TECHNICAL SPECIFICATIONS PLUMBING WORK

1. MATERIALS

1.0 GENERAL:

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

All materials shall be of the best-approved quality obtainable and unless otherwise specified they shall conform to the respective Bureau of Indian Standard specifications.

Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Employer.

In case of non – availability of materials in metric size, the nearest size in FPS units shall be provided with prior approval of the Employer / Consultants for which neither extra will be paid nor any rebate shall be recovered.

If directed / found necessary, materials shall be tested in any testing laboratory selected by the Employer and the Contractor shall produce the test results to the Consultant for his scrutiny and approval. The entire charges for original as well as repeated tests shall be borne by the Contractor. If required, the Contractor shall arrange to test portion of work at his own cost in order to prove the soundness of the same, to the Employer / Consultant or their representatives. The work or portion of work if found to be not satisfactory in the opinion of the Employer / Consultant or their representatives, Contractor shall pull down and re – do the same at his own cost. All defective materials shall be removed from the site immediately as ordered.

It shall be obligatory for the contractor to furnish certificates, if so demanded by the Employer / Consultant from manufacturer or the material supplier, that the work has been carried out by using their material and installed / fixed as per their recommendations.
Equipment offered for supply and installation shall include the following:

All minor items and incidental work, equipment accessories and materials may not be specifically mentioned but are required for the proper completion of the installation in accordance with the true intent and meaning of this specification.

All necessary safety devices for the protection of personnel against injury and the protection of plant and equipment against damage including relief valves, belt guards, fan inlet and / or discharge guards, safety railing effective earthing of electrical components, electrical interlocks, warning lights and alarms.

Readily accessible, dust-proof including facilities on all moving parts and equipment including provision for cleaning all lubricating lines and bearings and charging same with the correct lubricants after installation but prior to testing and commissioning.

Clearly visible and robust manufacturer's name-plates permanently fitted each item of equipment and showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw, etc.

The contractor also shall allow provision for the inspection of all plant and equipment by the manufacturer or his licensed representative, at least twice during the course of the installation.

2. MATERIALS

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

A : SANITARY FIXTURES AND FITTINGS:

A.1. SCOPE:

The scope of this section consists of but is not necessarily limited to supply, installation, testing and commissioning of following items:

a. Sanitary appliances and fixtures for toilets.
b. Chromium plated brass fittings
c. Stainless steel sinks
d. Whether specifically mentioned or not the Contractor shall provide for all appliances and fixtures. all fixing devices, nuts, bolts, screws, hangers as required.

GENERAL REQUIREMENT:

All appliances, fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the schedule of quantities, Specifications, drawings. Accessories shall include proper fixing arrangements, brackets, nuts, bolts, washers, screws and required connection pieces.

The sanitary fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the architect / Owner's site representative and shall fully meet with the aesthetic and symmetrical requirements as demanded by the architect / interior designer.

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

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.

Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.

All appliances, fittings and fixtures shall be fixed in a neat workman like manner true to level and to heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling, plaster, paint, insulations or terrace shall be made good by the contractor at his own cost. Fixtures shall be mounted rigid, plumb and true to alignment.
All materials shall be rust proofed: materials in direct contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

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

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

1)	Contractor shall during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as absolutely prevent any damages to the appliances until handing over (the original protective wrapping shall be left in position for as long as possible).
2)	The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.
3)	The appliances shall be fixed in a manner such that it will facilitate subsequent removal if necessary.
4)	The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust – proofed fixings shall be used. Fixing shall be done in a manner that minimize noise transmission.
5)	Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit e.g. ceramic unit).
6)	Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.
7)	Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacture and additional anchors or supports where necessary.

Size of sanitary fixtures given in the specification or in the schedule of quantities are for identification with reference to the catalogues of make considered. Dimensions of similar models of other makes may very with in +/- 10% and the same shall be provided and no claim for extra payment shall be entertained no shall payment be deducted on this account.

The contractor shall fix all plumbing fittings such as water faucets, shower fittings, mixing valves etc in accordance with manufacturer's instructions and connect to piping system. The contractor shall supply all fixing materials such as screws rawl plugs, unions, collars and shade to match that of the appliances / fixture and the floor / wall to the extent possible.

SUPPORTING AND FIXING DEVICES:

The contractor shall provide all the necessary supporting and fixing devices to install the sanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly appearance in the final assembly. Where the location demands, the architect may instruct the contractor to provide chromium plater or other similarly finished fixing devices. In such circumstances the contractor shall arrange to supply the fixing devices and shall be installed complete with appropriate vibration isolating pads, washers and gaskets.

FINAL INSTALLATION:

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

Fixtures shall be mounted rigid. Plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving

pipes before making the joints it shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, Attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, washbasins, sinks and other appliances.

PROTECTION AGAINST DAMAGE:

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

MEASUREMENT:

Rate for fixing only of sanitary fixtures accessories, CP fittings shall etc. include all items, and operations stated in the respective specifications and bill of quantities and nothing extra is payable.

Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same CP screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning and making good to the satisfaction of the owner's site representative.

TESTING:

All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The contractor shall block the ends of waste and ventilation pipes and shall conduct an air/smoke test.

WATER CLOSET:

Water closet shall be wash or siphonic wash down type floor or wall mounted set, as shown in the drawings. Exposed or concealed dual flush tank of 3/6 lit. capacity with fittings, 15mm dia CP angle stop cock with wall flange, 15mm dia and 600 mm long PVC connection pipe, 32mm dia Flush pipe / bend shall be connected to the WC by means of a suitable rubber adaptor.

Each WC set shall be provided with approved quality of seat, rubber buffers and chromium plated hinges, seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

Each WC shall be provided with 110 mm dia (OD) PVC pan connector connecting the ceramic outlet of WC to P.V.C pipe.

Squatting type water closet – Orissa Pattern:

Squatting type water closed (WC) pan shall be of Orissa pattern of size as specified in schedule of quantities. Each WC pan shall be provided with a 100 mm dia cast iron or porcelain P or S traps with or without vent horn as directed by owner's site representative.

WC shall be flushed by means of exposed or concealed PVC plastic low level flush tank of 8 lit. Capacity with internal fittings, 15mm dia CP angle stop cock with wall flange, 15mm dia and 600 mm long PVC connection pipe, 32mm dia Flush pipe / bend shall be connected to the WC.

URINALS:

Urinals shall be lipped type half stall with glazed vitreous china of size as called for in the bill of quantities.

Half stall urinals shall be provided with cp push button including CP flush pipe with CP spreaders, 32 mm dia CP bottle trap with extension piece,32 mm dia CP waste coupling half threaded, etc. with all necessary fittings. Stall be fixed to wall by CI brackets, CI wall clips and CP brass screws as recommended by manufacturer complete as directed by the owner's site representative.

