

**PARTICULAR SPECIFICATION
(PUBLIC HEALTH ENGINEERING)**

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PARTICULAR SEPCIFCATIONS : PUBLIC HEALTH ENGINEERING

1 GENERAL REQUIREMENT

1.1 Introduction

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below as amended up to 30th March. 2021. All equipment and material being supplied by the contractor shall meet the requirement of IS.

1.2 Standards, Codes and Regulations

The entire system and its basic components shall comply in all respect to the relevant International Standards and regulations of the National Building Code of India (NBC), and Bureau of Indian Standards.

In addition to the International Standards and NBC listed in the Technical Specifications, the Design shall also be governed by all applicable local codes, regulations, standards and requirements issued by all the Local Authorities, agencies and services providers. Given below is the list of standards to be followed at least, note that this list is not exhaustive

1.3 General

IS: 27	Pig Lead
IS: 554	Dimensions for pipe threads where pressure tight joints are
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: 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 1 manholes.
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 fire fighting
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

1.4 Pipes and Fittings

IS: 458	Specification for precast concrete pipes (with and without reinforcement)
IS: 651	Salt glazed stone ware pipes and fittings
IS: 1239 (Part 1)	Mild steel, tubes, tubular and other wrought steel fittings: Part 1 Mild Steel tubes
IS : 1239 (Part 2)	Mild Steel tubes, tubular and other wrought steel fittings : Part 2 Mild Steel tubular 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: 1879	Malleable cast iron pipe fittings
IS: 1978	Line pipe
IS: 1979	High test line pipe
IS: 2501	Copper tubes for general engineering purposes
IS: 2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and dimensions

IS: 2643 (Part 2)	Dimensions of pipe threads for fastening purposes: Part 2 Tolerances
IS: 3468	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 (spun) 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 engineering purposes
IS: 7181	Specification for horizontally cast-iron double flanged pipe for water, gas and sewage
1.5	Valves
IS: 778	Specification for copper alloy gate, globe and check valves for water works purposes
IS: 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size)
IS: 1703	Specification copper alloy flat valves (horizontal plunger type) for water supply fittings
IS: 2906	Specification for sluice valves for water works purposes (350mm to 1200mm size)
IS: 3950	Specification for surface boxes for sluice valves
IS: 5312 (Part 1)	Specification for swing check type reflux (non return) valves: Part2 Multi door pattern
IS: 5312 (Part 2)	Specification for swing check type reflux (non return) valves: Part2 Multi door pattern
IS: 12992 (Part 1)	Safety relief valves, spring loaded: Design
IS: 13095	butterfly valves for general purposes
1.6	Sanitary Fittings
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 1 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): Part 2 Specific requirements of wash-down water closets
IS: 2556 (Part 3)	Specification for vitreous sanitary appliances (Vitreous china): Part 3 Specific requirements of squatting pans

IS: 2556 (Part 4)	Specification for vitreous sanitary appliances (Vitreous china): Part 4 Specific requirements of wash basins.
IS: 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (Vitreous china): Part 6 Specific requirements of urinals, section 2 half stall urinals.
IS: 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (Vitreous china): Part 6 Specific requirements of urinals, section 4 partition slabs.
IS: 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (Vitreous china): Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
IS: 2556 (Part 7)	Specification for vitreous sanitary appliances (Vitreous china): Part 7 Specific requirements of half round channels.
IS: 2556 (Part 8)	Specification for vitreous sanitary appliances (Vitreous china): Part 8 Specific requirements of siphoning wash down water closets.
IS: 2556 (Part 11)	Specification for vitreous sanitary appliances (Vitreous china): Part 11 Specific requirements for shower rose.
IS: 2556 (Part 12)	Specification for vitreous sanitary appliances (Vitreous china): Part 12 Specific requirements for 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	Specification for waste plug and its accessories for sinks and wash basins
IS: 3311	Specification for waste plug and its accessories for sinks and wash basins
IS: 5961	Specification for cast iron gratings for drainage purposes
IS: 6249	Specification for gel-coated glass fibre reinforced polyester resin bath tubs
IS: 9758	Specification for flush valves and fitting for water closets and urinals
	Water Quality Tolerance
IS: 3025 (Parts 1- 44)	Method of sampling and test (physical & chemical) for water and waste water
IS: 4764	Tolerance limits for sewage effluents discharged into inland surface waters
IS: 10500	Drinking Water

1.7 Pumps & Vessels

IS: 1520	Specification for horizontal centrifugal pumps for clear cold fresh water
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

1.8 Abbreviations

ACRONYM	DESCRIPTION
PLUMBING & FIRE FIGHTING	
ASD	Aspirating Smoke Detector

ACRONYM	DESCRIPTION
BRE	Building research Establishment
BSI	British Standards Institute
BSP	British Standard Pipe threads
CCITT	International Telegraph and Telephone Consultative Committee (Comité Consultatif Internationale Télégraphique et Téléphonique) Bottom of Form
CCL	Communication Certification Laboratory
CENELEC	European Committee for Electrotechnical Standardization(Comité Européen de Normalisation Electrotechnique)
CGP	Clean Gas Panel
CISPR	The International Special Committee on Radio Interference (Comite International Special des Perturbations Radioelectriques)
CRT	Cathode Ray Tube
CSD	Combined Services Drawing
E&M	Electrical & Mechanical
EMC	Electro Magnetic Compatibility
EN	European Norms
EPROM	Erasable Programmable Read Only Memory
FAHU	Fresh Air handling Units
FM	Factory Manuals
FR	Fire Resistance
FRP	Fibre Reinforced Plastic
FSSD	Fire Safety and Shelter Department
HDHC	Hard Drawn High Conductivity
HDLC	High-level Data Link Control
HMI	Human Machine Interface
HRC	High Rupture Capacity
HVAC	Heating, Ventilation and Air Conditioning
IDC	Insulation Displacement Connection
IE	Indian Electricity Rules
IEE	Institution of Electrical Engineers
IFAT	Integrated Factory Acceptance test
IP	Ingress Protection
ISM	Industrial, Scientific and medical band
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
LCD	Liquid Crystal Display
LCX	Leaky Coaxial Cable
LED	Light Emitting Diode
LPC	Loss Prevention Council
LSC	Local Sequential Control
MAP	Main Alarm Panel

ACRONYM	DESCRIPTION
MMI	Man Machine Interface
PCB	Pollution Control Board
ROM	Read Only Memory
RP	Repeater Panel
RTV	Response Threshold Value
SAP	Sub Alarm panel
SCADA	Supervisory Control and Data Acquisition
SEM	Structural, Electrical and mechanical
SFSRTS	Standard for Fire Safety in Rapid Transit Systems
SPDT	Single Pole Double Throw
SWC	Station Wide Contractor
TCF	Technical Construction File
UL	Underwriters Laboratories
UPS	Uninterruptible Power Supply
V DC	Volt Direct Current
VDE	Verband der Elektrotechnik (German Association for Electrical, Electronic and Information Technologies)
VESDA	Very Early Smoke Detection and Alarm
WLAN	Wireless Local Area Network

2 SANITARY FIXTURES AND FITTINGS

2.1 Scope

Scope of work covers supply, installation, testing and commissioning of:

- i) Sanitary ware
- ii) Chromium plated (CP) fittings
- iii) Any other work to complete the systems

The contractor shall get the installation along with associated water supply distribution system and drainage system approved by the Bangalore Water Supply and Sewerage Board or other licensing authorities/owner.

2.2 Standards

All sanitary ware shall generally conform to IS: 2556 part I to VIII unless stated otherwise.

2.3 Materials

2.3.1 General

All sanitary ware and CP fittings shall be new, best of quality and of approved make, type and colour. All samples of materials with specifications/catalogues, performance data, shall be submitted and got approved before use on the work by the authorized representative. Approved samples along with other approved equipment/materials shall be neatly displayed on a board and such a display board of samples shall always be in exhibition in the construction office of the engineer-in-charge. Such display shall be used for the day-to-day checking of the materials on site.

Wherever multiple choices of fixtures are offered, the client shall have the final choice.

All fixtures shall be complete with all accessories as required for the working of the said fixture as specified.

2.3.2 European WC

European WC shall be wash down, floor mounted in white glazed vitreous chinaware with integral P or S trap as required. Wash down WC shall be supported on floor. The WC shall be provided with 32mm dia C.P. brass flush valve as specified in the schedule of work or shown on drawing.

Each WC shall be provided with a solid plastic seat. The seat shall be fixed to the WC with CP brass pillar bar hinges. Rubber buffers shall be provided for the cover.

2.3.3 Indian WC

White glazed vitreous chinaware Indian WC with flush tank should be installed as per IS :2065-1983 (clause 12.2,12.3,12.4) with integral P or S trap as required.

The WC shall be provided with 32mm dia C.P. brass flush valve as specified in the schedule of work or shown on drawing.

2.3.4 Urinals

Urinals shall be 610x410x380mm flat back wall hung urinal in white glazed vitreous chinaware of size mentioned in the schedule of work.

Urinals shall be provided with:

- 1) 15 dia spreader
- 2) 32 dia CP dome waste
- 3) 32 dia CP P-trap with unions
- 4) CP wall flange and pipe

All exposed pipes and fittings shall be of CP. The urinals shall be fixed with CP brass screws.

Urinal flushing shall be through an auto flush valve with electrically operated solenoid valve activated by infra red sensor.

Auto flush shall be concealed in wall and flush pipe shall be of copper or GI except the exposed part as specified.

Waste pipe for urinals shall be of:

GI pipes, heavy quality as per IS 1239 as specified in the schedule of work or shown on drawings.

Urinal partitions shall be both face polished granite or as approved by Architects 18mm thick, 750 x 500 mm size fixed in wall by cutting chase and making good in cement mortar (1:2) finished to match the surroundings.

2.3.5 Wash Basin

Wash basins shall be white glazed vitreous chinaware of size, shape and type specified in the schedule of work.

Each basin shall be complete with:

- 1) CI or galvanized steel supporting brackets & clips as required.
- 2) 32 dia CP waste and overflow
- 3) Waste with rubber plug and CP chain as specified
- 4) One no. pillar tap of 15 mm size

- 5) One no. 15 mm CP brass angle cock 15 mm size with CP brass flexible connection from angle cock to taps.

The tap shall be automatic in operation. Necessary solenoid valve (electrically operated) activated by infrared sensor shall be included.

2.3.6 Toilet Paper Holder

Toilet paper holder shall be white glazed vitreous china or chrome plated of size, shape and type specified in the Bill of quantities.

Porcelain toilet paper 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.

The latter (chrome) shall be fixed by means of screws / capping having finish similar to the toilet paper holder in wall/temper partitions with raw l plugs or nylon sleeves. When fixed on timber partition, it shall be fixed on a solid wooden base member provided by the Owner's Site Representative.

