickness 3.2 to
3.8 mm110 mm diameter	-	wall thickness 3.2 to
3.8 mm160 mm diameter	-	wall thickness 4.0 to
4.6 mm		

Pipes shall be fixed by means of clamps in two sections, bolted together, built into the walls, wedged and neatly jointed as directed and approved by the PMC. All bends, branches, swan neck and other parts shall conform to the requirement and standards as described for the pipes. Pipes shall be rested against the walls on suitable wooden cradles. Local authority regulations applicable to the installations shall be strictly followed.

Where indicated, the soil pipes shall be continued upwards without any diminution in its diameter, without any bend or angle to the height shown in the drawings. The soil / waste pipes shall be covered on top with cowl as directed and approved. All vertical soil pipes shall be firmly fixed to the walls with properly fixed clamps, and shall as far as possible be kept 50mm clear of

wall.

Every waste pipe shall be connected to the floor trap / P trap through the PVC hopper pipe / Tee / height raiser and branch saddle strip or to a multi floor trap. No waste pipe shall be discharged over the grating. The contractor will ensure that this requirement is adequately met with. Wherever floor traps are provided, it shall be ensured that at least one wash is connected to such floor traps to avoid drying of water seal in the trap. Ventilating pipes shall be of UPVC SWR pipes, conforming to the requirements laid down earlier.

Where soil, waste and ventilating pipes are accommodated in shafts ducts, adequate access to cleaning eyes shall be provided.

The internal and external pipe surfaces shall be smooth and clean. They shall be free from grooves, obstructions or other defects. All pipe ends shall be cut cleanly and shall be perpendicular to the axis of pipes.

All fittings used in UPVC piping systems shall be of similar characteristic and same make as those of the pipes. All uPVC fittings shall be factory fabricated suitable for jointing to pipes with rubber rings for 75 / 90 / 110 / 160 mm dia and with solvent cement for 65 mm dia and below. Appropriate solvents as recommended by the pipe manufacturer shall be used for installing the pipes at site. Solvents shall be supplied to site in original manufacturer's container.

All Water closets shall be connected through WC connectors of suitable type as per site requirements.

The water seal of all floor traps which are connected into the pipe and manholes shall be minimum 50 mm as per IS : 5329. For other traps used as branch connections may have lesser water seal.

All pipes and fittings shall be stored, handled, cut, laid and installed in position strictly as per manufacturer's recommendations.

As soon as uPVC pipes and fittings are received at site, they shall be examined for their wall thickness and pressure rating. Only pipes and fittings and solvents of approved manufacture shall be used.

UPVC pipes require supports at close intervals. Recommended support spacing for PVC pipes is maximum 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

3 INSTALLATION OF SOIL, WASTE & VENT PIPES

All Horizontal pipes running below the slab and along the ceiling, shall be fixed on structural adjustable clamps, sturdy hangers of the design as called for. The pipes shall be laid in uniform slope and proper levels. The Pipes will be supported by either rubber lined G.I. U strap clamps on 50x50x5 mm MS slotted angle duly painted (for a group of pipes) or G.I. rubber lined split clamp (for independent pipes). The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. Where the horizontal run off the pipe is long or where the pipes cross over building expansion joints etc.

Use WC connectors for the connection of WC to the soil pipes. Apply rubber lubricant on WC

connector ring as well as on the outer side of WC pan.

4 JOINTING

- (a) Make sure the spigot end and inside of socket is clean and the sealing ring is placed evenly in the socket.
- (b) When cutting pipes, make sure they are cut square. Chamfer the end cut to angle of 15° with a medium file.
- (c) A correct depth of entry of the spigot into the socket is required to allow thermal movement. To achieve this, push spigot fully into the socket (remove sealing ring at this time) and make a mark on the spigot. Withdraw the spigot by 10 mm & mark the spigot with a bold line. This bold mark indicates the correct depth of entry to allow the necessary expansion gap.
- (d) Smear rubber lubricant evenly on the chamfered spigot and the sealing ring. Then insert the spigot into socket with light twisting motion. Pull out the pipe to allow 10 mm expansion gap.
- (e) The joint is now complete and required no additional mastics, tape or cement or any other jointing sealants.

5 CUTTING AND MAKING GOOD

Pipes shall be fixed and tested as building proceeds. The civil contractor shall provide all necessary holes, cutouts and chases in structural members as building work proceeds.

Since, the toilets are not sunken, hence, all pipes will be suspended from the toilet floor and will be taken out to the plumbing shaft below the beam. The cut out in toilet floor will be made through core cutting after marking exact dimensions of fixtures and type of WC. The core cutting is suggested to be done at a later stage during plumbing works. Or, the necessary cutouts should be left in RCC slab during the casting.

For Sunk Toilets and Kitchens, 110 / 125 / 160 mm dia PVC sleeve should be left in beams before its casting for passing of soil / waste pipe. The contractor should prepare shop drawing for the exact location of sleeve and get it approved from the consultant. Cutting of structural member will not be permitted at later stage

For Sunk Kitchens, a 160 / 125 mm dia PVC sleeve (as per the drawings) will be provided for crossing of waste pipe before the casting of beam (wherever required).

6 PIPE PROTECTION

Where pipes are embedded in floors, slabs, columns, beams etc., they shall be given a protection by encasing them with 75 mm thick 1:2:4 cement concrete all-round the pipes and fittings as specified in tender.

(uPVC PIPES)

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to IS:4985-1981. The pipes shall be of Class-III; 6 Kg/sqm pressure rating.

Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

Laying and Jointing

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions / direction of the Owner's site representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with GI adopter for insertion in the RCC slab for a water proof joint complete as directed by Owner's site representative.

Supports

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

Repairs

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs shall be made by replacement of the damaged section. If any split or chip out occur in the wall of the pipe, a short

piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

INSTALLATION OF SOIL, WASTE & VENT PIPES

Soil, waste & vent pipes in shafts under the floors / suspended below slab shall consist of Upvc pipes as described earlier. Waste pipes from bottle trap to floor/urinal traps for wash basin, urinal and sink shall be upvc pipes and fittings.

All Horizontal pipes running below the slab and along the ceiling, shall be fixed on structural adjustable clamps, sturdy hangers of the design as called for in the drawings. The pipes shall be laid in uniform slope and proper levels. All vertical pipes shall be truly vertical fixed by means of stout clamps in two sections, bolted together, built into the walls, wedged and neatly jointed. The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. Where the horizontal run off the pipe is long or where the pipes cross over building expansion joints etc. suitable allowance shall be provided for any movements in the pipes by means of expansion joint etc. such that any such movement does not damage the installation in any way.

All upvc pipes and fittings shall be jointed with drip seal / Best Quality pig lead free from impurities confirming to IS 27.

Before jointing, the interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of threaded spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment. The remainder of the socket is left for the lead caulking. Where the gasket has been tightly held, a jointing ring shall be placed round the barrel against the face of the socket. Molten Lead shall be poured to the remainder of the socket.

The depth of the lead joints for the cast iron pipes shall be 45mm for the pipes upto 100mm dia and 50mm for the pipes beyond 100mm dia respectively.

The joint shall not be covered till the pipe line has been tested under pressure. Rest of pipe line shall be covered so as to prevent the expansion and contraction due to variation in temperature.