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

Urinal Partitions:

Urinals partitions shall be white glazed vitreous china of size specified in the schedule of quantities.

Porcelain partitions shall be fixed at proper height with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer and directed by the owner's site representative.

CISTERNS / FLUSH VALVE:

Low-level flushing cistern (exposed/ conceled) shall be provided for WC in specified toilets. Contractor shall install cistern in accordance to the manufacturer's specification to the satisfaction of the owner site representative.

WASH BASIN:

Washbasins shall be as per client's / architect's selection.

Each basin shall be provided with painted MS angle or CI brackets and clips and the basin securely fixed to wall / counter slab. Placing of basins over the brackets without secure fixing shall not be accepted. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make brand and cooler as approved by the owner's site representative. The cost of fixing the basin shall be inclusive of supply and installation of bracelets as described above.

Each basin shall be provided with 40mm dia CP waste with overflow pop-up waste or rubber plug and CP brass chain as specified in the schedule of Quantities.

SINKS:

Sinks shall be stainless steel as specified in the schedule of Quantities.
Each sink shall be provided with painted MS or CI brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable painted angle iron brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40mm dia CP waste and rubber plug with CP brass chain as given in the schedule of Quantities. The MS angle shall be provided two coats of red oxide primer and two coats of synthetic enamel paint of make. Brand and color as approved by the owner's site representative.

Sanitary fittings for sinks shall be deck mounted or wall mounted CP swivel faucets with or without hot and cold water mixing fittings as specified in the schedule of Quantities. Installation of fittings shall be measured and paid for separately.

Shower Set:

a Shower set shall comprise of C.P. brass hot and cold-water mixer / diverter with spout and overhead shower or as specified in Bill of Quantities.

Electric Water Heaters:

a Electric water heaters wherever specified in BOQ shall be pressure type instant heaters conforming to IS 2082 and shall bear the ISI mark.

b The capacity of the storage vessel shall be as given in the Bill of Quantity or as indicated on the drawings.

c The recovery rate or the input in kW shall not be less than what is given in IS 2082.

d Water heaters will be provided with high temperature tinned copper, Monel or glass lined tank approved for 10 bar working pressure.

e Water heaters shall be completely factory assembled and shall be provided with a immersion thermostat with high limit control, a temperature and pressure relief valve and vacuum relief and not return valve on the cold water connection to heater.

f The complete unit shall be insulated with at least 50mm thick PUF or fiber glass insulation and provided with a powder coated steel jacket.

g. The Contractor shall furnish the Project Manager a warranty issued by the manufacturer of the water heater. Any replacement under this warranty shall include free replacement to the project location. The manufacturer shall warrant the complete heater assembly to be free of defects as regards material and workmanship under normal use and shall repair or replace free of charge all parts of the heater which may develop defects during the first year beginning with the beneficial use after acceptance of the water heater. In addition the manufacturer shall agree that if water heater becomes defective or inoperative during the first three years in use a complete new assembly will be supplied at no extra cost to the Owner.

Waste Fittings:

All waste fittings (waste, chain, pop-up, over-flow) shall be brass / copper, heavy chromium plated of the make and design specified and match the supply fittings. They shall confirm to Indian Standard specification IS: 2963 – 1964 waste fittings for wash basins and sinks, non-ferrous.

Bottle Traps:

Bottle traps (for wash basins, sinks, urinals, etc.,) shall be deep seal (minimum 6cm. seal) cast brass bottle traps, heavy chromium plated. All bottle traps shall be provided with suitable cleaning eye, extension piece, flare nuts – all chromium plated. Bottle traps shall be of approved make and design. Waste coupling for washbasins shall be 40mm, for sinks 50mm, for urinal.

Wall Flange:

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

Floor Traps:

Floor traps shall be of PVC of the size required, of approved design incorporating a deep seal (6cm. minimum) and venting device unless otherwise indicated. All PVC floor traps in general /unless otherwise specified, shall be of molded type only. However, floor traps of sizes as mentioned in the BOQ and that are not available in molded type, shall be of fabricated type.

Samples of these fabricated floor traps including other PVC fabricated fittings to be got approved by plumbing management Consultant. The traps shall be supplied with cast iron / PVC cap with collar capable of receiving a grating.

C.P./stainless steel grating:

Floor traps shall be provided of heavy quality with 100/150mm square or round C.P./ stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4mm or as specified in the Schedule of Quantities.

LIQUID SOAP DISPENSER:

Liquid soap dispenser shall be wall/counter mounted suitable for dispensing liquid soaps. Lotions. Detergents. The cover shall lock to body with concealed locking arrangement, opened only be key provided.

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

The valve shall operate with less than 2.27 Kg (5 lbs.) of force.

MOCKUP AND TRIAL ASSEMBLY:

The installation of the sanitary fixtures and fittings shall be as per the shop drawings approved by the architect/consultant.

The contractor shall have to assemble at least one set of each type of sanitary and fittings in order to determine precisely the required supply and disposal connections, relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes. Holes holding devices etc. which will be required for final installation of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the architect/ interior designer.

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

a) Water closets: (European type) shall be of vitreous china of approved pattern, quality, capacity and color. The closet shall be fixed with CP brass screws floor for floor mounted type and mounted MS brackets with bolts for wall mounted type and shall be provided with solid plastic seat and cover with chrome plated pillar brass hangers as specified.

b) Indian pattern closet shall be of similar quality and specified capacity as mentioned above. The pan shall be 580 x 440mm in size with `S' or `P' trap of the same material of the pan. The WC with the trap shall be fitted and fixed in position and built round soil with brick and cement to required level after all connections are made. The finished floor of the water closet shall be 15mm below the level of the room or passage in front of it.

c) Both types of closets should confirm to the requirements of I.S. 771 for glazed vitreous china sanitary appliances.

Mode of measurement:

All drainpipes shall be measured in linear lengths along the centerline of drainage line laid. Deductions shall be made for chambers and fitting lengths, etc. The rate shall include all works as specified in the respective items.

Stoneware or cast iron gully, traps, bends and junctions, sewer traps etc. shall be measured in numbers as in above.

All GI pipes for water supply shall be measured in linear lengths along the center line completed including the fittings like collars, elbows, tees, hex nipples etc. the rate shall include cutting, threading, jointing, pressure testing etc. complete as specified in the respective items.

Same rate shall be applicable for pipes of same size and materials laid in building at any level or floor.

The rock cutting shall be measured in cu. m of the stacks of excavated rock. The deductions for voids being 50%of the stack measurement. Only the rock which is removed by chiseling or blasting etc., shall be measured for this item of work. Boulders shall not be considered as a rock. The excavated rock will be the owner's property.