2.3.7 Drinking Water Fountain

Drinking water fountain shall be well mounting type made of vitreous china, stainless steel or any other material as given in the Bill of quantities.

The drinking water fountain shall be with anti-squirt bubble less, self closing valve type with automatic volume regulator.

The drinking water fountain shall be provided with an anti-splash back and integral strainer with 32mm or 40mm cast brass trap.

2.3.8 Liquid Soap Dispenser

Liquid Soap Dispenser shall be wall/counter mounted suitable for dispensing liquid soaps, lotions, detergents. The cover shall lock to the body with concealed locking arrangement, opened only by key provided.

Liquid soap dispenser body and shank shall be of high impact resistance material. The piston and spout shall be stainless steel with 1 litre capacity polyethylene container.

2.3.9 Toilets for the disabled

Where specified in washroom facilities designed to accommodate physically disabled, accessories shall be provided as per drawing.

Stainless steel grab bars of required size suitable for concealed or exposed mounting and preened non-slip gripping surface shall be provided in disabled toilet. The flushing cistern/valve shall be provided with chromium plated long handles.

2.4 Installation

All sanitary ware and CP fittings shall be installed in accordance with the interior requirements. Neat workmanship and maintaining exact position and level of each fixture shall be the sole objective of the installation. Care shall be taken to fix inlet and outlet pipes at correct positions. Faulty positioning shall be made well without any damage to the finished floor or wall tiling and any damage to the finished surfaces shall be made good at the tenderer / contractor's cost.

In order to ensure quality of workmanship and compliance with interior requirements, one or two mock-up installations shall be done and got approved. Fixtures used in the mock-up may be reused with the approval of the Engineer-in-charge.

All fixing accessories like bolts, nuts, brackets etc. as required shall form part of the installation. All such accessories shall be CP brass or galvanized or stainless steel as approved by the Engineer-in-charge. All exposed pipes and bends shall be of CP brass.

Wall-hung European WC shall be mounted on CI chairs, which are fixed to the wall and floor using Anchor fasteners. The bolts and nuts used for fixing the chairs shall be stainless steel and the fixing bolts for the WC and chairs could be CP brass or stainless steel. Floor-mounted WC shall be fixed with Anchor fasteners using stainless steel bolts and nuts. The gap between the WC and floor or wall shall be neatly sealed with waterproof non-hardening sealant of approved colour. The sealant should not extrude beyond the footprint or WC outline.

All WCs shall be aligned and levelled with the floor and wall tiles so as to present an integrated look. Utmost care and skill shall be exercised to achieve a good installation in keeping with the interior designs.

Urinals shall be fixed to the wall using anchor fasteners and stainless-steel bolts and nuts. The urinals shall be held in line and level according to the interior designs and tile modules. Partitions, wherever required to be provided, shall also maintain line and level as shown on drawings and as required. Supply spreader and drain piping and P-trap shall be of CP brass and installed in a neat and workman like manner. No unseemly bends or wooden support pieces shall be permitted.

Wall-mounted wash basins shall maintain line and level as specified by the interior drawings and also with the tile modules. The supply connections shall be of CP brass from the angle stop valves to the pillar taps and shall display good workmanship. Drain connections shall have a CP trap with unions and exposed CP drainpipe and a wall flange. In the case of counter mounted basins extreme care shall be taken to independently and adequately supporting the basin and aligning with the opening in the counter slab. Supply and drain connections shall be same as for wall mounted basins. The gaps between basin and wall or counter shall be neatly sealed with a non-hardening sealant of approved colour.

All accessories like the mirror, soap dish etc shall be neatly fixed as per interior designs. Good workmanship is the essence of all sanitary installation for achieving the interior design objectives.

During the construction period, the contractor shall protect all the sanitary fixtures from damage due to accidental or even intentional mechanical impact with hard objects and also misuse and vandalism.

2.5 Testing and Acceptance

The sanitary fixtures form the final terminal units of the water supply and drainage system and should meet the performance needs as a terminal unit. Each fixture shall be inspected for scratches or chippings and alignment before acceptance.

The following design flows shall be verified and validated for acceptance.

WC Flush Valve	15 liters to 20 liters per flush	Provide test 32 dia valve connection at the lowest floor and highest floor
Pillar taps	15 lpm max.	6lpm min
Wash Basin	Full basin drain time 3 min	To be measured and validated
Urinal Flush Valve	2 lpm max.	lpm minimum

All tests shall be conducted at each and every fixture except for flush valves which shall be at the lowest and highest test connections to be made on each riser / down take. The contractor shall make the temporary valve connections which shall be plugged with a brass after validation.

2.6 Mode of measurement

European water closet with flush valve or flushing cistern, flush bend, plastic seat and lid shall be measured and paid as a unit or as shown in the schedule of work.

Indian water closet with flush valve or flushing cistern and flush bend shall be measured and paid as a unit or as shown in the schedule of work

Wash basin with supporting brackets CP waste, P-trap, inlet connections, stop cocks, flexible pipes and mixer fitting shall be measured and paid as a unit or as shown in the schedule of work.

Urinals as mentioned in schedule, CP brass flush pipe, CP brass spreaders, CP brass waste with CP brass P-trap solenoid valve and sensor shall be measured as a unit and paid.

2.7 Mock Up

The contractor shall install all pipes, fixtures, clamps and accessories and fixing devices in mock-up shaft and room so constructed as directed by Engineer without any cost. The materials used in the mock-up may be reused in the works if found undamaged.

Any tiles or finished surfaces or floors damaged by the contractor while doing his work shall be made good with new tiles or other finishing material. No payment shall be admissible for such repairs. The engineer may, at his discretion get the damaged work repaired by other agencies and debit the cost of such repairs to the contractor.

3 WATER SUPPLY WORKS**3.1 Basis of Design**

The Plumbing, Sanitary and Drainage for the project are designed keeping in view the following.

Requirement of adequate and equal pressure availability of cold water lines in Staff Room Toilets, Public Toilets and other identified areas.

Adequate storage of water in under ground raw + overhead treated domestic water tanks

Provision of fire fighting appurtenance such as fire hydrants, hose reel, and portable extinguishers

Levels of roads / pavements and other services in the area

Landscape layout

The execution of works and materials used shall be as per the latest relevant. I.S. specifications

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Bill of quantities.

3.2 Concept of the System

The following services are envisaged for the Depot buildings/ Sheds:

Domestic water supply through overhead gravity feed system.

Sewage and Sullage collection system based on IS: 1742 and applicable standards for domestic drainage.

Storm / Rain water drainage system from various levels of the building and disposal to available storm water drain.

Firefighting system for the complex comprising of Hydrant, Hose Reels, Sprinklers and portable fire extinguishers

3.3 Water Storage & Distribution System

3.3.1 Water Requirement

The water requirement for the project is proposed to be based on the provisions of IS: 1172 and prevalent practice.

3.3.2 Source of water

It is expected that part of the daily domestic water requirement for the complex shall be through municipal mains supply / bore wells

3.3.3 Water Distribution

The water distribution for hot and cold water supply for the complex shall be designed on principle of gravity flow. Raw water from underground water storage tank is transferred and stored in the overhead water storage tank. Water from overhead tank is supplied by gravity to the Depot buildings/sheds.

3.4 Piping Material

i. G.I PIPES

The pipes shall be galvanized mild steel welded pipes and screwed and socketed tubes confirming to the requirement of I.S 1239-1982 required for medium grade. They shall be of the diameter (Nominal bore) as specified.

The pipes and sockets shall be clearly finished, well galvanized in and out and free from cracks, surface flaws, laminations and other defects. All screw flaws, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut clean and square with the axis of the tube. Unless otherwise specified all concealed pipe shall be G.I 'B' class and exposed pipe shall be G.I. 'B' class.

All screwed tubes and sockets shall have pipe threads confirming to the requirements of IS: 554 – 1961 (or revised) screwed tubes shall have threads while the sockets shall have parallel the threads.

ii. cPVC PIPES

The piping system shall consist of cPVC pipes and fittings conforming to BIS. The sizes and makes are specified in the Schedule of Quantities.

For any internal works, the cPVC pipes and fittings shall be embedded in the wall chase or run on the floor/ ceiling unless otherwise specified. No unsighted exposed runs shall be permitted.

The pipes shall be cPVC conforming to the requirements of BIS. The pipes should have smooth inner surface with Non – contracting diameters. The pipes shall be cleanly finished, free from cracks and other defects.

The pipes shall be clean and well cut along ends after taking into consideration the desired length, using the Pipe scissors.

The fittings shall be as follows:-

- Plain fittings from sizes 16mm to 125mm
- Chrome Plated Brass Threaded fittings from sizes 16mm to 125mm.
- Valves from sizes 20mm to 40mm.
- Plain fittings from sizes 16mm to 125mm

The plain fittings shall be cPVC and comply with all the requirements of the pipes. The size of fitting is specified in the schedule of quantities, corresponding to the size of the pipe. The plain fittings shall comprise of Socket, Elbow, Tee, Cross, Unions, Reducer socket, Reduction Tee, End Cap, Crossover, Omega, Threaded plug, and Wall Clamps in available sizes.

Chrome Plated Brass Threaded fittings from sizes 16mm to 125mm

The Chrome Plated Brass threaded fittings shall be Chrome Plated Brass threaded piece molded inside Polypropylene Random copolymer fitting. The Plastic end shall comply with all the requirements of the pipes while the C.P. Brass end shall comply with BSP standards of Threading. The size of the C.P. Brass threaded fitting is specified in the schedule of quantities, corresponding to the pipe size. The Chrome plated Brass threaded fittings shall comprise of Socket, Elbow and Tee (Male & Female) in available sizes. These are the fittings for C.P. connections and for continuations from existing Galvanized Iron Pipes and fittings.

However, the other Brass/ Bronze Valves can be connected to Polypropylene pipes using C.P. Brass threaded fittings of desired sizes.

For specifications of UPVC pipes to be used for soil and waste discharge in the buildings, IS 13592 latest version shall be referred.

Piping Installation Support

Architectural and Services Consultant drawings indicate the schematic Line diagram for the size and location of the pipes. The Services Consultant /Architect before the perusal of actual work on site by the contractor shall prepare the detailed working drawings, showing the cross-sections, longitudinal sections, fittings details, locations of control valves and all pipe supports. The consideration while doing all this designing part is to keep in view the specific openings in buildings and other structure through which the pipes are desired to pass.

Piping shall be properly supported by means of wall support clamps as specified and as required, keeping in view the proper designing for expansion and contraction. Risers shall be supported at each floor with Clamps.