SANITARY FIXTURES & CP FITTINGS

1 SCOPE

The scope of this section consists supply, installation, testing and commissioning of following items.

- a. Sanitary appliances and fixtures for toilets.
- b. Chromium plated brass fittings
- c. Stainless steel sinks in kitchen area
- d. Accessories e.g. towel rods, toilet paper holders, soap dish, towel rails, coat hooks etc.

Whether specifically mentioned or not the Contractor shall provide for all appliances and fixtures all fixing devices, nuts, bolts, screws, hangers as required.

All exposed pipes within toilets and near appliances/fixtures shall be of chromium plated brass or copper unless otherwise specified.

(Note : The supply of sanitary fixtures and bathroom fittings shall be made by the owner. The contractor has to receive, store, transport and handle the goods in proper manner. Any breakage & wastage will be in contractor's account.)

Note :The model and make of sanitary fixtures and C P Fittings will be as approved by the architect / consultant / owner.

2 GENERAL REQUIREMENTS

All glazed Vitreous China Sanitary Ware fixtures shall conform to Bureau of Indian Standards IS: 2556. The details make and type of the fixtures shall be as provided in the tender. The Vitreous China Sanitary ware shall be of one of the makes specified in the document. They shall be of non- porous and fully vitreous, with all the visible portions perfectly glazed and shall absolutely be free from hairline cracks pinholes and local depressions. It shall be perfectly symmetrical, uniform and with smooth curves. All sanitary fixtures and fittings shall be stored under covered roof and handled carefully to prevent any damage.

All materials shall be new and of quality conforming to specifications and subject to the approval of the PMC. Wherever particular makes are mentioned, the choice of selection shall remain with the Architect/Consultant.

All appliances, 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 tender, specifications, and drawings. Accessories shall include proper fixing arrangements, brackets, nuts, bolts, washers, screws and required connection pieces.

The sanitary fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the PMC and shall fully meet with the aesthetic and symmetrical requirements as demanded by the PMC.

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architect requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern as called for.

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified. Chromium plated fittings shall be cast brass chromium plated of the best quality as detailed in the tender and shall be approved by PMC prior to installation.

Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice. Manufacturer's instructions shall be followed for the installation of fixtures. Fixtures in

all toilets shall be standard height mounting as called for on the drawings. Fixtures shall be mounted rigid, plumb and true to alignment.

All appliances, fittings and fixtures shall be fixed in a neat workmanlike manner true to level and to heights shown on the drawings and in accordance with the manufacturers' 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, plaster, paint, insulation or terrace shall be made good by the Contractor at his own cost.

All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

Wall flanges shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pierce through them. These wall caps shall be of chromium plated brass snugly fitting and the receiving pipes and shall be large enough to cover the punctures properly.

Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards and the following:

Contractor shall, during the entire period of installation and afterwards, protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over (The original protective wrapping shall be left in position for as long as possible)

The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.

The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.

The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust proofed fixings shall be used. Fixing shall be done in a manner that minimize noise transmission.

Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit (e.g. ceramic unit)

Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.

Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacturer and additional anchors or supports where necessary.

Sizes of sanitary fixtures given in the Specifications or in the tender are for identification with reference to the catalogues of make considered. Dimensions of similar models of other makes may vary within $\pm 10\%$ and the same shall be provided and no claim for extra payment shall be entertained nor shall any payment be deducted on this account.

Samples of Sanitary appliances and fixtures for toilets, chromium plated brass fittings, stainless steel sinks, accessories like towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails coat hooks, hand driers, drinking water fountains etc as listed in the relevant items in the tender shall be approved by the Architect /Consultant /PMC prior to installation. The Contractor shall quote his rates for the items in the tender accordingly. The rates shall be inclusive of accessories (in such case) required for installation. Bottle traps (for wash basins, sinks, urinals etc) shall be deep seal (Min. 6 cm seal) cast brass bottle traps, heavy chromium plated. All bottle traps shall be two piece construction to enable removal of the bottom portion for cleaning purpose.

3 VITREOUS CHINA SANITARY WARE

Indian Type Water Closet

Squatting pans shall be of white vitreous china conforming to IS : 2556 Part – I for General Requirements and relevant I.S. codes for each pattern as described below :

- i) Long pattern – conforming to IS : 2556 (Part – III).
- ii) Orissa pattern – conforming to IS : 2556 (Part – III).

The flushing rim and inlet shall be of the self-draining type. It shall have weep hole at the flushing inlet to the pan. The flushing inlet shall be in the front, unless otherwise specified or ordered by the PMC-in-charge. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have grooves at right angles to the axis of the outlet. In all cases a pan shall be provided with a (100 mm) S.C.I. trap 'P' or 'S' type with approximately 50 mm water seal and 50 mm dia vent horn, where required by the PMC-in-charge or 110 mm dia UPVC WC Connector.

European Type Water Closet

Water closets shall be of white vitreous china conforming to IS : 2556 (Part-I) and 2556 (Part-II). The closets shall be of one piece construction. Water Closet shall be siphonic wash down type floor or wall mounted set, as per tender or as shown in the drawings. Wall hung WC shall be supported by C. I. floor mounted chair, which shall be fixed in a manner as approved by the PMC. Each WC set shall be provided with approved quality of seat, rubber buffers and chromium-plated hinges. Seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

The WC for the disabled toilet shall be complete with grab rail and other accessories as required and directed.

Urinals

Urinals shall be lipped type half stall with glazed vitreous China of size as called for in the tender. Half stall urinals shall be provided with 15mm dia CP spreader, CP domical waste and CP cast brass bottle trap with pipe and wall flange and shall be fixed to wall by CI brackets, CI wall clips and CP brass screws as recommended by manufacturer complete as directed by the PMC.

Flush pipes shall be GI pipes concealed in wall chase but with chromium-plated bends at inlet and outlet.

GI / PVC waste pipes shall be provided for urinals. Waste pipes may be exposed on wall or concealed in chase as directed by the PMC.

Urinal Partitions

Urinal partitions shall be white glazed vitreous china of size specified in the tender or as specified by the Architect in the Architectural drawings.

Porcelain partitions shall be fixed at proper heights with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer and directed by the PMC.

Wash Hand Basin

Washbasins shall be white glazed vitreous china of size, shape and type specified in the tender. Each basin shall be provided with painted MS angle or CI brackets and clips and the basin securely fixed to wall/counter slab. Placing of basins over the brackets without secure fixing shall not be accepted. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the PMC.

Each basin shall be provided with 32mm dia CP waste with overflow, pop-up waste or rubber plug and CP brass chain as specified in the Tender, 32mm dia CP brass bottle trap with CP pipe to wall flange.

Basins shall be fixed at proper heights as shown on drawings. If heights are not specified, the rim level shall be 800 mm from finished floor level or as directed by the PMC.

Where oval shape or round shape wash basins are required to be fixed these shall be fixed preferably in RCC platform with local available stone topping either fully sunk in stone top or flush with the stone topping as directed by PMC's Engineer in-charge.