All PVC pipes such as soil, waste, vent and rainwater shall be measured in linear lengths along the centerline, to nearest centimeter as completed including length over fittings. The rates shall include all joints and clamps etc. as specified in the respective items.

Plain cement concrete for supports and for encasement or bedding etc. shall be measured as specified in the respective items in the schedule ofquantities.

All sanitary fittings and CP fixtures including CP extension pipe with brass screws shall be measured in numbers and the rates shall include all the work specified and described under item in the schedule of quantities.

All gate valves, ball valves, non- return valves, sluice valves, pressure reducing valves etc. shall be measured in numbers, after excluding them from linearmeasurement.

The diameters of pipes and fittings mentioned in the specifications are the inside nominal diameters in all cases except PVC pipes or unless otherwisespecified.

B .1.0 WATER SUPPLY:

SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for internal services as follows:

a. Domestic Water Supply.
b. Flushing Water Supply
c. Delivery lines from UG tanks to OH tanks through an independent pumping System (as required).
d. Connection to various mechanical equipments to be supplied and installed by the other specialist contractors.

The Contractor shall make all necessary application and arrangements for his work to be inspected by the Local Authorities.

The Contractor shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the complete water supply / distribution installation to the Owner.

PIPING MATERIALS

The piping system shall consist of CPVC SDR 11.0 piping from 15 mm to 50 mm for toilet / kitchen internal concealed & exposed works hot & cold application.

For terrace & shaft down comers Unplasticize Polyvinyl Chloride pipes (UPVC) schedule 40 ASTM IPS confirming to ASTM D 1785 & fittings and specials (schedule 80) such as tees, elbows, couplers, bends, enlargers etc shall be used. Up to dia 50mm pipe shall be schedule 40 & dia 65mm onwards shall be schedule 80.

DIMENSIONS CPVC SDR -11 shall confirm to the following thickness and weight for various dimensions.

Nominal Pipe Size (Inch)	Mean Outside Diameter Inch	mm	Minimum Wall Thickness Inch	mm	Nominal Weight Kg / m
½	0.840	21.34	0.147	3.73	0.337
¾	1.050	26.67	0.154	3.91	0.457
1	1.315	33.40	0.179	4.55	0.671
1- ¼	1.660	42.16	0.191	4.85	0.928
1- ½	1.900	48.26	0.200	5.08	1.13
2	2.375	60.33	0.218	5.54	1.56

Outside Diameters, Wall Thickness & Pressure Rating For CPVC 4120, Schedule 40 Piping System As per ASTM F 441

Nominal Size (in.)	(mm)	Outside Diameter, in. (mm) Average	Tolerance	I.D. Average	Wall Thickness, in. (mm) Minimum	Tolerance	Pipe - Pr. R. PSI (Kg/Cm²) 73.4°F	(23°C)	Fitting - Pr. R. PSI (Kg/Cm²) 73.4°F	(23°C)
2½	(65)	2.875 (73.0)	±0.007 (0.18)	2.444 (62.07)	0.203 (5.16)	+0.024 (0.61)	300	(21.10)	180	(12.65)
3	(80)	3.500 (88.9)	±0.008 (0.20)	3.041 (77.26)	0.216 (5.49)	+0.026 (0.66)	280	(18.28)	156	(10.96)
4	(100)	4.500 (114.3)	±0.009 (0.23)	3.998 (101.55)	0.237 (6.02)	+0.028 (0.71)	220	(15.47)	132	(09.28)

Pr. R. = Pressure Rating

Outside Diameters, Wall Thickness & Pressure Rating For CPVC 4120, Schedul 80 Piping System As per ASTM F 441

Nominal Size (in.)	(mm)	Outside Diameter, in. (mm) Average	Tolerance	I.D. Average	Wall Thickness, in. (mm) Minimum	Tolerance	Pipe-Pr. R. PSI (Kg/Cm²) 73.4°F	(23°C)	Fitting-Pr. R. PSI (Kg/Cm²) 73.4°F	(23°C)
2½	(65)	2.875 (73.0)	±0.007 (0.18)	2.288 (58.14)	0.276 (7.01)	+0.033 (0.84)	420	(29.53)	252	(17.71)
3	(80)	3.500 (88.9)	±0.008 (0.20)	2.864 (72.75)	0.300 (7.62)	+0.036 (0.91)	370	(26.01)	222	(15.60)
4	(100)	4.500 (114.3)	±0.009 (0.23)	3.778 (95.97)	0.337 (8.56)	+0.040 (1.02)	320	(22.50)	192	(13.49)
6	(150)	6.625 (168.3)	±0.011 (0.28)	5.710 (145.04)	0.432 (10.97)	+0.052 (1.32)	280	(19.69)	168	(11.81)
8	(200)	8.625 (219.1)	±0.015 (0.38)	7.565 (192.15)	0.500 (12.70)	+0.060 (1.52)	250	(17.57)	150	(10.54)
10	(250)	10.750 (273.1)	±0.015 (0.38)	9.493 (241.12)	0.593 (15.06)	+0.071 (1.80)	230	(16.17)	138	(09.70)
12	(300)	12.750 (323.90)	±0.015 (0.38)	11.294 (286.87)	0.687 (17.45)	+0.082 (2.08)	230	(16.17)	138	(09.70)

Pr. R. = Pressure Rating

pipes	fittings
SDR 11 Pipe: Tan colored with red stripe	SDR 11 fittings: Tan Color
SDR 13.5 Pipe: Tan colored with brown stripe	SDR 11 fittings: Tan Color
SCH 40 Pipe: Tan color	SCH 40 fittings: Tan Color
SCH 80 Pipe: Tan color	SCH 80 fittings: Grey Color

PIPES & FITTINGS:

The pipes shall be CPVC (Chlorinated Poly Vinyl Chloride) material for hot & cold water supply piping system with pipes as per CTs SDR -11 at a working pressure of 320 PSI at 23 deg C and 80 PSI at 82 deg.C, using solvent welded CPVC fittings i.e. Tees, Elbows, Couples, Unions, Reducers, Brushing etc. including transition fittings (connection between

CPVC & Metal pipes / GI) i.e. Brass adapters (both Male & Female threaded and all conforming to ASTM D-2846 with only CPVC solvent cement conforming to ASTM F-493, with clamps / structural metal supports as required /directed at site including cutting chases & fitting the same with cement concrete / cement mortar as required, including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of manufacturer & Project Manager. Pipes from 65 mm to 150 mm dia shall be Schedule 80 For duct down take. terrace ring main and pump delivery pipe(GI) as well.