When necessary cPVC can be bend by heating, but the pipes should not be put on flame. Heating should be done by hot air blowing device. To bend the pipes, they should be heated upto 140 Degree Celcius. Due to high coefficient of thermal expansion the heat losses through the pipes is highly reduced. Therefore, for internal Bathroom hot geyser water distribution lines, the insulation is often not required. However, where the hot water has to travel long distances before being distributed in the individual connections, the insulation can be provided in the form of Insulating tapes/ Ply available in the form of tubes or sheets. However, the Thermal conductivity value for cPVC pipes and fittings is 0.23 W/mK while for insulation is 0.035 W/mK. The insulation thickness can be greatly reduced, because of the insulation characteristic of the cPVC pipes.

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 organised in consultation with other agencies work, so that all works can be carried out in one stretch.

cPVC pipes can be used in mixed installations and repair works. The pipes running parallel, should be separated by putting insulation parts to prevent sound reflection. To prevent noise, under or above ground installations the pipes should not contact to each other.

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

All pipes shall be accurately cut to the required lengths and then cleaned with a clean cloth before fixing.

Open ends of the pipes where the C.P. Brass threaded fittings are joined for C.P. connections at the later stage should be closed by means of Plugs to avoid the entrance of foreign matter shall also be provided on hot water risers. Discharge from the air valves shall be piped to the nearest drain or sump. All pipes shall be pitched towards the drain points.

3.5 Pipe Fittings

- 1) The fittings shall be of malleable cast iron or galvanized mild steel tubes as called for complying with all the appropriate requirements given above designated by the respective nominal bores of the pipes for which they are intended.

The fitting shall be of malleable cast iron or galvanized mild steel tubes as called for complying with all the appropriate requirements given above designated by the respective nominal bores of the pipes for which they are intended.

The fitting shall have screw threads at the ends and conforming to the requirement of IS: 554 – 1964 (or revised). Female threads or fittings shall be parallel and male threads (except on running nipples and collars of union) shall be maintenance/ Repair / Replacement of pipes.

- 2) Laying and Jointing of Pipes and Fittings
- 3) The cPVC Pipes and Fittings shall run in wall chase or ceiling or as specified. The installation of cPVC pipes is similar to that of the metal pipes with the only difference in the Jointing procedure. The jointing of the cPVC pipes and fittings is done by means of a necessary adhesive.
- 4) The quality of each installation system ultimately depends on the tightness, stability and lifetime of its connections. The homogeneous connection of cPVC pipes by necessary adhesive.
- 5) Gives a safe pipe connection and guarantees utmost operational safety. It takes only a few seconds to make a connection by fixing process. The pipe to the desired length is cut using the Pipe Scissors.
- 6) The fixing procedure shall be adapted for exposed as well as concealed fittings. The Crossovers may be used wherever the overlapping of the cPVC pipes is required. The fixing shall be done by means of Wall Support Clamps keeping the pipes about 1.5 cm clear of the wall where to be laid on the surface. Where it is specified to conceal the pipes, chasing may be adopted.
- 7) For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. Where directed by the owner's site representative/ Architect, 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. Fixed supports prevent any movement of the pipe by fixing it at some points. Fittings are used in creating the fixed points. Fixed supports must not be installed at bending parts and the direction changes must be done in the pipe itself. In between the fixed supports some arrangements must be done to compensate any potential elongation or shrinkage in the pipe length.
- 8) Expansion or shrinkage compensation arrangements can be installed in buildings very easily. For making one expansion loop, four elbows will be enough. For straight pipes having length more than 5 meters, to compensate the expansion an expansion piece must be used.

3.6 Valves**3.6.1 Ball Float Valve:**

The ball valve shall be of high pressure type shall be of sizes as specified. The normal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball valve shall be of brass or gun metal as specified, and the float of copper sheet. The minimum thickness of copper sheet used for making the float shall be of 0.45 mm for float exceeding 115 mm dia. Plastic floats may also be used if specified. The body of the high pressure ball valves when assembled in working conditions with the float immersed to not more than half of its volume shall remain closed against a test pressure of 3.5 kg/sq.cm.

The ball valve shall generally conform to I.S. specification No.1703:1862. The weight of ball cock and the size of the ball cock shall be as per I.S. Specification.

3.6.2 Brass full way Valve:

Full way valve is a valve with suitable means of connection for insertion in a pipe line for controlling or stopping the flow. The valve shall be of brass fitted with a cast iron wheel and shall be of gun metal gate valve type opening full way of the size as specified. The valve shall be of best quality or approved by the Engineer-in-charge.

3.6.3 Gun-metal full way valve with wheel:

These shall be of the gun metal fitting with wheel and shall be of gate valve type opening full way and of the size as per specification. These shall generally conform to IS 7780 - 1957.

3.6.4 Butterfly Valves:

All valves shown in the drawings for water piping for sizes 50 mm and above shall be wafer type butterfly valves. The valves should be suitable for mounting between flanges drilled to IS 6392 Table 10 to 20. The valve body shall be cast iron. Body liner shall be integrally moulded and bonded to the body. The material shall be Buna-N Rubber. This body liner shall provide seating to the valve disk and "Gasket Joint" with mating pipe flanges. The valve disk material shall be Stainless steel or Ductile (SG) Iron with Nickel Coating. The valve stem shall be high tensile stainless steel (AISI 410). The Valve Stem shall be sealed properly using 'O' rings. All valves up to 200 mm NB shall be provided with flow control levers. Valves of 250 mm NB and above shall be provided with gear operated levers. The valve should have a pressure rating of ANSI 150.

3.6.5 Ball Valves

All valves for shut-off purposes for sizes of 50 mm and below shall be ball valves. The valve body and body connector shall be carbon steel as per ASTM A216-WCB, the ball and stem shall be stainless steel SS 304/316. The seats and stem packing shall be PTFE. All Valves shall have socket weldable ends, in 2/3 piece construction and the central portion could be bolted out for maintenance. All valves should be supplied in full bore construction. The valves should have a pressure rating of ANSI 150.

3.6.6 Foot Valves

Provide cast iron body with brass disc and strainer of approved quality, wherever shown.

3.6.7 Sluice Valve

The sluice valves are used in a pipe line for controlling or stopping flow of water. They shall be of specified size and class and shall be of inside non-raising screw type spindle with either double flange or double sockets ends and cap or hand-wheel.

These shall in all respects comply with the Indian Standard Specification I.S 780 - 1963 for valves up to and including 300 mm, size and No. BDC (429) p2 for valves above 300 mm size

Class - I sluice valves are used for maximum working pressure of 10 kg/cm² (100 meter head) and Class - II sluice valves for 15 kg/cm² (150 meter head).

The body, domes, covers, wedge gate and stuffing box shall be of good quality cast iron, the spindle of bronze the nut and valves seats of leaded tin bronze. The bodies, spindles and other parts shall be truly machined with surfaces smoothly finished. The area of the water way of the fitting shall be not less than the area equal to the nominal bore of the pipe. The valve wheel shall be marked with an arrow to show the direction to turn for closing the valves. The valve shall be fully examined and cleared of all foreign matter before being fixed. The fixing of the valve shall be done by means of bolts, nuts and 3 mm rubber insertions or chemically treated compressed fibre board of 1.5 mm thick minimum thickness and of weight not less than 0.183 gm per sq.cm. with the flanges of spigot and the socketed tail pieces drilled, to the same specification in the case of S & S pipe and with flanges in case of flanged pipes. The tail pieces shall conform to I.S 1938 - 1960. These shall be jointed to the pipe line by means of lead caulked joints.

3.6.8 Valve Schedules

Service	Type	Size	Rating	Ends	Materials
Cold Water	Butterfly	50 mm NB & above	150	Wafer type slip on	Cast iron body
Cold Water	Ball with through bore 3 piece construction	40 mm NB & below	150	Screwed	Cast steel body and SS Ball.
Cold Water	Dual Plate Check Valve	100 mm NB	150	Wafer type slip-on	Cast Steel & SS flap

Service	Type	Size	Pressure	Ends	Materials
Water	Gate	65	300psi/	Screwed	Bronze
Water	Gate	75 & Over	20 kg/	Flanged	C.I body bronze trim
Water	Globe	65 & under	20 kg/ cm ²	Screwed	Bronze
Water	Globe & Angle	65 & under	20 kg/ cm ²	Screwed	Bronze
Water	Globe & Angle	65 & over	20 kg/ cm ²	Flanged	Iron body bronze trim
Water	Horizontal Vertical check	65 & under	20 kg. cm ²	Screwed	Bronze
Water	Horizontal Vertical check	65 & under	20 kg. cm ²	Screwed	Bronze
Water	Horizontal Vertical check	65 & under	20 kg. cm ²	Flanged	Iron body bronze

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

3.7 Other Pipe Fittings

3.7.1 Water Meters

Water meters of approved make and design shall be supplied for installation at locations as shown. The water meters shall meet with the approval of local supply authorities. Suitable valves and chambers or wall meter box to house the meters shall also be provided along with the meters.

The meters shall conform to Indian Standard IS: 779 and IS : 2373

Provision shall also be made to lock the water meter. The provision shall be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks the hold provided for padlocks shall be a diameter not less than 4mm.

3.7.2 Installation of water meter and stop cock

The G.I lines shall be cut to the required lengths at the position where the meter and stop cock is required to be fixed. Suitable fittings shall be attached to the pipes. The meter and stop cock shall be fixed in a position by means of connecting pipes, jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed. And the meter installed exactly horizontal or vertical in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken that the factory seal of the meter is not disturbed. Wherever the meter shall be fixed to a newly fitted pipe line, the pipe line shall have to be completely washed before fitting the meter.

3.7.3 Air valve

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.

3.7.4 Pressure Gauges

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.

The pressure gauge shall be constructed of die cast aluminium and stove enamelled. It shall be weatherproof with an IP 55 enclosure. It shall be a stainless-steel Bourdon tube type pressure gauge with a scale range from 0 to 16kg / 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.

3.8 Pipe Laying

3.8.1 Cutting in masonry walls

Cold water distribution pipes to fixtures and equipment exposed to view in the bathrooms, kitchens, and sanitary compartments shall be chased into walls or floors or placed in wall cavities. The contractor shall be responsible for cutting all notches. Chases and recesses in walls and floors and only a diamond cutter shall be used. The maximum size of conduit or pipe permitted to be concealed in floor slabs shall be 32 mm diameter unless otherwise approved by the Engineer In-charge

The chases up to 7.5 x 7.5 cm shall be made in the walls for housing GI pipes etc. These shall be provided in correct positions as shown in the drawings or directed by the Engineer In charge. Chases shall be made by chiselling out the masonry to proper line and depth. After the pipes etc are fixed in chases, the chases shall be filled with cement mortar 1:2:4 or as may be specified and made flush with the masonry surface. The concrete surface shall be roughened with wire brush to provide a key for plastering.

Where pipes pass through beams or structural walls, subject to the approval of the Structural Consulting Engineer, the Contractor shall ensure that sizes and locations of openings required are formed in when the relevant beams or walls are cast

3.8.2 Pipe Support

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 pie 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 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. To permit free movement of common piping support shall be from a common hanger bar.