White glazed pedestals for wash basins, where specified shall be provided. The quality of the glazing of the pedestal shall be exactly the same as that of the basin along with which it is to be installed. It shall be completely recessed at the back to accommodate supply and waste pipes and fittings. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor to top of the rim of basin 75 to 85 cm.

Sinks

Sinks shall be stainless or any other material as specified in the Tender.

Each sink shall be provided with painted MS or CI brackets and clips and securely fixed.

Counter top sinks shall be fixed with suitable painted angle iron brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40mm dia CP waste and rubber plug with CP brass chain as given in the Tender.

The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the PMC.

Supply fittings for sinks shall be deck mounted or wall mounted CP swivel faucets with or without hot and cold water mixing fittings as specified in the Tender. These shall be measured and paid for separately.

Toilet Paper Holder

Toilet paper holder shall be glazed vitreous china (Colour of the unit shall match with the other fixtures or wall tile) or chrome plated of size, shape and type specified in the Tender.

Porcelain toilet paper holder 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.

In case of chrome plated ones the same shall be fixed by means of screws/capping having finish similar to the sanitary fixtures or wall/partitions. When fixed on timber partition, it shall be fixed on a solid wooden base member provided by the Project Manager.

Towel Rail

Towel rail shall be chromium plated brass or of stainless steel or powder coated brass of size, shape and type specified in the Tender.

Towel rail shall be fixed with screws/capping having finish similar to the towel rail in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by the PMC.

Accessories

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.

Joints/gaps between all sanitary appliances/fixtures and the floor/walls shall be caulked with an approved mildew resistant sealant, having antifungal properties, of colour and shade to match that of the appliances/fixture and the floor/wall to the extent possible.

Fittings

All C P bathroom fittings and accessories will be supplied as per the make and model number specified in the BOQ / Or specified in CPWD specifications.

HAND DRIER :

The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.

The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).

The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.

The hand drier shall be of wall mounting type suitable for 230V, single phase, 50 Hz, AC power supply.

TOILETS FOR DISABLED:

Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by the PMC.

Stainless steel grab bars of required size suitable for concealed or exposed mounting and non-slip gripping surface shall be provided in all washrooms to be used by physically handicapped as directed by the PMC.

INSTALLATION OF SANITARY FIXTURES AND FITTINGS

(Note : The contractor has to receive the goods and store them in proper condition, install & erect them as required and as per the specifications and manufacturer's guidelines upto the satisfaction of Engg-in-charge. The work involves fixing and testing in position of all items including threading the pipes, cutting and making good the walls and floors where required, painting of any exposed part where ever required, supply and fixing of minor accessories such as C P screws, nuts, washers, extension pieces, brackets, wooden cleats, rawl plugs etc to complete the work. Any breakage & wastage will be in contractor's account)

a) General

All setting and bedding of sanitary fittings shall be done carefully to suit the required levels. Mortar drops, paint splashes etc. shall be removed from fittings, walls and floors immediately before these get dry.

b) Fixing Water Closet Squatting Pan (Indian Type W.C. pan)

The pan shall be sunk into the floor and embedded in a cushion of average 15 cm cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate/ brick aggregate 40 mm nominal size) as specified. This concrete shall be left 115 mm below the top level of the pan so as to allow for flooring and its bed concrete. The floor should be suitably sloped so that the wastewater is drained into the pan. The pan shall be provided with a 100 mm 'p' or s trap as required in the item with a approximately 50 mm seal. The joint between the pan and the trap shall be made leak proof with cement mortar 1:1 (1 cement : 1 fine sand).

c) Fixing Wall hung Wash down Water Closet (European Type W.C. pan)

- i. WC shall be single or double siphonic wash down type floor wall mounted set, as shown in the drawings, flushed by means of a flushing cistern.
- ii. Each W.C. set shall be provided with a solid plastic seat of any colour, rubber buffers and chromium plated hinges. Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.
- iii. Flush pipe/bend shall be connected to the Water Closet by means of suitable rubber adapter.
- iv. Wall hung Water Closet shall be supported by C.I. chair.

d) Fixing flushing Cistern

The cistern shall be fixed on two C.I. or mild steel brackets which shall be firmly embedded in the wall in cement mortar 1 : 4 (1 cement : 4 fine sand).

The height of the bottom of the cistern from the top of the pan shall be 2 meters for high level and 30cm. for low level cistern.

e) Fixing flush pipe and its connection

Low level flushing cistern

In case of low level flushing cistern it shall be connected to the closet by means of 40mm dia white porcelain enameled flush bend using Indian rubber adapters joint. The other specification shall be the same as described at (i) above.

f) Fixing plastic seat and cover

The seat shall be fixed to the pan by means of two 8mm dia corrosion resistant hinge bolts with a minimum length of shank of 65mm and threaded to within 15mm of the head. Each bolt shall be provided with two suitably shaped washers of rubber or other similar material for adjusting the level of the seat while fixing it to the closet. In addition one 8mm nonferrous metal or stainless steel washer shall be provided with each bolt. The maximum diameter of the washers fixed on the underside of the pan shall not be greater than 25mm. One arm of the hinge in each bolt shall be fixed to the under site of the seat by three nos. 20mm long No.6 gauge wood screws. The other arm of the hinge shall be fixed to the underside of the cover flush with the surface by means of 3 nos. 10mm long No. 6 gauge wood screws.

g) Fixing bowl pattern urinals

Urinals shall be fixed in position by using wooden plugs and screws, and shall be at a height of 65cm. From the floor level to the top of the lip of urinal, unless otherwise directed. The wooden plugs shall be fixed in the wall in cement mortar 1:3 (1 cement : 3 fine sand).

h) Fixing wash basins and kitchen sink

The basin shall be supported on a pair of R.S. or C.I. brackets fixed in cement mortar 1:3 (1 cement : 3 coarse sand). The R.S. or C.I. brackets shall conform to IS 775-1962. The wall plaster on the rear shall be cut to rest over the top edge of the basin. After fixing the basin plaster shall be made good and surface finished to match with the existing one.

The C.P. brass trap and unions shall be connected to 32mm dia waste pipe which shall be suitably bent towards the wall and which shall discharge into an open drain leading to a gully trap or direct into the gully trap, on the ground floor and shall be connected to a waste pipe stack through a floor trap on the upper floors. C.P. brass trap and union may not be provided where the surface drain or a floor trap is placed directly under the basin and the waste is discharged in to it vertically.

i) Fixing Mirror

The mirror shall be mounted on asbestos sheet or plywood sheet and shall be fixed in position by means of 4 C.P. brass screws and C.P. brass washers over rubber washers and wooden plugs firmly embedded in the wall.

The height of the bottom edge of the mirror shall generally be 120cm above the floor level unless otherwise specified or shown in drawing. Unless otherwise specified the longer sides shall be

fixed horizontally.

j) Fixing glass shelf unit

The bracket of the unit shall be fixed with C.P. brass screws to wooden plugs firmly embedded in the wall with cement mortar 1 : 3 (1 cement : 3 coarse sand).

The height of the glass shelf above the floor level shall 115cm unless otherwise specified or shown in drawings.

k) Fixing towel rail

The brackets of the wall rail shall be fixed by means of C.P. brass screws to wooden plugs firmly embedded in the wall with cement 1 : 3 (1 cement : 3 coarse sand).