Cutting, Joining Pipes & Fittings

a. Cutting: Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

b. Deburring / Beveling: Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fittings during assembly.

c. Fitting preparation: A clean dry rag/cloth should be used to wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

d. Solvent Cement Application: Only CPVC solvent cement confirming to ASTM-F493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket, otherwise too much of cement solvent can cause clogged water ways.

e. Assembly: After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up. An even bead of cement should be equipment around the joint and if this bead is not continues remake the joint to avoid potential leaks.

f. Set & Cure times:

Solvent cement set and cure times shall be strictly adhered to as per the below mentioned table.
Minimum Cure prior to pressure testing at 150 PSI

Solvent cement set and cure times are a function of pipe size, temperature, and relative humidity. Curing time is shorter for drier environments, smaller size, and higher temperatures. Refer to the following table for minimum cure time after the last joint has been made of before pressure testing can begin.

MINIMUM CURE PRIOR TO PRESSURE TESTING AT 150 PSI (10 BAR)

AMBIENT TEMPERATURE DURING CURE PERIOD	PIPE SIZES ½" – 1"	PIPE SIZES 1 ¼" – 2"	PIPE SIZES 2 ½" – 3"
Above 15^0 C	1 Hour	2 Hours	3 Hours
4-15^0 C	2 Hours	4 Hours	3 Hours
Below 4^0 C	4 Hours	8 Hours	9 Hours

Special care should be exercised when assembling Flow Guard systems in extremely low temperature (below 4^0 C) or extremely high temperature (above 38^0 C). In extremely hot temperatures, care should be taken to ensure both surfaces to be jointed are still wet with cement when putting them together.

g. Testing

Once an installation is completed and cured as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi(10 Bar) which will be 1.5 time pressure of actual line pressure, for one hour. During pressure testing, the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using couplers.

h. Primer / Cleaner Application:

Primer or cleaner shall be applied for preparing the bonding area for the addition of cement and subsequent assembly. A proper applicator shall only be used. A dauber or natural bristle paint brush approximately ½ the size of the tubing diameter shall be appropriate. Apply primer to both the outside of the tubing end and in the fitting socket. Primer should not be allowed to puddle in the fitting.

SOLVENT CEMENT APPLICATION:

Only CPVC solvent cement conforming to ASTMF 493 should be used for joining pipe with fittings and valves. When the primed pipe and fitting surfaces are dry, apply a thin coat inside the fitting socket. CPVC cement solvent have a minimum shelf life of 1 year. Aged cement solvent will often change color or being to thicken and become gelatinous or jelly like and when this happens, the cement should not be used. The cement solvent should be used within 30 days after opening the company's seal and tightly close the seal after using in order to avoid its freezing. The freezed cement solvent should be discarded immediately and fresh one should be used. The CPVC solvent cement usage should be adhered to as given in table below

Diameter of pipe in inch (flow guard)	½"	¾"	1"	¼"	1½"	2"
Approx. nos. of joints which can be mode per litre of solvent cement.	200 Nos	180 Nos	150 Nos	130 Nos	100 Nos	70 Nos

LAYING AND JOINTING:

The defective pipe shall be rejected. Where the pipes have to be cut or jointed the ends shall be carefully filed, so that no obstruction to bore is offered. The jointing to be dry fit checked. A thick coat of solvent cement shall be applied to the Inner surface of the socket by mean of a brush. Solvent cement shall be of approved and of good quality ASTM – F493. The pipe shall be then inserted in to the fitting and turned 90 degree to ensure even distribution of solvent cement with in the joint. Excess solvent cement shall be wiped off. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set – up. An even bead of cement should evident around the joint. If this bead is not continuous around the socket edge, it may indicate that insufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and surfaces for an attractive professional appearance. Clamps / pipe hooks a required size shall be used for clamping the pipe to the walls.

TESTING:

Once an installation is completed and cured per these recommendations, the systems should be hydrostatically pressure tested. 10bar (150 PSI) which will be 1.5-time pressure of actual line pressure, for Five hour is recommended. When pressure testing, the system should be filled with water and all air bled from the highest and farthest points in the run. If a leak is found, the joint must be cut out and discarded. A new section should be installed using couplings. During sub – freezing temperatures, water should be blown out of the lines after testing to eliminate potential damage from freezing.

HANDLING AND STORAGE:

CPVC is a tough, corrosion resistant material, but it does not have the mechanical strength of metal. Reasonable care should be exercised in handling CPVC pipes and fittings. They should not be dropped, stepped on, or have objects thrown on them. If improper handling or heavy impact results in cracks, splits, or gouges, the damaged section shall be discarded. Pipes & fittings should be covered with a non-transparent material when stored outdoors for long periods of time.

HANGERS AND SUPPORTS:

For vertical runs supports shall be provided a at each floor level, plus a mid – story guide. For horizontal runs, supports shall be provided at three-foot (90-cm) intervals for diameters of one inch and below and at four-foot (1.2 m) intervals for larger sizes. Piping should not be anchored tightly to supports, but rather secured with smooth straps or hangers that allow for movement caused by expansion and contraction. Most hangers designed for metal pipe are suitable for Flow Guard. Hangers shall not have rough or sharp edges which come in contact with the tubing.

HORIZONTIAL AND VERTICAL SUPPORT:

A typical Cold-water distribution system operating at 26^0-30^0 C supports shall be provided for horizontal lines at every 3'(90cm) for sizes ½" – 1", and every 4' (120 cm) on sizes larger than 1". However, the following spacing shall be used at water temperatures indicated.

Size of Pipe	21°C	49°C	71°C	82°C
Inch	Ft.	Ft.	Ft.	Ft.
½"	5.5	4.5	3.0	2.5
¾"	5.5	5.0	3.0	2.5
1"	6.0	5.5	3.5	3.0
1¼"	6.5	6.0	3.5	3.5
1½"	7.0	6.0	3.5	3.5
2"	7.0	6.5	4.0	3.5

SCHEDULE - 40

Recommended Support spacing (in feet)

Nom. Pipe Size		Temperature °C					
(In)	(mm)	23	38	49	60	71	82
2 ½	65	7 ½	7	7	6 ½	6	3 ½
3	80	8	7	7	7	6	3 ½
4	100	8 ½	7 ½	7 ½	7	6 ½	4
6	150	9 ½	8	8	7 ½	7	4 ½
8	200	9 ½	8	8	7 ½	7	5

SCHEDULE - 80

Recommended Support spacing (in feet)

Nom. Pipe Size		Temperature °C					
(In)	(mm)	23	38	49	60	71	82
2 ½	65	8	7 ½	7 ½	6 ½	4 ½	4
3	80	8	8	7 ½	7	4 ½	4
4	100	9	9	8 ½	7 ½	5	4 ½
6	150	10	9 ½	9	8	5 ½	5

For internal concealed water supply pipe shall be fixed with GI clamp.