Pipe hangers shall be provided at the following maximum spacing:

Pipe Dia (mm)	Hanger Rod Dia (mm)	Spacing between supports
Up to 25	6	2
33 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 at least 15c.m 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.

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.

3.8.3 External Works

The galvanized iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be given as in the table below, and shall be enough to have a clear cover of at least 400 mm above the top of pipes.

Dia of Pipe	Width of trench	Depth of Trench
15 mm to 50 mm	300 mm	600 mm
65 mm to 100 mm	450 mm	750 mm

At joints and multi pipe routes the trench width shall be widened where necessary. To work of excavation and refilling shall be done true to line and gradient

The pipes shall be painted with two coats of anti-corrosive bitumastic paint of approved quality and wrapped with Hessian cloth impregnated with bitumen. The pipes shall be laid on a sand cushion layer of 75 mm. river sand and filled with excavated earth. The surplus earth shall be disposed off as directed. The filling shall be done after testing & rectifying leakages and after final passing of work by Engineer In charge / Owners Representative at site.

When the excavation is done in rocks the bottom shall be cut deep enough to permit the pipes to be laid on a sand cushion of minimum 75 mm. In case of bigger diameter pipes where the pressure is very high thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 nominal size) shall be constructed on all bends to transmit the hydraulic thrust without impairing the ground and spreading it over a sufficient area, as directed by the Engineer-in-charge / Owners Representative at Site.

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

3.9 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 / Engineer In-charge.

The equipment's to be supplied by the other agencies consist mainly for air-conditioning and any other service. The work of connections to the various equipments shall be done through proper union 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 / Engineer In-charge. The various aspects of connection work shall be executed in a similar way to the work of respective trade mentioned elsewhere in these specifications.

3.9.1 Basic Piping System

Soil, waste and vent pipes in shafts, raised floors and in concealed areas i.e. false ceilings etc. shall consist of uPVC SWR pipes & fittings conforming to I.S.: 13592 cut to required lengths including all necessary fittings and specials such as bends, junctions, offsets, access pieces (plain or door) & vent cowl. In general wastes and vents smaller than 50mm dia shall be of uPVC conforming to I.S.: 4985.

The soil pipes shall be circular with a minimum diameter of 75mm. Pipes shall be fixed by means of stout MS / GI clamps in two sections bolted together, built into the walls, wedged and neatly jointed as directed and approved by the Engineer's Representative. 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 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. Joints throughout shall be made with molten lead as described under jointing of pipes. All vertical pipes shall be firmly fixed to the walls with properly fixed clamps, and shall as far as possible be kept 50mm clear of wall.

3.9.2 Piping Materials

1. UPVC SWR PIPES

The pipes shall be round & shall be supplied in straight lengths with socketed ends. The internal & external surfaces of pipes shall be smooth, clean, free from groovings & other defects. The ends shall be cleanly cut & square with the axis of the pipe.

- a) Soil & Waste pipe shall be UPVC (SWR) type 'B' confirming to IS: 13592-1992 [From 75mm OD to 160mm OD].
- b) Fixtures Waste and vent pipe (40 mm OD to 63 mm OD) shall be conforming to IS:4985

Technical Detail for UPVC SWR Pipe:

S. No.	Nominal Outside diameter (d) mm	Tolerance on outside diameter mm	Wall Thickness Type-A (t) mm		Wall Thickness Type-B (t) mm		Wall Thickness – Sufla (Non – standard) (t) mm	
			Min	Max	Min	Max	Min	Max
1.	40	+0.3	1.8	2.2	3.2	3.8	-	-
2.	50	+0.3	1.8	2.2	3.2	3.8	-	-
3.	63	+0.3	1.8	2.2	3.2	3.8	-	-
4.	75	+0.3	1.8	2.2	3.2	3.8	1.4	1.6
5.	90	+0.4	1.9	2.3	3.2	3.8	-	-
6.	110	+0.4	2.2	2.7	3.2	3.8	1.5	1.65
7.	160	+0.5	3.2	3.8	4.0	4.6	2.7	3.2

Notes :

- (i) As per IS : 13592-1992 Type 'A' pipes are recommended for use in rain water application and Type 'B' pipes are recommended for use in soil & waste discharge system.
- (ii) Fitting dimension shall be as per DIN 19531 and DIN 19534 and conforms to IS : 14735-99.
- (iii) Rubber ring shall conforms to IS : 5382.

a) Fittings

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

b) Laying & Jointing

The pipes shall be laid & 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. Keep a gap of 10 mm between all pipes and fittings to accommodate thermal expansion and contraction of pipe for longer life of the system. Jointing of UPVC SWR pipe and fitting shall be rubber ring joint using rubber lubricant.

c) Supports

UPVC pipes require supports at close intervals. Recommended vertical support spacing for unplasticized PVC pipes is 2000 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 & hangers & be responsible for their structural sufficiency. Pipe supports shall primer coated with rust preventive paint & finish coated black.

Maximum Support Distance in Meters

S.No.	Size in mm	Horizontal Supports	Vertical Supports
1.	40 mm OD	0.4	1.2
2.	50 mm OD	0.5	1.5
3.	75 mm OD	0.75	2.00
4.	110 mm OD	1.10	2.00
5.	160 mm OD	1.60	2.00

d) Repairs

Temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. If any split or chip out occur in the wall of the pipe, the repair shall be carried out by cutting the pipe and the inserting new piece of pipe of same length and bath joints (ends) should be sealed with couplers. However, in horizontal lines no joint shall be given.

e) Pipe Sleeves

Pipe sleeves, 50 mm larger diameter than pipes shall be provided wherever pipes pass through walls & slabs and annular space filled with fiberglass & finished with retainer rings. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes & burrs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matter.

2. CLEAN OUT PLUGS:

Contractor shall provide UPVC clean out plugs as required. Clean out plugs shall be threaded and provided with key holes for opening.

3. WASTE PIPE FROM APPLIANCES

Waste pipe from appliances e.g. washbasins, kitchen sink shall be of UPVC as given in the Schedule of Quantities.

All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps as directed by the Architect/Consultants. Spacing for the clamps shall be 3000mm for vertical runs and 2400mm for horizontal runs.

Pipes shall be of UPVC conforms IS: 13592-1992 class 5 and quality certificates shall be furnished. Tees, couplings, bends, elbows, unions, reducers, nipples, plugs etc. All UPVC waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

3.9.3 Rain water Pipe

For draining rainwater, depot building/shed roofs shall be provided with Soil & Waste pipe shall be UPVC (SWR) type 'A' conforming to IS : 13592-1992 [From 110mm OD to 200mm OD] down take water pipes of ISI brand as mentioned in Bill of Quantity. These shall be provided with necessary

bends and shoes wherever required. Necessary clamps shall be fixed to hold the pipe tightly to the wall. The work includes cost of all materials and skilled and unskilled labour.

3.10 Testing of Joints

The contractor shall notify the Engineer In-charge three days in advance of any test so that the Architect can witness the tests if he so wishes.

All water supply system shall be tested to hydrostatic pressure test of at least one and a half (1.5) times the maximum pressure but not less than 10Kg/Sq.cm for a period of not less than 8 hours. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner.

System may be tested in sections and such sections shall be entirely rested on completion.

The contractor shall make sure that proper noiseless circulation of fluid is achieved through the entire piping network of the system concerned. In case of improper circulation, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectification's including the tearing up and refinishing of floors and walls as required.

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

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

A test register shall be maintained and all entries shall be signed and dated by contractor(s) and Owner's site representative.

3.11 Measurements

The length above ground shall be measured in running meter correct to 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 bill of quantities.

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 bill of quantities.

3.12 Masonry Chambers

3.12.1 General

All masonry chambers for stop cocks, sluice valves, etc., shall be built as per supplied drawings.

3.12.2 Excavation

The excavation for chambers shall be done true to dimension and levels as indicated on plans or as directed by the Engineer-in-charge.

3.12.3 Bed Concrete

This shall be cement concrete 1:3:6 (1 cement : 3 fine sand : 6 graded stone aggregate 40 mm nominal size).

3.12.4 Brick Work

This shall be in Class B bricks (Table Moulded) with crushing strength not less than 35 kg / sq.cm in cement mortar 1:5 (1 cement : 5 fine sand).

3.12.5 Plastering

Plastering not less than 12 mm thick shall be done in cement mortar 1:3 (1 cement: 3 coarse sand) finished with a floating coat of neat cement.

3.12.6 Surface Box:

This shall be of cast iron, well made and free from casting and other defects. All sharp edges shall be removed and finished smooth. The shape and dimensions for surface boxes for stop cocks, sluice valves, etc., shall be as per approved samples.

3.12.7 Measurements

Masonry chambers shall be measured as No. of units and the item may or may not include, excavation and back-filling as detailed in the BOQ.

3.12.8 Rating

The rate shall include the cost of materials and labour involvement in all the operations described above, except the excavation in soft or decomposed and hard rock.

The difference in cost, between ordinary soil and soft or decomposed or hard rock as the case may be, shall be paid for separately if the rock is met with.

3.13 Connection of RCC Water Tanks

The contractor shall provide all inlets, outlet, 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 an 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 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.

3.14 Disinfection of Piping system and Storage Tanks

Before commissioning the water supply system the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph.

The water storage tanks and pipes shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water.

If ordinary bleaching powder is used, the proportions will be 150 gm of powder to 1000 liters of water. The powder shall be mixed with water in the storage tank. If a proprietary brand of chemical is used the proportions shall be specified by the manufacturer. When the storage tanks are full the supply shall be stopped and all the taps on the distributing pipes are opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell of chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose.

The pipe work shall be thoroughly flushed before supply is restored.

3.14.1 Sterilization of Mains

After the pipe work has been tested and approved, but before it is coupled, it shall be sterilized with a solution of chloride of lime.

3.15 System Testing

Plumbing equipment fixtures, piping etc., shall be free of stampings, marking (Except those required by codes) iron cutting and other foreign materials.

Cold and drinking water systems shall be cleaned thoroughly filled and flushed with water. The entire mechanical apparatus shall operate at full capacity without objectionable noise or vibrations

On completion of the works, the following tests shall be performed to the satisfaction of the consultants / clients representative before issue of virtual completion certificate, if so required.

1. Smoke Test
2. Hydraulic Test
3. Performance test for fixtures
4. Tests for anti-siphonage system
5. Pump rating and output
6. Inspection of all units and fixtures.

The contractor shall arranged for similar tests during the progress of works to ensure that there are no defects in material/work ship in portions of work to be concealed or embedded under the floor or walls in ceiling and get this approved by the consultants. The under floor pipe works shall not be closed without the approval of consultants.

Test entire system of soil, waste and vent piping by smoke test after scaling all traps.