The height of the towel rail above the floor level shall be 75cm unless otherwise specified or shown in drawings.

l) Fixing toilet paper holders

It shall be fixed in a position by means of screws and wooden plugs embedded in the wall with cement mortar 1:3 (1 cement : 3 coarse sand).

m) Fitting

Contractor shall install all chromium plated, stainless steel or powder coated brass fittings as shown on the drawings or as directed by the PMC and given in the Tender.

All CP accessories shall be fixed with CP brass half round head screws and cup washers if required in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or as directed by the PMC.

The fittings shall be supplied complete with chromium plated matching flanges, wall cover plates, nuts and extension pieces of required lengths. Metallic washers where required shall also be of chromium plated brass. All bib cocks and stopcocks shall conform to Indian Standard IS: 781. Brass screw down pillar taps shall conform to IS: 1701 and all other fittings shall match the supply fitting in construction and appearance. All fixing accessories and screws shall be similar to fittings. All washers shall conform to Indian Standard IS: 4346.

All waste fittings (Waste, Chain, Overflow, Spreader Caps etc.) shall be of brass / copper heavy chromium plated of the make and design specified and match the supply fittings. They shall conform to Indian Standard IS:2963.

The flushing system of the EWC shall be with 32 mm control cock and elbow set complete with adjustable sleeves and wall flanges. The flush valve for EWC shall be in conformity with IS: 6249.

n) Testing

All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested.

o) Mockup and Trial Assembly

The installation of the Sanitary fixtures and fittings shall be as per the shop drawings approved by the PMC.

The contractor shall make a mock up toilet in consultation with the PMC. The sanitary fixtures and fittings shall be got approved by the PMC prior to the procurement. On completion of the mock

up, changes if any required shall be carried out to the satisfaction of the PMC. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of cut outs in the building structure, holding devices etc. which will be required for final installation of all sanitary fixtures and fittings.

The fixtures in the trial assembly can be re-used for final installation without any additional payments for fixing or dismantling of the fixtures.

The contractor shall provide all the necessary supporting and fixing devices to install the sanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly appearance in the final assembly. Where the location demands, the PMC may instruct the contractor to provide chromium plated or other similarly finished fixing devices. In such

circumstances the contractor shall arrange to supply the fixing devices and shall be installed complete with appropriate vibration isolating pads, washers and gaskets.

p) Final Installation

The contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, washbasins, sinks and other appliances.

q) Protection Against Damage

The contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. At the time of handing over, the contractor shall clean, disinfect and polish all the fixtures and fittings. Any fixtures and fittings found damaged, cracked chipped stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

r) Measurement and Rates

Sanitary fixtures (Vitreous China ware and CP fittings) shall be measured by numbers.

Rate of providing and fixing of sanitary fixtures, accessories, shall be include all items, and operations stated in the respective specifications and Tender and nothing extra is payable.

Rates of all items under specification clauses above shall be inclusive of cutting holes and chases and making good the same, CP brass screws, nuts, bolts and any other fixing arrangements required and recommended by manufacturers, testing and commissioning etc. complete.

LAYING AND JOINTING OF SEWER AND DRAIN PIPES AND FITTINGS

GENERAL SPECIFICATIONS

UNLOADING :

- (a) The pipes shall be unloaded where they are required.
- (b) Unloading (except where mechanical handling facilities are available) – pipes weighing upto 60 kg shall be handled by two persons by hand passing. Heavier pipes shall be unloaded from the lorry or wagon by holding them in loops, formed with ropes and sliding over planks set not steeper than 45 degree. The planks shall be sufficiently rigid and two ropes shall always be used to roll the pipes down the planks. The ropes should be tied on the side opposite the unloading. Only one pipe shall be unloaded at a time.
- (c) Under no circumstances shall the pipes be thrown down from the carriers or bedragged or rolled along hard surfaces.
- (d) The pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded.

STORING :

- (a) The pipes and specials shall be handled with sufficient care to avoid damage to them. These shall be lined up on one side of the alignment of the trench socket facing upgrade when line runs uphill and upstream when lines run on level ground.
- (b) Each stack shall contain pipes of same class and size, consignment or batch number and particulars of the suppliers, wherever possible, shall be marked on the stack.
- (c) Storage shall be done on firm, level and clean ground. Wedges shall be provided at the bottom layer to keep the stack stable.

CUTTING :

- (a) Cutting of pipes may be necessary when pipes are to be laid in lengths shorter than the lengths supplied, such as while replacing accessories like tees, bends, etc. at fixed position in the pipe lines.
- (b) A line shall be marked around the pipe with a chalk piece at the point where it is to be cut. The line shall be so marked that the cut is truly at right angle to the longitudinal axis of the pipe.

TRENCHES :

- (a) The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.
 - (b) The minimum width of the trench should be " $D + 400 \text{ mm}$ ", where, D is outer diameter of the pipe.
 - (c) The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layer.
 - (d) If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe or provide lean cement concrete as required and specified.
 - (e) After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.
 - (f) Roots of trees within a distance of about 0.5 meter from the side of the pipe line shall be removed or killed.
 - (g) The excavated materials shall not be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling that may be re-laid and compacted in the same order to the satisfaction of the PMC's Engineer in-charge.
 - (h) The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after dewatering the trenches.
 - (i) Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water main cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the PMC-in-charge.
 - (j) When pipes are laid under road and pavements, subjected to heavy traffic loads, the trench may be covered with RCC slabs of suitable dimensions.
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LAYING :

- (a) The pipes shall be lowered into the trench by means of suitably pulley blocks, sheer legs chains ropes etc. In no case the pipes shall be rolled and dropped into the trench. One end of each rope may be tied to a wooden or steel peg driven into the ground and the other end held by men which when slowly released will lower the pipe into the trench. After lowering, the pipes shall be arranged so that the spigot of one pipe is carefully centered into the socket of the next pipe, and pushed to the full distance that it can go. The pipe line shall be laid to the levels required. Specials shall also be laid in their proper position as stated above.
- (b) Where so directed, the pipes and specials may be laid on masonry or concrete pillars. The pipe laid on the level ground, shall be laid with socket facing the direction of flow of water.
- (c) In unstable soils, such as soft soils and dry lumpy soils it shall be checked whether the soils can support the pipe lines and if required suitable special foundation shall be provided.

BACK FILLING AND TAMPING :

- (a) Back filling shall follow pipe installation as closely as possible to protect pipe from falling boulders, eliminating possibility of lifting of the pipe due to flooding of open trench and shifting pipe out of line by caved in soil.
 - (b) The initial back fill material used shall be free of large stones and dry lumps.
 - (c) The initial back fill shall be placed evenly in a layer of about 100 mm thick. This shall be properly consolidated and this shall be continued till there is a cushion of at least 300 mm of cover over the pipe.
 - (d) If it is desired to observe the joint or coupling during the testing of mains they shall be left exposed. Sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing.
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S. W. GULLY TRAP

a) **MATERIAL :**

S.W. Gully Trap :

Gully traps shall conform to IS : 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters.

Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.50 kg and the frame not less than 2.70 kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

b) **EXCAVATION :**

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the PMC's Engineer in-charge.

c) **FIXING :**

The gully trap be fixed over cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) foundation 650 mm square and 100 mm thick. The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes as described above.

d) **BRICK MASONRY CHAMBER :**

After fixing and testing gully and branch drain, a brick masonry chamber 300 mm x 300 mm (in side) with bricks in cement mortar 1:5 (1 cement : 5 fine sand) shall be built with a 100 mm brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls and the trap shall be filled with cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 10 nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered in side with cement mortar 1:3 (1 cement : 3 sand), finished with a floating coat of neat cement. The corners and bottoms of the chamber shall be rounded off so as to slop towards grating.

C.I. cover with frame 300 mm x 300 mm (inside) size shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) 40 mm thick and rendered smooth. The finish top of the cover shall be left about 40 mm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

REINFORCED CEMENT CONCRETE (RCC) PIPES (NP2 / NP3)

All NP2 / NP3 RCC pipes shall be spigot and socket end pipes. The ends shall be suitable for rubber ring joints. The pipes shall be ISI marked as per IS:458:2003. The rubber rings shall confirm to IS 5382.

a) MATERIAL:

General - The pipes shall be with reinforcement and shall be of the specified class. These shall conform to IS : 458 amended up to date. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Concrete – The concrete quality shall be as per IS: 456 for at least very severe environmental exposure condition. Concrete used for the manufacture of reinforced concrete pipes shall have minimum cement content of 450 kg/cum and a compressive strength not less than 35N/sq.mm at 28 days.

Aggregates – The aggregate shall confirm to 3 of IS : 383. The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm dia and 10 mm size for pipe dia from 80 to 250 mm.

Reinforcement - The reinforcement shall confirm to mild steel grade 1 or medium tensile steel bars confirming to IS:432 (part 1) or hard drawn steel wire confirming to IS : 432 (part 2) or structural steel (standard quality) bars confirming to IS : 2062. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

CLASS NP2 – REINFORCED CONCRETE LIGHT DUTY, NON PRESSURE PIPES

Internal Diameter of Pipes Nominal (mm)	Barrel Wall Thickness(mm)
80	25
100	25
150	25
200	25
225	25
250	25
300	30
350	32
400	32
450	35
500	35
600	45

700	50
800	50
900	55
1000	60

CLASS NP3 – REINFORCED CONCRETE MEDIUM DUTY, NON PRESSURE PIPES

Internal Diameter of Pipes(mm)	Barrel Wall Thickness(mm)
150	25
200	30
225	30
250	30
300	40
350	75
400	75
450	75
500	75
600	85
700	85
800	95
900	100
1000	115
1100	115
1200	120
1400	135
1600	140

b) TRENCHES :

- (i) The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.
 - (ii) Cover shall be measured from top of pipe to the surface of the ground.
 - (iii) The width of the trench shall be $D+400$ mm with a minimum of 750 mm. (D= External diameter of pipe). Note : The width should not be more than the mentioned for structural safety of the pipes.
 - (iv) The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layer.
 - (v) If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe.
 - (vi) After the excavation of the trench is completed, hollows shall be cut at the
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required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

- (vii) Roots of trees within a distance of about 0.5 meter from the side of the pipe line shall be removed or killed.
- (viii) The excavated materials shall not be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling that may be re-laid and compacted in the same order to the satisfaction of the PMC's Engineer in-charge.
- (ix) The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after rewatering the trenches.
- (x) Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water main, cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the PMC's Engineer in-charge.

c) LAYING:

Pipes shall be lowered into the trench carefully. Mechanical appliances may be used, where necessary, pipes shall be laid in straight lines or with easy curves and true to line and gradient as specified. Laying of pipes shall proceed up grade of a slope. In the pipes spigot end socket joints, the socket ends shall have face up stream. In the case of pipes with joints to be made with loose collars the collars shall be slipped on before the next pipe is laid.

The Cement Concrete bedding shall be provided below RCC pipes as per tender and drawings.

When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

d) JOINTING:

SPIGOT AND SOCKET JOINT :

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The jointing of pipe shall be done by rubber ring method. The rubber rings shall conform to IS : 5382.

A rubber ring shall be placed on the spigot which shall be forced into the socket of pipe

previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar 1:2 (1 cement : 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After days work any extraneous material shall then be removed from inside of the pipe and the newly made joint shall be cured,.

e) **TESTING OF JOINTS :**

HYDRAULIC TEST :

The pipes shall be subjected to a pressure of at least 2.5meter head of water at the highest point of the section under test. The test shall be carried out by suitably plugging the low end of the drain and the ends of the connection, if any and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head; or the top end may be plugged with a connection to a

hose ending in a funnel which could be raised or lowered till the required head is obtained and fix suitably for observation.

Subsidence of the test water may be done to one or the more of the following causes :-

- i) Absorption by pipes and joints;
- ii) Sweating of pipes or joints;
- iii) Leakage at joints or from defective pipes and
- iv) Trapped air.

Allowance shall be made for (i) above by adding water until absorption has ceased after which the proper test should commence if any leakage is visible the defective part of the work should be made good. A slight amount of sweating which is uniform may be over looked but excessive sweating from a particular pipe or joint shall be watched for as taken as indicating a defect to be made good.

RECTIFICATION OF FAULTY JOINTS :

Any joint leaking or sweating shall be rectified or embedded into into 150mm layer of cement concrete (1:2:4) 300mm in length and the section retested.

MANHOLES

i) GENERAL :

Manholes of different types and sizes specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawing or as directed by the PMC's engineer in-charge. The size specified shall indicate the inside dimensions (between wall faces) of the manholes. The branch sewer should deliver sewage in the manhole in direction of main flow and the junction must be made with care so that flow in the main is not impeded.

No drain from house fitting i.e. gully taps or soil pipes etc. to manholes shall normally exceed a length of 6 meter unless it is unavoidable.

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 45 m for up to 300 mm dia, 75 meter for 350 to 500 mm dia and 90 meter for 600 mm dia and above.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber.

Manholes shall be built to the following specifications :-

a) Bed concrete :

The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement : 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) The thickness of Bed Concrete shall be 150 mm upto 0.90 meter depth, 200 mm thick for manholes from 0.90 meter to 2.25 meter depth and 300 mm for manholes of above 2.25 meter depth.

b) Walls :

The walls of the manholes shall be of brick masonry. The brick masonry shall be with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) of brick work shall be carefully built in English bond. The jointing face of each brick being well buttered with cement mortar before laying so as to ensure a full joint. The thickness of wall shall not be less than 230mm upto 2.25 meter in depth, 345 mm thick for depth 2.25 to 3.0 meter, 460 mm thick for depths 3.0 m to 5.0 meter and 575 mm thick for 5.0 to 8.0 meter depth. For greater depths and for subsoil water conditions the exact thickness of wall shall be governed by the structural design & site conditions.

c) Plaster :

The inside of wall shall be plastered by 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) and finished with a floating coat of neat cement. All angle shall be rounded to 7.5 cm. radius and all rendered internal surfaces shall have impervious finish obtained by using a steel trowel.

Where the saturated soil is met with, also the external surface of the walls of the manhole shall be

plastered with 12 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished smooth upto 30 cm above the highest sub-soil water level with the approval of the PMC's Engineer in-charge. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications.

d) Channels and benching :

Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel on appropriate shall suitably rounded off in the direction of flow in the main channel shall be given.