B .2.0 Galvanized Iron Pipes & Fittings

The pipes shall be galvanized heavy graded 'C' class pipe screwed and socketed conforming to the requirements of IS:1239. The Galvanizing shall conform to IS:4736, the zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanized in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly, and square with the axis of the pipe.
The fittings shall be malleable iron and comply with all the requirements of the pipes. The sizes of pipes and fitting is specified in the schedule of quantities.

B .2.1 Laying and Jointing of GI Pipes

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

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

VALVES

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

Sluice valves, where specified shall be flanged sluice valves of cast iron body. The spindle,

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

Ball valves with floats to be fixed in storage tanks shall consist of cast brass lever arm having plastic balls screwed to the arm integrally. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers. The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system. Where called for brass valves shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe.

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

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

All valves shall be suitable for the working pressure involved.

Motorized Butterfly Valve with Float Switch:

Motorized Butterfly Valves (MBFV) with float switch for auto On/Off function, complete system automation. (MBFV) 230V On/Off type with Manual Over Ride, IP67, 2 aux switch and with inbuilt thermal protection against moisture, connected with Float Switch (High & Low) with relay controller box with 1.5sq.mm 3core cable to required length & necessary connecting fittings.

Brass full way Valve:

Full way valve is a valve with suitable means of connection for insertion in a pipeline for controlling or stopping the flow. The valve shall be of brass fitted with a cast iron wheel and shall be of gunmetal gate valve type opening full way of the size as specified. The valve shall be of best quality approved by the Consultants \ Architects.

Butterfly/Ball Valves:

Valves up to 50 mm dia and below shall be Nickel plated Gun metal body heavy stainless-steel ball, lever operated, as per require tested pressure with female screwed ends. All ball valves shall be of full-bore type.

Valves from 50mm up to 150mm dia shall be of cast of iron body butterfly valves lever operated with flange ends. Valves shall carry IS certification mark.
All valves shall be approved by consultants before they are used on work.
All globe and check valves shall have working parts suitable for hot and cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type or duty.

Check Valves (Non return valves)

a) Check valves of 50 mm and smaller size shall be gun metal conventional swing/lift check valve type used in all water services.

b) Check valves larger than 50mm shall be wafer / Dual plate with CI body check valve type used in all water services. The valves shall be supplied inclusive of M.S. Pipe flanges and high tensile steel bolts of dimension recommended by suppliers of valves.

Foot Valves:

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

"Y" STRAINERS:

"Y'' strainers up to 50mm shall be of gunmetal and above 50mm shall be of cast iron body. Strainers shall incorporate a removable bronze screen with mm (1/8'') perforations and a permanent magnet. Strainers shall be provided with flanges at both inlet and outlet. They shall be designed to enable blowing out of accumulated dirt and facilitate dirt and facilitate removal and replacement of the screen without disconnection of the main pipe.

PRESSURE REDUCING VALVE SET:

Each pressure reducing valve set shall be complete with pressure reducing or pressure regulating valve, isolating valves, pressure gauges on inlet and outlet, pressure relief valve on outlet and filter on inlet.
Each pressure reducing valve shall contain loading neoprene diaphragm and a full floating, self aligning, ignition resistant seat and shall be of the single stage, pressure reduction type with provision for manually adjusting the delivery pressure. The valve shall fail safe to the low pressure.

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

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

PRESSURE RELIEF VALVES:

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

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

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

PRESSURE GAUGE:

The pressure gauge shall be constructed of die cast aluminum and enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless bourdon tube type pressure gauge with a scale range from 0 to 16 kg / cm square and shall be constructed as per IS: 3524. Each Pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by ball valve.

WATER FITTINGS

Unless otherwise specified all Gunmetal fittings such as gate, globe, check & safety valves

shall be fitted in pipe line in workman like manner. Necessary unions shall be provided on both ends of the valves for easy replacement. The joints between fittings and pipes shall be leak proof when tested to desired pressure rating. The defective fittings and joints shall be replaced or redone.

Measurements:

The lengths shall be measured in running meter correct to a cm for the finished work, which shall include GI pipes and sockets, GI fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gunmetal taps (cocks), valves, lead connection pipes and shower rose. The length shall be taken along the central line of the pipefitting. All pipes and fittings shall be classified according to their diameter of the internal bore. The pipe shall be described as including all cuttings and wastage. In case of fittings of unequal bore, the largest bore shall be measured.

Digging and refilling of trenches shall be measured separately or clubbed with main item as called for in the item specification/tender bill of quantities.

Regulations and Standards:

All equipment supply erection testing and commissioning shall comply with the requirements of Indian standards and code of practices given below as per latest amendment. All equipment and material being supplied by the contractor shall meet the requirements of IS. Tariff advisory committee's regulation (fire insurance) electrical inspectorate and Indian Electricity rule other Codes / publications as given below:

DRAWINGS:

a.	Contract drawings duly signed by Architect / Consultant are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings and with the prior approval of Architect.
b.	Architectural drawings shall take precedence over services drawings in regard to all Dimensions.
c.	Contractor shall verify all dimensions at site and bring to the notices of Engineer-in-charge / Consultant discrepancies if any Engineer-in-charge's decision in this respect shall be final.
d.	Large size details and manufactures' dimensions for materials to be incorporated shall take precedence over small-scale drawings.

WORK TO BE CARRIED OUT BY LICENCED PERSONS / FIRMS:

All service installations namely water supply plumbing drainage and sewerage electrical fire detection and fire protection works shall be carried out by technically competent persons holding valid license to carry out their respective trade at the site and having a minimum experience of five years in their relevant trades.

DRILLING, CUTTING, ETC.:

All cutting and drilling of walls or other elements of the building for the proper entry / installation of pipes, and other equipment shall be carried out using electrically operated tools, only. Manual drilling, cutting, chiseling, etc shall be cut or chased with the written permission of the project engineer.

C. INTERNAL DRAINAGE (SOIL, WASTE, VENT & RAIN WATER PIPES)

SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of internal drainage services. Work under this section shall consist of furnishing all labour,

materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the schedule of quantities.

BASIC PIPING SYSTEM

Soil, waste and vent pipes in shafts, ducts and in concealed areas i.e. false ceilings etc. shall consist of Upvc SWR 'B' class pipes & fittings as called for. In general wastes and vents smaller than and upto 50mm dia shall be of Upvc high pressure pipe.

The soil pipes shall be circular with a minimum diameter of 100mm. Pipes shall be fixed by means of GI clamps in two sections, bolted together, built into the walls, wedged and neatly jointed as directed and approved by the Owner's site representative / Architect. 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 m.s 80 micron galvanized coated with 2 coats of approved enamel paint 3" bracket. 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 solvent weld or rubber ring as described under jointing of Upvc SWR 'B' Class pipes.