Water tests: Tests entire system or sections of system by closing all openings except the highest opening and filling system with water to the point of overflow. If the system is tested in sections, plug each opening except the highest opening of the section filled with water. Keeps the water in system or in portion under test for at least 45 minutes before inspection starts with test pressure/head lasting for two hrs. The system must be tight at all joints.

Test all down spouts or rain headers and their branches within the building by water as described for the above soil waste and vent system.

All tests on below ground lines shall be continued until backfill on such lines is Completed to disclose any damages caused by back filling.

3.16 Reverse Osmosis Plant**3.16.1 Technical Specifications**

Plant of 50 m³/day treatment capacity (@ 2.78 m³/hr. capacity operating for 18 hrs. per day)

Reverse Osmosis Water Treatment Plant of 2.78 m³/hr treatment capacity as per following parameters,

3.16.2 Key Raw Water Parameter:

- | | | | |
|----|------------------------|---|------------------|
| 1. | Total Dissolved Solids | = | Maximum 3000 ppm |
| 2. | Source of Raw Water | = | Bore-well |

Key RO Treated Water Parameters:

- Total Dissolved Solids < 100 ppm (without pH correction).

Reverse Osmosis Plant shall consist of the following:

Supplying, Fixing, Testing and Commissioning of skid mounted automatic Reverse Osmosis Water conditioning system of 2.78 m³/hr. capacity with minimum recovery of 65%, consisting of 2 nos. raw water pumps (1 working + 1 standby), solenoid valve at inlet, micron filter, 1 nos. high pressure pump (in S.S. construction), reverse osmosis membrane block, anti-scalant dosing & post treatment pH correction & chlorine dosing systems with 100 litres chemical dosing tanks, MIMIC & power cum control panel with PPLC based SIRO-Logic controller with necessary flow & pressure indicators. RO plant electrical panel shall also have starters for RO plant feed pumps, level controllers for chemical dosing tanks & treated water tank level controlling. The RO plant shall also comprise of Pre-treatment Chlorination & De-chlorination equipment complete with ORP controller & automatic dump valve. Interconnecting Piping Work, Power & control cabling within the RO plant.

RO plant shall be complete with C.I.P. (Cleaning in Place) equipment for periodic membrane cleaning.

3.17 Bore-well**3.17.1 Scope**

The scope of this section comprises the supply, installation, testing and commissioning of bore. The contractor shall make all necessary application and arrangements for his work to be inspected by the Local Authorities, Consultants and Site personnel.

The contractor shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the complete bore-well to the owner.

The general character and the scope of work to be carried out under this contract is illustrated in the following specification. It gives only general guidance as regards design, drilling and construction of tube-wells. The construction and testing of tube-well shall be as per IS 2800-1991 part I & IS 2800-1979 part II. The contract is an item rate contract. All payments shall be made for the actual work executed. The required minimum yield shall be ensured by the contractor.

3.17.2 Selection of site

The proposed site for the tube-well decided based on hydro geological tests carried out, shall be examined by tenderer. The tenderer shall satisfy himself about the suitability of site selected for the drilling of tubewell. If any changes are required, these shall be got approved from the Engineer prior to starting the work. Any previous data available with the contractor regarding nearby tubewells should be made use of to evolve suitable procedure for drilling, developing, testing etc.

3.17.3 Geological data

During the drilling time, contractor shall collect the samples of different strata @3 mtrs. It shall be carefully examined and analyzed and data shall be preserved carefully and handed over to the Engineer's Representative. The contractor shall make one drilling time log during the execution of work for the bore well.

3.17.4 Design and lowering of pipe assembly

The length and diameter of the housing pipe (blind and slotted) and the capacity and head of the pump have been tentatively selected based on information available presently. However the selection would depend on the actual conditions encountered during drilling. Housing and casing pipes shall be freshly painted before lowering into the bore. Centering guides are to be used to ensure verticality. The depth of the casing and its size shall be selected to seal the entire clay which moves up to the point of an encountering hard rock.

3.17.5 Gravel packing

All gravels shall consist of hard, well rounded particles reasonably uniform in diameter and shall be of a size, determined after analyzing the character of the water bearing formation tapped. The gravel around the screen shall be uniform.

3.17.6 Development of tube-well

The well shall be developed either by surging and agitating or by over pumping and back washing with an air lift and high velocity jetting etc. Any other acceptable method may also be adopted. This development process shall be continued until the stabilization of sand and gravel pack has taken place.

Over pumping shall be done at 25% higher discharge than the expected yield of the well. The development shall be continued till sand free discharge is obtained. Maximum permitted sand shall be 20PPM by volume after 20 min of starting the pump. Subsequently, 12-16 hrs. continuous pumping must be carried out to measure draw down and recovery to draw up pump specifications and yield of the tube well.

3.17.7 Disinfection

The well shall be disinfected after completion of test for yield. All the exterior parts of the pump coming in contact with the water shall be thoroughly cleaned and dusted with powdered chlorine compound. In fact it shall be disinfected every time when a new pump is installed or the one replaced after repairs.

3.17.8 Grouting and sealing

Grouting and sealing of tube-well shall be done as instructed by the engineer. To ensure a satisfactory seal, it shall be applied in one continuous operation. Sealing of the tubewell shall be done by grouting the annular space between bore and the housing pipe, thickness of grouting depending upon the quality of water.

3.17.9 Handing over of the tube-well

The tube-well shall be handed over to the engineer's representative in complete shape. The housing pipe shall be closed by a well cap for the period between the completion of the tube-well and the installation of the pump set.

The following information shall be furnished by the drilling agency on completion of the tube-well:

Strata chart of the tube-well indicating the different types of soils met with at different depths.

Samples of strata collected, neatly packed and correctly marked in sample bags.

Chart of actual pipe assembly lowered indicating the size of pipes, depth ranges, where slotted/strainer pipes have been used, depth and diameter of housing pipe, reduced level of the top of the housing pipe and the diameter and depth of the bore hole.

- Position of every joint in the well assembly.
- Hours of development done by compressed air pump sets or by other means.
- Pumping water level and draw down at the developed discharge. Result of yield test.
- Routine chemical and bacteriological tests on the water for.
- Suitability for drinking.
- Suitability for construction.
- Two attested copies of all test certificates by the testing agency approved by the engineer.

3.17.10 Tube-well pumps

Tube-well pumps shall be a compact unit made up of a submersible motor with shaft connected by a sleeve. The pump shall be single/multi stage centrifugal pump with stainless steel jacket and non-return valve fitted to the pump discharge. The pump shall be provided with sleeve bearings and the motor with sleeve and thrust bearings. All these bearing shall be water lubricated and protected against the ingress of sand by suitable structural elements. Different parts of tube-well pumps shall be made from following materials:

1.	Suction casing	Cast iron
2.	Diffuser	Cast iron
3.	Impeller	Bronze
4.	Pump shaft	Chrome steel
5.	Thrust bearing housing	Cast iron
6.	Upper/Lower bearing	Carbon steel
7.	Thrust bearing plate	Stainless steel
8.	Rotor complete	Chrome steel
9.	Bearing bush for motor	Gunmetal
10.	Stator casing	Seamless steel

3.17.11 Electrical works

3.17.11.1 Cables

Contractor shall provide all power and control cables from motor control centre to motor.

Cables shall conform to IS: 1554 and carry ISI mark.

Wiring shall conform to IS:694.

All power cables shall be 3.5/4 core aluminium conductor PVC insulated/ PVC sheathed FRLS armored cables of 1100 volts grade with fire proof coating of approved make.

All control cables and wiring cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 grade.

All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

3.17.12 Motor control centers

Cubicles switch board of wall mounted as approved shall be fabricated from preferably 14 gauges with 16 swg doors, M.S. sheet with dust and vermin proof construction. It shall be powder coated with stove enameled paint of approved make and shade, It shall be fitted with suitable etched plastic identifications plates for each motor. The cubicles shall be in general comprise of the following (switchgear as given in the schedule of quantities).

- Income main fuse switch unit with HRC fuses of required capacity.
- Isolation switch fuse unit one for each motor.
- Fully automatic DOL Starter appropriate for motor rating with ON/OFF push buttons and on/off indicating neon lamps for individual motor.
- Single phase preventor & overload protection of appropriate rating for each motor.
- Selector switch for pump operation.
- Panel type ampere meters of appropriate rating one for each motor.
- Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
- Rotary switch for manual or auto operation for each pump.
- Space for liquid level controllers specified separately in this contract.

The panel shall be prewired with colour coded wiring (all interconnecting wiring from incoming main to switch gear, meters and accessories within the switch board panel).

3.17.13 Shop drawings

The contractor has to submit the model of submersible pump that he proposes to install. The shop drawings for electrical panel shall also be submitted for approval before the installation.

3.17.14 Installation

The pumps and accessories shall be installed in a true workman like manner true to level and grade in accordance with the best current practice.

Vendor shall employ sufficient and proper equipments for lifting and placing of pumping equipment, in a manner which shall not strain or cause damage to the existing structures. If any damage is done, the sample shall be made good to the satisfaction for the engineer's representative without any additional cost.

The vendor shall submit detailed shop drawing showing sizes of all piping, valves, etc. for approval. The work shall be started only after approval of shop drawings.

3.17.15 Commissioning

On completion of the work in all aspects, the vendor shall start up the pumps in a manner normally done for the continuous operation for a period of not less than 48 hours and shall rectify and adjust the pumps and equipments for leakages and balancing the system.

After satisfactory commissioning of the pumps, the vendor shall conduct performance tests to satisfy the engineer's representative that all pumps and equipments are performing to the rated outputs of any or all pumps and equipment shall be rectified or replaced if the same is not performing in accordance with the specifications.

3.17.16 Guarantees

On award of the work the vendor shall submit a guarantee covering the quality and performance of all materials and installations under the contract. This guarantee shall cover each and every material whether manufactured by the contractor or not.

Vendor shall specify a suitable procedure to test the rated performance of the equipment and the system and shall provide all necessary equipments, gauges, etc. for conducting such tests.

3.18 Pumps, Accessories And Associated Electrical Works**3.18.1 Pumping Sets**

Water supply pumps shall be suitable for clean filtered water. Pumps shall be single or multistage, vertical pumps with S.S. body, S.S. impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling and C.I. base plate. Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 400/440 Volts, 3 phase, 50 cycles A.C. Power supply. Each pumping set shall be provided with a 150 mm dia gunmetal "BOURDEN" type pressure gauge with gunmetal isolation cock and connecting piping. Provide vibration eliminating pads appropriate for each pump.

3.18.2 Submersible Sump Pumps

Pumps shall operate with high water level in sump and stop at low water level by means of an electronic level controller/ float ball valve.