The channels and benching shall be done in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) rising at a slope of 1 in 6 from the edges of channel. The channels of the bottom of the chamber shall be finished with the floating coat of neat cement.

e) Foot Rests :

All manholes deeper than 0.8 m shall be provided with C. I. foot rests. These shall be embedded 20 cm deep in 20 x 20 x 10 cm blocks of cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size). The concrete block with C.I. foot rest placed in its center shall be cast in situ along with the masonry and surface finished with 12 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished smooth.

Foot rests which shall be of 20 x 20 sq. C.I. bars shall be fixed 30 cm apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot rest shall be 45 cm below the manhole cover.

Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block being painted with thick cement slurry before fixing.

f) Cover slabs :

These shall be of R.C.C. 1:1.5:3 (1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size) 15 cm thick with surface and edge finished fair. Full bearing equal to the width of the wall shall be given to the slab on all sides. The frame of the man hole cover shall be embedded firmly in the R.C.C. slab so that the top of the frame remains flush with the top of the R.C.C. slab. Where the opening of manhole is only 560 mm dia, the MH cover shall be fixed in 150 mm thick PCC (1:2:4).

ii) TESTING :

Manholes shall be tested by filling with water to a depth not exceeding 1.2 meter as directed by the PMC's Engineer in-charge.

After completion of the work manhole covers shall be sealed by means of thick grease.

iii) CONNECTION TO EXISTING SEWER :

The connection to an existing sewer shall, as far as possible, be done at the manholes. Where it is unavoidable to make connection in between two manholes, the work of breaking into the existing sewer and forming the connection shall be carried out under the supervision Administrative Authority.

Breaking of sewer shall be effected by the cautions enlargement of sewer hole and every precaution shall be taken to prevent any material from entering the sewer. No connection shall be former in such a way so as to constitute a projection into the sewer or to cause any diminutions in its effective size.

iv) DROP CONNECTIONS :

Where it is uneconomic or impracticable to arrange the connection within 600 mm height above the invert of the manhole, the connection shall be made by constructing a vertical shaft outside the manholes chamber. If the difference in the levels between the incoming drain and the sewer does not exceed 600 mm and there is sufficient room in the manhole, the connection pipe may be directly brought through the manhole wall and the fall accommodated by constructing a ramp in the benching of the manhole.

PRECAST CONCETE MANHOLE COVERS & FRAMES

Precast reinforced cement concrete manhole covers intended for use in sewerage, drainage and water works shall generally conform to IS : 12592 - 2002. Detailed specification are as under :

1. GRADES : TYPES & USES

Manhole covers and frames shall be of the following four grades and types :

Grades	Grade Designation	Type / shape of cover
Light Duty	LD – 2.5	Rectangular, Square, Circular
Medium Duty	MD – 10	Rectangular, Circular
Heavy Duty	HD – 20	Circular-Square, Rectangular,
Extra Heavy Duty	EHD – 35	Circular, Square, Rectangular,

2. The different grades and types of manhole covers may be used as follows :

a) *LD – 2.5 Rectangular, Square or Circular types :*

These are suitable for use within residential and institutional complexes / areas with pedestrian but occasional LMV traffic. These covers may also be used for inspection chambers.

b) *MD – 10 :*

These are suitable for use in service lanes / roads, car parking areas etc.

c) **MD – 20 :**

Suitable for use in institutional/commercial areas / carriage ways with heavy duty vehicular traffic like buses, trucks, etc. for a wheel load between 50 to 100 KN.

d) **EHD – 35 : Circular, square, or rectangular (scraper manhole) types -**

These are suitable for use on carriage way in commercial industrial / port areas / near warehouses / godowns where frequent loading and unloading of trucks / trailers are common, with slow to fast moving vehicular traffic of the types having wheel loads upto 115 KN, irrespective of the location of the manhole chambers.

3. MATERIALS :

(i) **Cement :**

cement used for the manufacture of precast concrete manhole covers shall conform to IS :269 or 455 or 1489 or 6909 or IS : 8041 or IS : 8043 or IS : 8112.

(ii) **Aggregates :**

The aggregates used shall be clean and free from deleterious matter and shall conform to the requirements of IS: 383–1970. The aggregates shall be well graded and the nominal maximum size of coarse aggregate shall not exceed 20 mm.

(iii) **Concrete :**

The mix proportions of concrete shall be determined by the manufacturer and shall be such as will produce a dense concrete without voids, honey combing etc. (IS : 456) The minimum cement content in the concrete shall be 360 kg/m³ with a maximum water cement ratio of 0.45. Concrete weaker than grade M-30 (design mix) shall not be used. Compaction of concrete shall be done by machine vibration.

(iv) **Reinforcement :**

a) The reinforcement steel shall conform to Grade A of IS : 2062 or IS 432 (Part I) or IS : 432 (Part 2) or IS : 1786 as appropriate.

Reinforcement shall be clean and free from loose mill scale, loose rust, and mud, oil, grease or any other coating which may reduce or destroy the bond between the concrete and steel. A light film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.

b) **Fibers steel :** In association with in the main steel bars reinforcement steel fibers of appropriate types and forms may also be used as secondary reinforcement (upto 0.5% by volume).

4. **SHAPES AND DIMENSIONS :**

(i) **Shapes :**

The shapes of precast concrete manhole covers shall be square, rectangular or circular as specified.

(ii) **Dimensions :**

Dimensions of precast concrete manhole covers shall be as given in Table below, the minimum clearance at top between the frame and cover shall be 5 mm.

TABLE

S. No.	Description	Heavy / Extra Heavy duty HD / EHD	Medium duty M.D.	Light duty L.D.
1.	Clear opening matching the top opening of manhole	560 mm dia or 600 mm dia or square or 560 mm	450 mm dia. 480 mm dia. 500 mm dia. dia or square	600 x 450 mm (rectangular) 450 mm dia or 350 mm dia or square
2.	Precast slab with integral frame (D/T)	900 mm dia x 180 mm or square corners cut 1000 mm dia x 200 mm or square corner cut	800 mm. dia x 130 mm 800 mm dia x 150 mm	850mmx700mmx100 mm 625mm dia x 100 mm or 575 mm dia x 100 mm or square
3.	Thickness of cover depth of frame (T1)	100 mm or 110 / 120 mm	70 / 80 mm	50 mm
4.	Matching Manhole Cover (B)	685 / 660 mm or 735 / 710 mm dia or square	585 mm dia or 645 mm dia or square	685 x 535 mm 515 mm dia or square 435 mm dia or square
5.	Edge protection of covers/lifting facility	Precast manhole covers are designed and provided with MS rims of 2.5 mm thickness welded around with provision of two lifting hooks welded at appropriate locations.		
6.	Chequered pattern on operative surface	The MS rims along with the edges of precast manhole covers and their operative surface are suitably coated/finished using corrosion resistant paint.		
7.	Marking on the covers	Precast manhole covers/precast slabs are suitably marked on the operative surface with the following letters, unless specified otherwise Name of the Department/Sewer or SWD/Grade/Date of MFR/Trade Name etc.		