Every waste pipe shall discharge above the grating of properly trapped gully. The contractor will ensure that this requirement is adequately met with. Wherever floor traps are provided, it shall be ensured that at least one wash is connected to such floor traps to avoid drying of water seal in the trap. Ventilating pipes shall be of Upvc SWR 'A' Class pipes, conforming to the requirements laid down earlier. The pipes shall be of the diameter shown on the drawings.

All traps on branch soil and waste pipes shall also be ventilated at a point not less than 75mm or more than 100mm from their highest part and on the side nearest to the soil pipe or waste pipes.

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

All the fittings used for connections between soil, waste and ventilation pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. The doors shall be provided with 3mm thick rubber insertion packing and when closed and bolted shall be air and water tight.

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

Head (starting point) of drains and sewage / wastewater sumps (as and where applicable) having a length of greater than 4 m up to it connection to the main drain or manhole shall be provided with a 80 / 100 mm vent pipe.

PIPING MATERIALS

UPVC SWR 'B' CLASS Pipes and Fittings

a) Wherever specified in BOQ un-plasticized Poly vinyl Chloride (UPVC) B class pipe or Ultra Violet Stabilized (UVS) pipes of high density conforming to IS: 13592 & IS 4985 shall be used for internal Kitchen / toilet / refuge area & down takes. UPVC type A shall be used for vent within plumbing shaft.

b) UPVC pipes shall be bent cold to a radius of not less than eight times their external diameter. Pipes bent for smaller radius may be made by not bending.

c) Fittings used for PVC pipes shall be compression moulded fittings matching the above specifications.

d) Jointing for UPVC pipes shall be made by means of solvent cement for detachable joints (or screwed joints). The type of joints used shall be as per the site condition/direction of the Project Manager. Where UPVC pipes are used for rain water pipes, the pipe shall be finished

with G.I. adaptor for insertion in the RCC slab for a waterproof joint complete as directed by the Project Manager.

Testing of pipes shall be done as per IS 12235.

e) STORAGE AND HANDLING:

PVC Pipes: The pipes should be given adequate support at all times. Pipes should be stored in a reasonably flat surface free from stones and sharp projection so that the pipe is supported throughout its length. In storage, pipes racks should provide continuous support and sharp corners of Metal Racks should be avoided. Socket and spigoted pipes should be stacked in layers with sockets placed at alternate ends of the stacks to avoid top sided stacks. It is recommended not to store pipe inside another pipe.

On no account pipes shall be stored in a stressed or bent condition or near the source of heat. Pipes should not be stacked more than 1.5M high and pipes of different sizes and classes should be stacked separately. The ends of pipes should be protected from abrasion particularly those specially prepared for jointing either by spigot or socket solvent welded joints or soldered for use with couplings. If due to unsatisfactory storage or handling a pipe becomes kinked' the damaged portion should be cut out completely.

f) **JOINTING OF UNPLASTICISED P.V.C. PIPES:**

Methods of Jointing:

i) Solvent Welded Joints
ii) White cement & linseed oil mixture (Connection of U.P.V.C. to Cast Iron Pipes)
iii) Screwed or threaded Joints
iv) Rubber ring joints

g) SOLVENT WELDED JOINTS:

This technique is used with spigot and socket type joints, in which the socket is made specially to form a close fit on the pipe end and with injection moulded/fabricated fittings.

Solvent Cement of approved make shall be used as per the recommendations of the manufacturers. The dust, oil, water grease etc. should be wiped out with dry cloth from the surface to be coated with solvent cement. The coating of solvent cement shall be applied evenly on the inside of the fittings for full length of insertion and then on the outside of the pipe end up to the marked line and the pipe twisted to a quarter of a turn to spread the cement evenly at the same time ensuring the pipe, pushed home fully into the socket. The pipe should be pushed into the fitting socket and held for one to two minutes as otherwise the pipes comes out of the fitting due to slippery quality of cement and the tapering inside bore of the fitting.

The surplus cement on the pipe surfaces shall be wiped out. In most of the cases the pipe inserted should be up to the marked line and in no case shall be less than 2/5 of the diameter of the pipe and up to marked line.

When the joint is made, the remaining cement on the pipe surfaces shall be wiped off immediately without fail as the continued action of solvent cement will weaken the wall on the pipe and cause failure under pressure.

Since solvent cements are inflammable they should not be used near the naked flames. In certain cases, fumes given off from cement may be a source of danger if not carried in a well-ventilated area.

When not in use containers of cement should be kept closed tightly to avoid loss of solvent or entry of dirt. Cement which has gelled or hardened should be discarded and removed from site.

h) RUBBER RING JOINTS OR 'O' RING SHRINK JOINTS (SHAFT PIPING):

Unplasticized P.V.C. Pipe may be joined by employing approved rubber ring to provide the water tight seal. The ring may be housed in groove formed in a plastic or metallic housing. The rubber is compressed and makes a seal between the pipe and the housing.

uPVC Pipes to be connected to cast iron pipes shall be joined by using putty (mixture of white cement and linseed oil) as directed by Engineer-in-charge and as shown in the Drawing.

i) Rainwater Pipes

All open terraces shall be drained by rain water down takes. Rainwater down takes are separate and independent of the soil and waste system and will discharge into the underground rainwater harvesting drainage system of the complex. Rainwater in open courtyards shall be collected in catch basins and connected to the Storm Water Drains. Any dry weather flow from waste appliances, e.g. AHU's pump rooms shall be connected to storm water drainage systems. Stp waste water sumps shall connected to waste water drainage after traps and not in the storm water drainage systems.

All rain water and fittings used within the plumbing shafts vertical run, shall be PVC pipes of SWR quality of pressure rating 6kg / sq. cm. They shall be made of polyvinyl chloride (UPVC) 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 a 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.

I) Pipe Sizes and wall thickness:

Pipe dia (mm)	Wall Thickness (mm)
110mm	2.2mm
75mm	1.8mm

II) Tolerances:

Tolerances on diameters and wall thickness shall be as per IS 4985.

III) 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 IS 7834. Pressure ratings and Tolerances shall be as per IS 4985.

a) 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 shown on the drawings and directed by the Project Manager.

b) TRAPS

Floor Traps

PVC Multi Inlet Floor Trap & Nahani trap as per drgs requirements of self-cleansing design molded or fabricated, with or without vent arm jointing with rubber ring / solvent cement followed by application of leak proof adhesive like FRP paste including making good the floors etc. 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 sand: 4 stone aggregate 20 mm nominal size).