- Pumps for drainage shall be single stage, single entry pump.
- Each pump shall be provided with air cooled squirrel cage induction motor suitable for 415 volts, single/three phase $\pm 10\%$, 50 cycle A.C. power supply.
- Each pump shall be provided with inbuilt liquid level controller for operating the pump between predetermined levels.
- The pumping set shall be for stationary application and shall be provided with pump connector unit. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation.
- Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.

3.18.3 Level Controller

Provide and install low voltage transistorized level controllers as specified below. Each level controller shall be provided with required number of PVC sheathed stainless steel probes. All sumps shall be provided with two pumps, one running and one standby, the pump panel shall be provided with an auto/off/manual and a pump selector switch. At high-water level conditions the pump selected by the selector switch will first start automatically. If for some reason the level continues to rise, the second pumps would start automatically at extra high level. If for some reason the level of water in the sump continues to rise then a third sensor would provide an audio visual alarm at specified point. Each controller shall be provided with an audible alarm for low water level and High water level in underground tank.

3.18.3.1 Raw water pumping system

To start/cut pump at high water level and stop at low water level in the sump.

3.18.3.2 Sump pump

To start pump at high water level and stop at low water level in the sump.

3.18.4 Vibration Eliminators

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturers' details. Flexible connector shall be of approved make only.

4 DRAINAGE WORK**4.1 Salt Glazed Stone ware pipe**

All pipes with spigot and socket ends shall inform to be 651 – 1980 and shall be of grade 'I' as specified. These shall be sound, free from visible defects such as fire cracks or hair cracks. The pipes shall give a sharp clear note when struck with a light hammer. These shall be no broken blisters or chipping on the spigot or socket.

The appropriate thickness of 60 cm pipes shall be given in the table below:

Internal Diameter of the Pipe	Thickness of the weight of each barrel and of as kept pipe per m	
	Mm	Kg.
100	12	14
150	16	22
200	17	33
230	19	44
250	20	52
300	25	79

The length of pipes shall be 60 cm exclusive of the internal depth of the socket.

4.2 Trenches for Stone ware pipes

Unless otherwise mentioned the widths of trenches for various dia of stoneware pipes shall be as given in the table given below for depth up to 3 m

Size of Pipes	Width of Trench
100 mm dia	400 mm
150 mm dia	600 mm
200 mm dia	700 mm
250 mm dia	750 mm
300 mm dia	900 mm

Wherever depth exceeds 3 m, the width will be increased by 1.1 m

4.3 Laying of Stone ware pipes

All pipes shall be laid on a bed of 15cm cement concrete of 1:1:8 using 10 to 12cm graded granite aggregates projecting on each side of the pipe to the width of the trench specified. The pipes with their crown level at 1.20m. Depth and less from ground shall be covered with 15cm thick concrete above the crown of the pipe ends sloped off to meet the outer edges of the concrete to give a minimum thickness of 15cm all round the pipe. Pipes laid at a depth greater than 1.20m at crown shall be concreted at the sides up to the level of the centre of the pipe and sloped off from the edge to meet the pipe tangentially.

The pipes shall be carefully laid to the alignments, levels and granites shown on the plans and sections, great care shall be taken to prevent sand etc., from entering the pipes. The pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation. The pipes shall be laid with socket up the gradient.

If the excavation has been carried to low, the desired levels shall be made up with concrete 1:5:10 (1 cement; 5 fine sand: 10 graded stone aggregate 40 mm nominal size) for which no extra payment shall be made.

If the floor of the trench consists of rock or very hard ground that cannot easily be excavated to a smooth surface the pipe shall be laid on a leveling course of concrete the pipe shall be laid on a leveling course of concrete as desired.

4.4 Jointing of Stone ware pipes

Tarred gasket of hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be slipped home well into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly home so as to fill not more than 1/4th of the total depth of the socket.

The remainder of the socket shall then be filled with stiff mixture of cement mortar in the proportion of 1:1 (1 cement: 1 fine sand). When the socket is filled a filler shall be formed round the joint with a trowel forming an angle of 45 degree with the barrel of the pipe. The joints shall be tested hydraulically as per given below and no concerting for encashment shall be done unless pipes are jointed and tested after a day's work any extraneous material shall be removed from the inside of the pipe. The newly made joints shall be cured.

4.5 Testing of Joints

Hydraulic test: Stoneware pipe used for sewers shall be subjected to a test pressure of 1.5m or required head of water at the highest point of the section under test. The test shall be carried out by suitable plugging the low end of the drain and the ends of the connection, if any and filling the system with top and a sufficient length of vertical pipe jointed to it so as to join with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

During the test required head is maintained for 30 minutes by adding water from a measuring vessel at 10 minutes interval and the average quantity added shall not exceed 1 liter per hour 100m length per 100mm dia of pipe.

Where leakage will be visible the defective part of the work shall be removed and made good, at no extra cost.

4.6 Refilling of Trenches

In case where pipes are bedded on concrete, special care shall be taken in refilling trenches to cement the displacement and subsequent settlement at the surface resulting in uneven surface and dangers to foundations etc., the backfilling materials shall be packed by hand under the around the pipe and rammed with a shovel and light tamper. The refilling shall raise evenly on both side of the pipe continued up to 50 mm above the top of pipe so as not to disturb the pipe.

The remainder of the backfill shall not be done until 7 days have elapsed for brick sewers and 14 days for concrete sewer unless local conditions of materials are suitable for the earlier placing of a load on the pipes. The tapping shall become progressively heavier as the depth of the backfill increases.

4.7 Cast Iron Pipes

Cast iron pipes and fittings shall be of good and tough quality and dark grey on fracture. The pipes and fittings shall be true to shape smooth and cylindrical their inner and outer surface being as nearly as practicable concentric. They shall be sound and nicely cast, shall be free from cracks taps pinholes and other manufacturing defects.

The pipes and fittings shall conform to IS: 3989 / IS: 1729 as called for. Fittings shall be of required degree with or without access door. All access doors shall be made up with 3mm thick insertion rubber gasket of white lead and tightly bolted to make the fittings air and water tight. The fittings shall be of the same manufacture as the pipes used for soil and waste.

All CI pipes and fittings shall bear the manufacturer's name and ISI specification to which it conforms.

All pipes and fittings shall be coated internally and externally with the same material at the factory, the fittings being preheated prior to total immersion in a bath containing a uniformly heated composition

having a tar/other suitable base. The coating material shall have good adherence and shall not scale off. The coating shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77 degree C but not so brittle at a temperature of '0' degree C as to chip off when scratched lightly with a pen knife.

All pipes and fittings before installation at site shall be tested hydrostatically to a pressure of 0.45 Kg/sq. cm without showing any sign of leakage sweating or other defects of any kind. The pressure shall be applied internally and shall be maintained for not less than 15 minutes. All these tests shall be carried out in the presence of the representative of the Project Manager. Alternatively a test certificate from manufacturers is obtained before dispatch of material to site.

4.7.1 **Cast Iron Specialties**

If required, cast iron specialty items such as deep seal floor traps, urinal traps, trap integral pieces with integral inlet/outlet connections manhole cover with frame, chamber cover etc. shall be fabricated to suit individual location requirements. The contractor shall arrange the fabrication of these items from an approved source.

4.7.2 **Lead Caulked joints with Pig Lead:**

The approximate depth and weights of Pig Lead for various diameters of CI pipes and specials shall be as follows:

Normal size of pipe (mm)	Leader per Joint (Kg)	Depth of Lead Joint (mm)
50	0.77	25
80	0.88	25
100	0.99	25
150	1.50	38

4.7.3 **Cast Iron Class (LA) pipes**

All drainage passing under building floor and passing through retaining wall shall be cast iron class (L) pipes (IS: 1536)

Cast iron class (LA) pipe shall be such that they could be cut, drilled or machined. Pipe centrifugally cast is unlined water cooled moulds shall be heat treated in order to achieve the necessary mechanical properties and to relieve casing stress; provided that the specified mechanical properties are satisfied.

4.7.4 **Material**

Cast iron pipe shall be centrifugally spun cast iron and conforming to IS: 1536-1976

4.7.5 **Fittings**

Fittings shall be used for cast iron class (LA) pipes shall conform to IS: 1538-1976). Whenever possible junction from branch pipe shall be made by wyes.

All cast iron water main pipes and fittings shall be manufactured to IS: 1536 of tested quality. The pipes and fittings shall either be spigot or socket type or as called for. The pipes and fittings shall be of uniform material throughout and shall be free from all manufacturing defects.

4.7.6 **Joints**

Cast iron class (LA) pipe used for soil and waste pipes shall be jointed with refined pig lead conforming to IS: 27-1977, sufficient skein of jute rope shall be caulked to leave minimum space of 25mm for the pig lead to be poured in. After surface lead shall be caulked in to the joint with caulking tools and hammer of proper width. All surface lead shall be out and joint left flush with the rim of the socket. One continuous lead pour shall be thoroughly caulked at least 3 times around.

4.7.7 Laying

Fittings used for CI drainage pipe shall conform to IS: 1538-1976. Wherever possible junction from branch pipes shall be made by a Y/tee.

Lead Caulked joints with Pig Lead:

The approximate depth and weights of Pig Lead for various diameters of CI pipes and specials shall be as follows:

Normal size of pipe (mm)	Leader per Joint (Kg)	Depth of Lead Joint (mm)
80	1.80	45
100	2.20	45
125	2.60	45
150	3.40	50
200	5.00	50
250	6.10	50

The spigot of pipe or fittings shall be centered in the adjoining socket by caulking. Sufficient turns of tarred gasket shall be given to leave a depth of 45mm when the gasket has been caulked tightly home. Joining ring shall be placed round the barrel and against the face of the socket. Molten pig lead shall then be poured to fill the remainder of the socket. This shall then be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighting not less than 2 kgs.

For lead wool joints the socket shall be caulked with tarred gasket, as explained above. The lead wool shall be inserted into the sockets and tightly caulked home skin by skin with suitable tools and hammers of not less than 2 Kg weight until joints is filled.

4.8 Pipes Hangers, Supports, and Clamps

All vertical pipes shall be fixed by clamps and angle brackets truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

Clamps shall be of approved design and fabricated from MS flats (which shall be enamel painted after fabrication) of thickness and sizes as per drawings or contractor's shop drawings. Clamps shall be fixed in accordance to manufacturer's details / shop drawings to be submitted by the contractors.

When required to be fixed on RCC columns walls or beam they shall be fixed with approved type of expansion anchor fasteners (Dash fasteners) of approved design and size according to load.

Structural clamps e.g. trapeze or cluster hangers shall be fabricated by electro-welding from MS structural members e.g. rods angles channels flats as per contractors shop drawings shall be enamel painted after fabrication.

4.9 Cement Concrete Pipe

The pipes shall be with reinforcement as required and of the class as specified. Those shall conform to IS: 458: 1971. The reinforced cement concrete pipes shall be manufactured by centrifugal process. M/s. Indian Hume pipe company.