8.	Performance requirements	When tested for ULTIMATE breaking load using 300 mm dia block as per the method described in IS : 12592 (Part I) manhole covers shall be within the following range :
	Test load	Light duty - 2.5 tones (L.D. – 2.5) Heavy duty – 20 tones (HD – 20) Medium duty - 10 tones (MD – 10) Extra heavy duty - 35 tones (EHD – 35).

5. LIFTING DEVICE :

The minimum diameter of mild steel rod used as lifting device shall be 10 mm for light and 12 mm for medium duty covers and 16 mm for heavy and extra heavy duty covers. The lifting device shall be protected from corrosion by not galvanizing or epoxy coating or any other suitable.

6. FINISHING AND COATING :

To prevent any possible damage from corrosion of steel the underside of the covers shall be treated with anticorrosive paint. The top surface of the covers shall be given a chequered finish.

In order to protect the edges of the covers from possible damage at the time of lifting and handling it is necessary that the manhole covers shall be cast with a protective mild steel sheet of minimum 2.5 mm thickness around the periphery of the covers. Exposed surface of mild steel sheet shall be given suitable treatment with anticorrosive paint or coating.

7. PHYSICAL REQUIREMENTS :

a) General :

All units shall be sound and free from cracks and other defects which interface with the proper placing of the unit or impair the strength or performance of the units. Minor chipping at the edge / surface resulting from the customary methods of handling during delivery shall not be deemed for rejecting.

b) Load test :

The breaking load of individual units when tested in accordance with the method described in IS : 12592 shall be not less than the values specified in Table below.

TABLE

Grade of cover	Type	Load in Tones	Diameter of Blocks in mm
EHD – 35	Circular, Square or Rectangular	35	300
HD – 20	Circular, Square or Rectangular	20	300
MD – 10	Circular, or Rectangular	10	300
LD – 2.5	Rectangular, Square or Circular	2.5	300

8. FIXING :

The frames of manhole shall be firmly embedded to correct alignment and level in RCC slab or plain concrete as the case may be on the top of masonry which shall be paid as extra unless specified otherwise.

9. HYDRO- PNEUMATIC PUMP SYSTEM FOR WATER SUPPLY

Scope (Item Description) - The item includes the Pumps (Vertical/Horizontal centrifugal type), Pressure vessels, pressure switches, gauges, pressure transmitter on delivery manifold, pump suction & delivery piping, manifolds & valves, flexible bellows, Fixed speed/ variable frequency drive, control panels, Microprocessor based operation) and all accessories including installation, testing & commissioning.

Pump –Motor Set Design & Construction Features

Two types of pumps i.e. inline vertical multistage or horizontal type centrifugal pump shall be provided. Variable frequency drive shall be provided with one of the installed pump – if specified in Schedule of quantity.

The pump motor set and shall be suitable for 3 Ph., 415 V, 50 Hz. AC power supply. The pump shall

be installed with isolation gate/ butterfly valve, non return valve, etc. The detailed specification for pump & motor is as below.

The design and manufacture of the pump shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

The pump shall be capable of developing required total head at rated capacity. Impeller shall be closed type and shall be dynamically balanced. The pump shall have non overloading characteristics.

The casing shall be of rigid construction and shall have side suction and side delivery in case of vertical multistage pump and side suction and central delivery in case of horizontal centrifugal pump.

The pump shall have very small length suction and delivery pipe connections which will result in minimum friction loss.

Impeller shall be of one piece and shall be of SS CF8 M.

The shaft shall be of S.S. and its surface shall be properly finished. Shaft sleeves shall be provided to protect shaft from any damage
Bearing shall be ball or roller type.

Mechanical seal shall be provided to avoid any leakage.

Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on an anti vibration pad.

All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be hot dip galvanized or of stainless steel construction.

Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. Shut off head shall be 120% of duty point head.

All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.

Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.

Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable.

Leakage from pump gland shall be drained to the nearest floor waste.

Pump shall be driven by directly coupled squirrel cage induction motor having TEFC enclosure, IP

55 protection & shall be of Class F insulation.

Pump motors above 7.5 kW shall be equipped with a spacer coupling which allows changing of shaft seals without removing the motor.

Inspection & Testing

The pump shall be offered for visual inspection before dispatch.

Material test certificates for the various pump components shall be furnished for purchaser's approval.

System Description

The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. When the water demand continues the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive. However, if the system pressure is still below the pre-set value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

At peak demand all the pumps operate, similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cut-off, followed by stopping of the duty pump.

The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/ standards.

The system shall be under the control of a microprocessor based control panel.

A pressure transmitter shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.

The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transmitter shall register the actual pressure on the discharge side.

The variable frequency drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Frequency Drive (VFD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VFD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

Under decreasing hydraulic demand the reverse sequence to the above description shall apply. Alternatively pumping system shall be with fixed speed drive motor. By getting the signal from microprocessor based control panel through pressure transmitter, pumps will operate in sequence & vice a versa.

The frequency converter shall be linked to the motor of the duty pump for continuous speed adjustment and ultimately the water delivery shall be maintained at constant pressure at the pre-set value.

Control Panel

The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions.

Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system pre-set delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges.

Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps.

When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/ day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s).

In event of control failure, the pumps shall be able to be start/ stopped manually at the local panel by means of pressure switches.

The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.

The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps form running dry.

Automatically starting the pumps when the water level is back to normal.

In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.

Functions to limit the no. of start/ stop of pumps per hour. The system control panel shall incorporate LCD Display.

Electrical Component

All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the architect. Electrical supply to the pump controller shall be protected using an isolating circuit

breaker

Method of Starting

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/ Delta, using Soft Starters

Pump Pressure Vessel

Diaphragm type pressure vessels shall be provided as shown on the drawings. They shall be incorporated into the system so that during normal operation the pump shall not need to be start within 30 seconds of it switching off in order to prevent the pump hunting.

The pressure vessel shall be of adequate capacity to accommodate a considerable fluctuation in water demand by the system with minimum start/ stop cycles of the pumps. The vessel shall be constructed of steel plate built to ASME Standards for Unfired Pressure Vessel. A rubber diaphragm shall be provided in the vessel for separating the water and pre-charge nitrogen. The pre-charge pressure shall be adjustable and charging port with non-return device shall be provided. The adjustable cut-in and cut-off pressure unit for the pumps shall be built-in at the vessel to suit the system.

Accessories

The system shall be provided with all accessories such as base plate, mounting pads, foundation bolts, foot valves, pressure gauge, pressure switches, pressure transmitter, level indicator, isolation valve for pressure vessel, etc. all accessories required for proper and safe operation shall be furnished with the pumps.