Floor Trap Grating

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

a) General: Provide traps on all fixtures connected to the waste system, except for fixtures having integral traps. All traps shall have a seal of not less than 40mm and not more than 100mm. All traps shall have the same internal diameter as the fixture's waste outlet.

b) Exposed Traps: Exposed traps for fixtures shall be heavy quality chromium plated cast brass.

Laying and Jointing

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.
Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and rubber ring 'O' for vertical line. The type of joint shall be used as per site conditions / direction of the Owner's site representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with GI adopter for insertion in the RCC slab for a water proof joint complete as directed by Owner's site representative.

Supports

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint. Repairs While temporary or emergency repairs may be made to the damaged pipes, permanent repairs shall be made by replacement of the damaged section. If any split or chip out occur in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

MAXIMUM DISTANCE BETWEEN SUPPORTS IN VERTICAL RUN

PIPE DIA.(mm)	25	32	40	50	65	80	100	150	200
DISTANCE (M)	3.0	3.0	3.6	3.6	4.5	4.5	4.5	4.5	5.0
U –BOLT	6mmø	6mmø	6mmø	8mmø	10mmø	10mmø	10mmø	16mmø	16mmø

MAXIMUM DISTANCE BETWEEN SUPPORTS IN HORIZONTAL RUN

PIPE DIA.(mm)	25	32	40	50	65	80	100	150	200
DISTANCE (M)	3.0	3.0	3.0	3.0	3.6	3.6	4.0	4.5	5.0
U -BOLT	8mmø	8mmø	8mmø	8mmø	10mmø	10mmø	12mmø	12mmø	12mmø
HANGER ROD	8mmø	8mmø	8mmø	8mmø	10mmø	10mmø	10mmø	12mmø	12mmø

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 be obtained before dispatch of material to site.

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.

Cast Iron Class (LA) pipes – location as mention in BOQ.

All drainage passing under building floor and passing through retaining wall shall be cast iron class (LA) pipes (IS : 1536) Cast iron class (LA) pipe shall be such that they could be cut, drilled or machined. Pipe centrifugally cast in 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. Material Cast iron pipe shall be centrifugally spun cast iron pipe and conforming to IS:1536-1976.

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 and socket type or as called for. The pipes and fittings shall be of uniform material throughout and shall be free from all manufacturing defects. Joints Cast iron class (LA) pipe used for soil and waste pipes shall be jointed with drip seal sufficient skein of jute rope shall be caulked to leave minimum space of 25 mm for the drip seal

Drip Seal Joints:

Drip seal PJS-43 (pipe joint sealant) shall be used for joining various diameters of C.I. pipes and specials. This sealant replaces the standard Drip seal caulked joints. The application is by Homogenously mixing the two-pack system in cold condition.

Application Procedure:

Clean the pipe joints thoroughly to ensure it is free from any traces of oil, dirt or any other foreign body. Mix two parts of Drip Seal thoroughly with an iron flat to get a homogenous compound. Place Spun yarn in the pipe joint as a filler and then take the required quantity of the compound and push it in the joint with a caulking tool, MS flat / damp finger uniformly all over to obtain a smooth and uniform joint. Dip the fingers in water every often to ensure the compound does not stick to the hands of the workmen, but this will ensure perfect sealing and the smooth surface for the joint cement. Preferably use disposable gloves for hand application.

Mix the pipe joint sealant as per the ratio given below homogeneously.

White Compound	-	200 gms
Black Compound	-	300 gms (i.e. ratio fo 1:1.5)

Apply the mixed sealant with suitable tool upto minimum depth of 25mm and press properly with damp finger and bewel it off at an angle of 45 Deg. With the outside of the pipe and allow it to dry till it is hard.

It should be ensured that mixed sealant should be used within 30 minutes

Precautions
Wash the hands with water, soap & thinner immediately before it hardens after the sealant is applied. Take all necessary precautions at the time of application and at site.

ACCESS DOOR FITTINGS FOR PIPES:

The access door fittings for cast iron (centrifugal) quality shall be of proper design so as not to form any Cavities in which dirt may accumulate. Doors shall be provided with (3mm) rubber insertion packing and when closed should be bolted. They shall be water tight.

PIPES SUPPORTS FOR SANITARY DRAIN OF C.I. PIPES:

Pipe Hangers for sanitary sewer shall be as per the supporting details shown in the Drawing. The support consists of Channels/Angles of suitable size as indicated in the Drawing fixed vertically and fixed to the ceiling walls with dash fasteners. The pipe is fixed with two `U' clamps of 25 x 6mm flats with Bolts and Nuts.

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 pipes running in sinking area should be adequately supported by brick masonry (uthala). The supports should be provided below the joints in pipes and wherever the alignment of pipe changes.

All vertical pipes shall be fixed by galvanized clamps and galvanized 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 galvanized structural adjustable clamps / structural supports made up of angles, channels 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 reset 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. All pipes clamps, supports and hangers shall be galvanized. Factory made prefabricated clamps shall be preferred. Contractor may fabricate the clamps of special nature and galvanize them after fabrication but before installation. All nuts, bolts, washers and other fasteners shall be factory galvanized.

Clamps shall be of approved design and fabricated from MS / GI (which shall be galvanized 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 galvanized 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 flat as per contractor’s shop drawings shall be galvanized after fabrication. All nuts, bolts and washers shall be galvanized.

Galvanized slotted angle/channel of approved sizes supports on walls shall be provided wherever shown on shop drawings. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with anchor fasteners mentioned above. The spacing of support bolts on support members fixed horizontally shall not exceed 1m.

Cleanout Plugs:

a) Pipe cleanouts shall be the same size as the pipe except that cleanout plug larger than 100 mm dia. shall not be used.

b) Cleanout installed in connection with a cast iron soil pipe shall consist of a long sweep 1/4 bend extended to the location shown. A heavy cast brass or cast iron ferrule with countersunk cast brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor.

c) Cleanout plugs at the head of C.I./S.S. horizontal pipes running under the floor shall be of cast brass screwed in type. Floor and wall cleanouts shall be of cast brass screwed type. The connecting pieces shall be of G.I. threaded to suit the cleanout with lead caulked joint. Cleanout plugs shall be provided with keyholes for openings as directed by the Project Manager/ Consultant.

d) Cleanouts in connection with other piping shall be T Pattern, 90^{o} branch drainage fitting with cast brass screw plug of the same size as the pipe.

e) Cleanouts installed in finished floors shall be provided with chrome plated cast brass, nickel brass or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface.

PIPE SLEEVES

Pipe sleeves, next 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 and burrs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matter.

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 sand : 4 stone aggregate of 12 mm size) 10 cm bed and around. 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.

CUTTING AND MAKING GOOD

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

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 bellow 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 out and made good.