All pipes shall be true to shape, straight, perfectly sound and freed from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defect resulting from imperfect grading of the aggregate, mixing or molding. The pipes shall be R.C.C light duty, NP type.

Concrete used for the manufacture of reinforced concrete pipes and collars shall not be leaner than 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregated). The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller. The reinforcement in the reinforced concrete pipe shall extend throughout the length of the pipe. The circumferential and longitudinal the specified hydrostatic pressure and further bending stresses due to the weight of water.

4.9.1 Laying of pipe

Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain block is recommended. All pipe sections and connections shall be inspected carefully. Mechanical appliances may not be used. Pipes shall be laid true to line and grade as specified. Laying of pipe shall proceed upgrade of a slope. If the pipes have spigot and socket joints, the socket end shall face upstream. In the case of pipe with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid.

Adequate and proper expansion joints shall be provided where directed. IN case where the foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed manholes etc., the pipe shall be encased all round in 15 cm thick cement concrete 16:5:10m (1 cement: 5 fine sand: 10 graded stone aggregate 10mm nominal size) or compacted sand or gravel.

In case where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundation or on any other suitably designed structure as specified. Of concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia and shall extend up to the sides of the pipe at least to a distance of 1/4th of the outside diameter. For pipes 300mm and over in dia. the pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe to the bed. This shall be fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

When the pipe is laid in a trench in rock, hard clay or other hard material the space below the pipe shall be excavated and replaced with an equalizing bed of conc., etc sand or compact earth. In on place shall pipe be laid directly on such hard material

When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipeline without any material settlement. Alternatively, the pipeline shall be supported on P.C.C saddle blocks. Similar arrangement shall be made to retain the pipeline in the proper alignment such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall be supported as far as possible close to the joints. In no case shall the joint come in centre of the span. Care shall be taken to see that superimposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted.

4.9.2 Jointing of pipes

Joints are generally of rigid type. When specified flexible type joints may also be provided.

4.9.3 Spigot and socket joint (rigid)

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 opening of joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 sand), which shall be rammed with caulking tool.

After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

4.9.4 Collar joint (rigid)

The two adjoining pipes shall be butted against each other and adjusted in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand), which shall be reamed with caulking tool.

After a day's work any extraneous materials shall be cured.

4.9.5 Testing of joints, Refilling of Trenches

The testing of joints, refilling of trenches for concrete pipes shall be similar to specification for stone ware pipe.

4.10 Soil, Waste & Vent Pipes

Soil waste and vent pipes in shafts under the floors / suspended below slab shall consist of cast iron pipes as described earlier. Waste pipes from bottle trap to floor / urinal traps for wash basin urinal and sink shall be GI 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 cast iron pipes and fittings shall be jointed with best quality soft pig lead free from all impurities conforming to IS 27.

Before joining 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 centred 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 pipeline 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 pig lead shall be poured to fill the remainder of the socket in one pouring. The lead then shall be solidly caulked with suitable tools by hammering right round the joints to make up for the shrinkage of the molten metal on cooling and preferably finish 3mm behind the socket face.

The depth of the lead joints for the cast iron pipes shall be 45mm for the pipes up to 100mm dia and 50mm for the 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.

4.11 Pipe Protection

Cast iron soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse and : 4 stone aggregate of 12 mm size) 10cm bed and all-round. When pipes are running well above the structural slabs, the encased pipes shall be supported with suitable cement concrete pillars of required height and size at intervals directed by the Project Manager.

4.12 Cutting and Making good

Pipes shall be fixed and tested as building proceeds. The contractor shall provide all necessary holes cut-outs and chases in structural members as building work proceeds. Wherever holes are cut or let originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse and: 4stone aggregate 20mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand). Cured and the surface restored to original condition.

4.13 Painting

Soil waste vent and rainwater pipes in exposed location in shafts and pipe space shall be painted with two or more coats of ready mix 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.

C.I Soil and waste pipes below ground and covered in cement concrete shall not be painted.

4.14 Testing

Testing shall be done in accordance with IS: 1172 and IS: 5329 except as may be modified herein under.

Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber below plugs, manometers smoke testing machines pipe and fitting work tests.

All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

Before use at site all CI pipes shall be tested by filling up with water for at least 30 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours. Pipes with minor sweating may be accepted at the discretion of the Project Manager.

Soil and waste pipes shall be tested in sections after installation by filling up the stack with water. All openings and connections shall be suitably plugged as approved by the Project Manager. The total head in the stack shall be 4.5 m at the highest point of the section under test. The period of test shall be minimum for 30 minutes or as directed by the Project Manager. If any leakage is visible the defective part of the work shall be cut and made good.

On completion of the work the entire installation shall be tested by smoke testing machine. The test shall be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging the outlets with bellows plugs. Apply dense smoke keeping the top of stack open and observe for leakages. Rectify or replace defective sections.

After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining has no leakages blockages etc. rectify and replace where required.

A test register shall be maintained and all entries shall be signed and dated by the Contractor and the Project Manager or his representative.

All pipes in wall chase or meant to be encased or buried shall be hydro tested before the chase in plastered or the pipe encased or buried.

4.15 Traps

4.15.1 Floor Traps

Floor traps where specified shall be siphon type full before P or S type cast iron having a minimum 50mm deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse and: 4 stone aggregate 20mm nominal size).

Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth.

4.15.2 Floor Trap Inlet / Hopper

Bathroom traps and connection shall ensure free and silent flow of discharging water. Where specified contractor shall provide a special type of floor inlet fitting fabricated from GI pipe, with one two or three inlet sockets welded on side to connect the waste pipe. All joint between waste hopper and CI inlet socket shall be lead caulked. Inlet shall be connected to a CI "P" trap. Floor trap inlet and the traps shall be set in cement concrete blocks where buried in floors without extra charge. Floor trap for the shower cubicle shall suit and as per the approval of Owner's site representative. All fabricated hoppers shall be hot dip galvanized.

4.15.3 Floor Trap Grating

Floor and urinal traps shall be provided with 100-150mm square or round stainless-steel gratings, with frame and rim of approved design and shape or as specified in the Bill of quantities approved by the Owner's site representative.

4.16 Cleanout Plugs

4.16.1 Floor Clean Out Plug

Clean out plug for soil. Waste or rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Clean out plugs shall terminate flush with the floor level. They shall be threaded and provided with key holes for opening. Clean out plugs shall be cast brass suitable for the pipe dia. With screwed to a GI socket. The socket shall be lead caulked to the drain pipes.

4.16.2 Cleanout on Drainage Pipes

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

4.16.3 Floor cleanout plugs shall be cast brass.

Cleanouts provided at ceiling level pipe shall be fixed to a CI flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanized sheets and angles with hinged type doors with fly nuts gasket etc as per drawing.

4.17 Gully Traps

Gully traps shall conform to IS: 651 – 1980. 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 note when struck with a light hammer. There shall be no broken blisters.

The size of the gully trap shall be as specified, and all dimensions will be as per drawing. 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 watertight C.I. cover with frame inside dimensions 300 x 200 mm, the cover weighing not less than 2.72 kg., the grating cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

4.17.1 Excavation

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the engineer – in – charge.

4.17.2 Fixing

The gully trap shall be fixed on cement concrete foundation 600-x 600cm square and not less than 10 cm thick. The mix for the concrete will be 1:5:10 (1 cement 5 fine sand: 10 graded stone aggregate 10mm nominal size) the jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipe.

4.18 Brick Masonry Chamber

After fixing and testing gully and branch drain, a brick masonry chamber 300 x 300 (inside) in Class b bricks in cement mortar 1:5 (1 cement 3 fine sand) shall be built with a 9" thick brick work round the gully trap from the top of the bed concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 10mm nominal size). The upper portion of the chamber i.e., above the top level of the trap shall be plastered inside with waterproof cement mortar 1:3 (1 cement: 3 coarse sand) finishing with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off as to slope towards the grating and form a hopper C.I cover with framed 300 x 200 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 1 graded stone aggregate 20mm nominal size) and rendered smooth. The finishing top of cover shall be left about the adjoining ground level so as to exclude the surface water from entering the gully trap.

4.19 Manholes, Inspection Chambers, Gullies**4.19.1 Inspection Chambers**

Where depth of sewer is less than 1.2m., below outside rectangular made up/finished level of paving, Chambers shall be used having size as specified. Usual sizes are 600 x 600 or 600 x 900. These shall be constructed in the sewer line at such places and levels and dimensions as indicated on the drawing. Sizes specified shall be clear internal dimensions of the chamber.

4.19.2 Manholes

Where depth of sewer exceeds 1.5m., with respect to outside made up ground/finished level of paving circular conical manholes shall be provided. Various types and sizes of manholes are specified for manholes shall be supplied to the contractor. In the absence of such drawings the manhole details as per IS 4111-1974 Part 1 to be followed.

Manholes and inspection chambers, which are provided on roads or where heavy vehicular traffic is expected, are provided with heavy duty C.I airtight frame & cover. With double seal as per IS 1726-

1974 for those built on footpaths, carriage drives and cycle tracks, medium duty covers shall be provided. For locations within domestic premises or areas not subjected to wheel traffic loads they shall be provided with light duty covers.

4.19.3 Construction of manholes, Inspection chambers and gullies,

4.19.4 Excavation

This shall be done to dimensions and levels on the drawings.

4.19.5 Bed Concrete

Base of the manholes shall be constructed in P.C.C. 1:2:4 using 10mm to 12mm graded stones Thickness shall be 200mm up to 4.25mm and 300mm for depths more than 4.25mm or as specified by the Engineer-in charge.

4.19.6 Brickwork

Brickwork shall be in C.M. 1:3 constructed with Class B wire cut bricks. Bricks masonry in arches and arching over the pipe shall be in C.M. 1:3 Walls shall be generally built in 225mm thickness for inspection chambers and manholes up to a depth of 2.1m and 350mm for depth over 2.2

4.19.7 Plastering

Walls of manholes shall be plastered inside with arrange 15mm thick cement plaster 1:3 using W.P. Compound and finished smooth. Where ground water table is high, external surfaces of manholes shall also be plastered in C.M. 1:3.

4.19.8 Filleting

75mm fillet shall be made with C.M. 1:3 all round the external joint between the bed concrete and brick masonry wall of manhole.

4.19.9 Benching

Channels and benching inside the manhole or inspection chamber shall be done in C.C. 1:2:4 and rendered smooth with cement.

4.19.10 R.C.C. Cap

RCC M 150 cap of 1:2:4 150mm thickness shall be provided on top of manholes for fixing the manhole frame.