Suction & Delivery Pipe Fitting, Flange & Valves

All suction, delivery and header pipe shall be GI & shall conform to IS: 1239, medium/ heavy duty. Fittings shall be as per the pipe thickness. All pipes shall have flanges connection & pipe shall conform to BS 10, Table - D. All hardware shall be zinc plated. The system shall be equipped with suction & delivery valves flanged valves. On suction side ball/gate valve shall be provided while on delivery side ball/ butterfly valves shall be provided. Also, spring operated check valves shall be provided on delivery side of each pump & on delivery header. In case of negative suction foot valve shall be provided for each pump suction or suction header as specified in data sheet. Flexible bellows shall be provided on suction & delivery side of each pump

HOT WATER GENERATOR

The scope shall include supply, installation; testing & commissioning of hot water generator with in-built storage tank all connections, safety accessories, instruments, thermostat, mounting pads, etc. Hot water generated shall be either electrically operated or gas/ HSD charged. 5.7.1 The body shall be fabricated from pressure vessel quality steel & shall be designed in accordance with ASME boiler & pressure vessel code, Section IV, for a maximum of 160 PSIG working pressure & 250 deg F. It can have horizontal/ vertical installation. 5.7.2 Vessel shall be provided with drain connection & a pressure relief valve at 150 PSI. 5.7.3 Pressure gauges with ball valves

& temperature gauges shall be provided at inlet & outlet. 5.7.4 Auto air vent shall be provided to bleed the air automatically. 5.7.5 Heater shall be a tubular element sheath made of Cu, SS, etc. With coil as per manufacturer's standard which shall provide excellent heat transfer & dielectric strength between coil & sheath. 5.7.6 Cabinet shall be made of CRCA steel sheet having minimum 16 gauge thickness & shall be powder coated with high grade paint & shall be provided with louvers to ensure adequate ventilation of the control & heater terminal compartment. The generators shall be mounted on base frame made of ISMC channels. 5.7.7 The generator shall be provided with temperature control, high temperature cut off, low water cut off, manual reset thermal cut out, audio visual alarms, etc. Complete with all electrical accessories required for complete installation. 5.7.8 Rating of generator shall be 1, 10,000 Kcal/hr. & design temperature shall be 55 deg+/- 5 deg C. It shall be designed for closed loop system.

SOLAR HOT WATER HEATING SYSTEM

Solar Hot Water Generation System with recirculation pumps shall be provided. Same shall be selected based on geographical location, cost optimization, functional requirement, space availability etc. It should be based on flat plate type solar hot water system. Solar Hot Water System shall be sized as per building hot water requirements. Recirculation system shall be provided for all buildings.

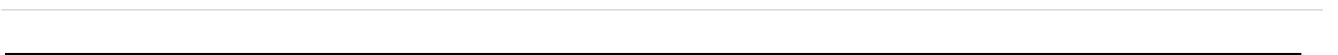
It should be complete with solar collector panels, support for collectors, mixing tank (as per building requirement), absorbers, heat exchangers (as per building requirement), electrical control panel, back up heaters, make up water tank, recirculation pumps, inter connecting pipes with suitable insulation, valves, pressure gauges, thermometers etc. complete in all respect as per OEM standards & directions of Engineer-In-Charge.

Solar Hot Water System shall be provided for buildings as per directions of E-I-C meeting min. GRIHA requirements. The dedicated water supply system to meet the supply requirement shall be provided from the solar hot water tanks to the requisite locations. Hot Water shall be considered and provided for lab, scrub, bathing, washing hands, utensils, clothes, etc. Thus, Hot Water points shall include tap point/ shower point in bathroom, Kitchen sink, wash basin, etc.

During detailed engineering, Hot water requirement/ building will be determined based on relevant standards/codes. The hot water requirements, Equipment capacities & overall scheme & placement of equipment given in the above tables are minimum to be provided. During detailed designing, if required and found necessary, the capacity / rating of the equipment (solar hot water generator/ heat pump) may be upgraded/ revised subject to concurrence of Engineer-In-Charge

CENTRALIZED RO WATER SUPPLY SYSTEM

CENTRALIZED RO WATER SUPPLY SYSTEM



The Centralized RO shall comprise of RO High Pressure Feed Pumps (HPP), RO Raw Water Pumps (RWP) of Vertical multistage centrifugal type and suitable head to generate permeate flow as per requirements. The pump casing construction shall be preferably of SS-316 & impeller shall be also SS 316. The motor shall be TEFC with min. IE-2/IE-3 efficiency suitable for a supply of 415V / 3 Phase at 50 Hz. Supply. The pump shall be supplied complete with base channel, coupling foundation bolts, pressure gauge, valves at inlet and outlet of each pump. One standby pump needs to be considered for each type. Central R.O Plant shall be preferably placed at buildings Terrace. Capacity of Centralized R.O Plant shall be selected based on meeting functional requirement (RO water demand of each building/day) as stated above within minimum operating hours (preferably 10 hrs. /day).

It shall consist of Package type RO module capable of giving a net treated water output as per requirement, Special Anti-sealant dosing system consisting of suitable no. SS tank of capacity as per requirement with a positive displacement diaphragm dosing pump having variable flow rate, Micron cartridge filter (shall be made of FDA compliant high quality poly propylene or some other suitable material) suitable for a flow rate as per requirements, CIP system (Cleaning in Place) consisting of SS tank with agitator complete with inlet/outlet, drain overflow etc. along with SS pump of capacity and cartridge filter of 10 micron, PH correction dosing system consisting of one SS tank with a positive displacement diaphragm dosing pump having variable flow rate, High pressure side piping from the RO high pressure pumps to the rejects stream control valves shall be of SS 316 using all SS fittings ball valves of suitable pressure rating shall be used till 50 mm size, above 50 mm, flanged globe / water butterfly valves in SS construction shall be used. Rejects pressure control valves shall be globe valve and feed flow control valve shall be of SS 316, SS 316 RO Water storage tank (Capacity as per requirements) of required thickness. Tank shall be provided with water flow meter at inlet & outlet, inlet / outlet valves, overflow / drain connection with MH cover. All RO distribution pipes shall be with SS 304 with press fittings. Centralized control panel made out of CRCA sheet min. 2mm thick having main contactors for all pumps.

All control and power cabling along with double earthing between the panel shall be provided. An emergency stop push button shall be provided in the panel.

Portable RO water unit shall be with water Cooler with capacity of S.S construction of 80 Lit. (Approx.) Storage capacity & water flow rate 50 LPH through faucets including RO membranes, pumps, motors, cartridge filters, interconnecting pipes, valves, cables etc. or as per OEM standards meeting each building's drinking water requirement & as per directions of E-I.C. The R.O Units shall be placed at different locations with minimum two Units on each floor or as per requirement. It should be complete with all interconnecting piping, valves, cartridge filters, diaphragm type pumps, RO membranes, cable, drain pipe & other related accessories. It shall be with UV unit. The system shall be suitable for a supply of 240 V AC / 50 Hz.

RO capacity (portable & centralized) mentioned above table. During detailed designing, if required and found necessary, the capacity / rating of the equipment may be upgraded/ revised subject to concurrence of Engineer-In-Charge.

Design Basis (RO Plant)

Expected Treated Water Characteristics after RO (Reverse Osmosis Plant)	
Parameters	Characteristics
PH	6. 0 – 7.0
Total Dissolved Solids	<50 ppm
Suspended solids	Nil
Turbidity	Nil
Iron as Fe	Nil
Total Hardness	Less than 5 ppm

Instruments List including but not limited to (Provision to be considered in the Centralized R.O Plant)

Sr. No.	INSTRUMENT
1	Flow Indicator
2	Pressure Gauge
3	Pressure Switch (Low & High)
4	Conductivity Indicator
5	PH Meter etc.