4.19.11 Footrest

Footrests shall be C.I runs weighing 5.41 Kg. And conforming to IS2064-1973 made up of 20mm square or round bars. There shall be embedded 20cm deep in 20 x 20 x 10 cm blocks of PCC 1:2:4 the blocks with C.I foot rest placed on its centre shall be cast in-situ along with masonry. Footrests shall be placed 300mm apart vertically and 375 mm horizontally in staggered fashion. First footrest shall be 450mm below top. Footrest shall be painted with coal tar or bituminous paint and the portion embedded shall be painted with thick cement slurry before fixing.

4.19.12 Manhole frames and covers

Approximate weights for various dimensions of frames and covers various duties shall be as follows: (All M.H. cover of Heavy duty & medium duty shall be of double seal type and duty single seal type).

Size	Heavy Duty Kg.	Medium Duty Kg.	Light Duty Kg.
Rect. 510 x 455	-	80+54=144	23+15=19
500mm dia Cir.	-	58+58=116	-
560mm dia Cir.	108+100=203	64+64=128	-

Square 455x55	-	-	13+7=20
Square 510x610	-	-	25+13=38
Square 560x560	100+100=200	-	-

The cover and frames shall be clearly cast and shall be free from air and sand holes and form cold shifts. They shall be neatly dressed and carefully trimmed. All castings shall be free from voids either due to shrinkage gas inclusion or other causes.

Covers shall have raised chequered design on the top surface to provide adequate non-slip grip. The cover shall be capable of easy opening and closing and it shall be fitted in the frame in a workman-like manner. Covers shall be gas and water girth. Size of the cover shall be the clear internal dimension of frame. 2-1/2% variation in weights shall be permissible.

Covers and frames shall be coated with a black anti-corrosive paint of bituminous composition. The coating shall be smooth and tenacious. It shall not flow at 53-degree C. and shall not drip off at 0 degree C. The covers shall be so fixed as to be flushed with ground surface. After completion the manhole covers shall be sealed by means grease.

4.19.13 Testing

Manhole, after it is raised above highest expected sub-soil water level in monsoon, shall be suitably plugged with brick masonry or wooden or any other type of plug. Manhole under test shall then be filed with water up to general subsoil water level does not drop to more than 50mm in one hour, it shall be deemed as water tight. During testing the pit around shall be kept free of water and contractor shall observe the places where leakage takes place and takes steps to correct the same. Filling earth around manholes shall be done after testing.

4.19.14 Drop Connection

In cases where branch pipe sewer enters the manhole of main pipe sewer at level

Higher than the main sewer by more than 600mm a drop connection should be provided as per typical drawing for drop connection.

For 150 and 250mm main line, the difference in level between the water line and the invert level of branch line is less than 60cm. a drop connection may be provided within the manhole by giving ram. If the difference in level is more than 60cm. the drop should be provided externally.

4.19.15 Excavation

The excavation shall be done for the drop connections at the place where the branch line meets the manholes. The excavation shall be carried up to the bed concrete of the manhole and to the full width of the branch line.

4.19.16 Laying

At the end of branch sewer line stoneware shall be fixed to the line, which shall be extended through the wall of the manhole by a horizontal piece of S.W. pipe to form an inspection or cleaning eye. The stoneware drop shall be connected to the tee at the top and the S.W. bend at the bottom. The end shall be extended through the wall of the manhole by a piece of C.I pipe which shall be made with cement concrete 1:2, (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm, nominal size) and finished smooth to connect the main channel. The joint between S.W. pipe and tee and S.W. branch line shall be made with cement mortar 1:1 (1 cement: 1 fine sand) as per Para 2.1.3 for S.W. pipes. The exposed portion of the drop connection shall be encased all round with a single brickwork in C.M. 1:4 and pointed. The holes made in the walls of the manholes shall be good with brickwork in cement mortar 1:4 (1 cement: 3 coarse sand) on the inside of the manholes wall. The excavated earth shall be backfilled in the trench in level with the original ground level.

4.20 Rain Water Drainage**4.20.1 Rigid P.V.C Pipes for Rain Water:****4.20.1.1 General**

P.V.C. pipes shall conform to the relevant specification of I.S 4985 of SWR quality. They shall be made of Polyvinyl Chloride (PVC) and shall be sound with good surface finish, mechanical strength and capacity. During manufacture only those additives may be added to produce the above characteristics. No additives shall be added separately or together in quantities sufficient to constitute toxic hazard, or impair the fabrication or welding properties of the pipe or impair its physical or chemical properties. All pipes shall be spigot and socket type (bell end type).

4.20.1.2 Pipe Sizes and Wall Thickness - 6 kg class

Pipe Dia (mm)	Wall Thickness (mm)
110 mm	3.7 to 4.3 mm
160 mm	5.4 to 6.2 mm
200 mm	6.8 to 7.9 mm

4.20.1.3 Tolerances

Tolerances on diameters and Wall thickness shall be as per I.S. 4985.

4.20.1.4 Fittings

All fitting shall be injection moulded socket fittings with or without inspection doors as specified and shall be in accordance with the requirements of the relevant I.S. 7834. Pressure ratings and Tolerances shall be as per I.S. 4985.

4.20.1.5 Laying and Jointing

Pipes shall be cut to length required including the portion to be inserted in the socket with a hacksaw. The pipe shall be cut square. Pipes and Sockets shall be clean and dry and burrs removed both inside and outside with a file. The surface to surfaces to be in contacted shall be roughened with emery paper, and dry fit checked.

After cutting and chamfering the pipe as described above, insert the pipe into the socket without seal ring and mark along the pipe, when it is fully inserted. Fix the rubber ring into the groove without twisting it. Apply superior quality jointing lubricant to the chamfer end of the pipe right upto the mark made on the spigot or to the socket end of fitting. Push the pipe firmly into the socket till the tap between the mark on the spigot and socket is about 10 mm to allow for thermal expansion.

4.20.1.6 Rain Water and basement Collection Gratings

The rain water collection grating at the Terrace level shall be of C.I. Grating with C.I frame embedded on to the water proof surface. Water proofing shall be done around the pipe, frame and grating to ensure the water tightness around the collection point. Adequate slope on the terrace level shall be provided for collecting all rain water at the collection gratings.

The rain water collection at the balconies shall be done using PVC Nahani trap of 75 mm dia installed concealed in the concrete slab and connected to the vertical main PVC rain water stack, at the collection point heavy brass C.P frame with C.P grating shall be provided. The C.P frame shall be laid in the slab above the pipe with water seal joint around the frame to sewers after traps and not in the storm water drainage systems.

4.20.1.7 Balcony / Planter drainage

Wherever required, all balconies terraces planters and other frontal landscape areas will be drained by vertical down takes or other type of drainage system show on the drawings and directed by the project manager.

4.21 Septic Tank

In unsewered area, arrangements for sewage being treated in a septic tank, effluent from which should be given secondary treatment either in a biological filter or on the land on in a sub-surface disposal system.

Surface and sub-soil water should be excluded from finding way into the septic tank. Wastewater may be passed into the septic tank provided the tank and the means for extra liquid. Depending on the location of the water table and the nature of the strata, the type of disposal for the effluent from the septic tank shall be decided.

Dimensions: Septic tanks shall have minimum width of 75cm, minimum width of one meter below water level and a minimum liquid capacity of the one cubic meter. Length of tanks shall be 2 to 1 times the width.

Cover and Frames: Every septic tank shall be provided with C.I cover of adequate strength. The cover and frames shall be 500mm dia. (MD) minimum or 610mm x 455mm (LD).

Ventilating Pipe: Every septic tank shall be provided with C.I. Ventilating pipe of at least 50mm diameter. The top of the pipe shall be provided with a suitable cage of mosquito proof wire mesh.

The ventilating pipe shall extent to a height, which would cause no small nuisance to any building in the area. Generally the ventilating pipe may extend to a height of about 2m. When ten septic tank is at least 15m away from the nearest building and to a height of 2m. above the top of the building when it is located closer than 15 meters. The ventilating pipe may also be connected to the normal soil ventilating system of the building where so desired.

Disposal of Sludge: The sludge from septic may be delivered into covered pit of or into a suitable vehicle for from the site. Spreading of sludge on the ground in the vicinity shall not be allowed.

Testing: Before the tank is commissioned for use, it shall be tested for water tightness by filling it with water and allowing it to stand for 24 hours. It shall then be topped up, if necessary, and allowed to stand for a further period of 24 hours, during which time the fall in the level of the water shall not be more than 1.5cm

Commissioning of Septic Tank: The tank shall be fixed with water to its outlet level before the sewage is let into the tank. It shall, preferably, be seeded with small quantities of well digested sludge obtained from septic tanks or sludge a small quantity of decaying organic matter, such as digested cow dung, may be introduced.

Dislodging of Septic Tank: Septic tanks shall be desludged periodically, the intervals of desludging, depending upon the design of the septic tanks and the capacity in relating to its users. Desludging may be done when the sludge level reaches a predetermined level. A portion of the sludge may be left in the tank to seed the free deposits.

Desludging shall, preferably, be carried out by hydrostatic head or by using a portable pump. Manual handling of sludge shall be discouraged.

Sub surface Absorption system: The effluent from septic tank shall be disposed of by soak pit or dispersion trench depending on the position of the sub-soil water level, soil and sub-soil conditions and the size of the installation.

Rate: The rate shall include the cost of materials and labour involved in all the operation, except sub-surface absorption system.

4.22 Soak Pits

Construction: The earth excavation shall be carried out to the exact dimensions as shown in the Figure. In the soak pit shall be constructed a honeycomb dry brick shaft 45 x 45 and 292.5cm high. Round the shaft and within the radius of 60cm shall be placed well-burnt brickbats. Brick ballast of size from 50 to 80mm nominal size shall be packed round the brickbats up to the radius of 90cm. The remaining portion shall be filled with ballast of 10mm nominal size. The construction of shaft and filling of the bats and the ballast shall progress simultaneously.

Cover and Drain: Over the filling shall be placed single matting, which shall be covered with minimum layer of 7.5cm earth. The shaft shall be covered with 7.5cm thick stone or R.C.C. slab. 10cm wide and 10cm deep brick edging with bricks of class designation 75 shall be provided round the pit. The connection of the open surface drain to the soak pit shall be made by means of 100mm diameter S.W. pipe with open joints. Measurements: Soak pit shall be enumerated.

Rate: Rate shall include the cost of labour and material involved in all the operations described above.

4.23 Bio Digester.

Design and construction of bio digester should be as per DRDO approved requirement. Capacity of bio-digester should be as proposed by depot designer. overflow from bio-digester should be connected to the municipal storm drainage as per site condition.

For maintenance Secondary sewage drainage line from soak pit should be provided with the control valve which bypass the bio-digester and connected to the municipal sewage drain line as per site condition.

Suitable Location of bio-digester should be proposed by contractor and its should be approved by site engineer or respective responsible engineer.

Detail design should be submitted and it will be got approved by contractor from respective site engineer before starting the construction.