Water Test:

a) Horizontal Piping – Full of Pipe with water with head of 1.50 Meter

b) Vertical Piping – Pouring of water in pipes & checking for leakage.

All C.I. Pipes & fittings including joints shall be tested by a smoke test and left in working order after completion. The smoke test shall be carried out as stated below:

Smoke shall be pumped into the drains at the lowest and from a smoke machine which consists of a Blower and a Burner. The materials usually burnt are greasy cotton waste which emits clear pungent smoke to be easily detectable by light as well as by smell if leaking at any point of the drain. During testing if any joint is found leaking the same shall be rectified by the contractor at no extra cost.
If tests are made with air, a pressure of not less than 1.5kg/sqcm shall be applied with a smoke machine and maintained for at least 15 minutes without leakage.
The contractor shall give a final smoke test for the entire system after the fixtures have been connected and their traps filled with water. Smoke shall be produced by a smoke machine and a pressure equal to 25mm water column shall be maintained for 15 minutes before inspection starts.

All soil, waste, vent and drainage piping shall be tested by the contractor and got approved before acceptance. Drainage and vent piping shall be tested with water or air before the fixtures are installed. After the plumbing fixtures have been set and their traps filled with water, the entire system shall be submitted to a final water test.
Water test shall be applied to the drainage and venting system either in its entirety or in sections. If the entire system is tested, all openings in the pipes shall be tightly closed except the highest opening, and the system filled with water to the point of overflow. If the system is tested in sections, each opening except the highest opening of the section under test shall be tightly plugged and each section filled with water and tested with at least the upper 3m of the next preceding section shall be tested so that each joint or pipe in the building except the uppermost 3m of the system shall be submitted to a test of at least 3m head of water. The water shall be kept in the system or in the portion under test for at least 15 minutes before the inspection starts.

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

These tests shall not relieve the contractor from responsibility for leaks which may develop after the tests are made.

Painting:

All pipes and fittings exposed shall be painted with 3 coats of anticorrosive paint as per identification colour code.

Soil, waste and vent pipes in exposed location, in shafts and pipe spaces shall be painted with 3 coats of anticorrosive paint as per identification color code**.** Before painting, all dust and extraneous matter shall be removed.

Paint shall be of approved make and quality and shade. Where directed pipes shall be painted in accordance with approved pipe color 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 one or two coats of synthetic enamel paint after removing dust end extraneous matter.

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

D COMMISSIONING AND GUARANTEE

SCOPE OF WORK:

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

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

On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.
All tests shall be made in the presence of the architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

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

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

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

PRECOMMISSIONING:

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

a)	Prior to start – up and hydraulic testing, the contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.
b)	All strainers shall be inspected and cleaned out or replaced.
c)	When the entire systems are reasonably clean, a pre – treatment chemical shall be

	introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre – treatment. The pre – treatment chemical shall:
	Remove oil, grease and foreign residue from the pipe work and fittings.
	Pre – condition the metal surfaces to resist reaction with water or air.
	Establish an initial protective film.
	After pre – treatment, the system shall be drained and refilled with fresh water and left until the system is put in to operation.
	Details and procedures of the pre – treatment shall be submitted to the architect for approval.
d)	Check all clamps, supports and hangers provided for the pipes.
e)	Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. There after conduct and hydro test of the system as for (b) above.
f)	Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

STATUTORY AUTHORITIES TESTS AND INSPECTIONS:

As and when notified in writing or instructed by the architect, the contractor shall submit shop drawing and attend all tests and inspections carried out by local fire authorities, water authority and other statutory authorities, and shall forth with execute free of charge any rectification work ordered by the architect as a result of such tests and inspections where these indicate non – compliance with statutory regulations. Some of these tests may take place after the issue of practical completion of the main contract and the contractor shall make all allowances in this respect.

The contractor shall be responsible for the submission of all necessary forms and shop drawings to the statutory authorities, which shall conform in layout to the latest architectural plans submitted to and kept by these authorities.

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.

Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.

All appliances, fittings and fixtures shall be fixed in a neat workman like manner true to level and to heights shown on the drawings and in accordance with the manufactures recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling, plaster, paint, insulation or terrace shall be made good by the contractor at his own cost. Fixtures shall be mounted rigid, plumb and true to alignment.

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

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

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

a)	Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over (the original protective wrapping shall be left in position for as long as possible).
b)	The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.

c)	The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.
d)	The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust – proofed fixings shall be used. Fixing shall be done in a manner that minimize noise transmission.
e)	Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit (e.g. ceramic unit)
f)	Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.

The submission shall comply with the requirements set forth in the current codes of practice and circular letters of the statutory authorities. The shop drawings to be submitted shall be forwarded to the architect for checking before submission.

The contractor shall allow for at least two submissions of complete sets of shop drawings to the authorities, one to be made within six months after the award of the contract but not less than six weeks before the inspection. The architect may at his discretion instruct the contractor for additional submissions to the local authorities wherever necessary.

The contractor shall notify the architect at least seven days in advance of his application for local authority tests and inspections. On receipt of a confirmed date for test and inspection the contractor shall inform the architect without delay.

FINAL ACCEPTANCE TESTS:

Following commissioning and inspection of the entire installation, and prior to issue of the completion certificate, the contractor shall carry out final acceptance test in accordance with a programme to be agreed with the architect.
Should the results of the acceptance tests show that plant, systems and / or equipment fail to perform it the efficiencies or other performance figures as given in this specification, the contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant authorities having jurisdiction, these tests shall be carried out by the contractor prior to the issue of completion certificate to the acceptance of the authorities.

REJECTION OF INSTALLATION / PLANT:

Any items of plant or system or component which fails to comply with the requirements of this specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the architect either in whole or in part as he considers necessary / appropriate.
Adjustment and / or modification work as required by the architect so as to comply with the authority's requirements and the intent of the specification shall be carried out by the contractor at his own expense and to the satisfaction of the authority / architect.
After works have been accepted, the contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the architect / employer.

WARRANTY AND HANDOVER:

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

HANDING OVER OF DOCUMENTS:

All testing and commissioning shall be done by the contractor to the entire satisfaction of the owner's site representative and all testing and commissioning documents shall be handed over to the owner's site representative.
The contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the owner's site representative.

PIPE COLOUR CODE: Color code to confirm to IS: 2379:1990.

S.No.	Pipe Lines	Ground / Base Colour	First Colour Band	Second Colour Band
1	Cooling Water	Sea Green	French Blue	
2	Boiler feed	Sea Green	Gulf Red	
3	Condensate	Sea Green	Light Brown	
4	Drinking Water (All cold water lines after filter)	Sea Green	French Blue	Single Red
5	Treated Water (Soft Water)	Sea Green	Light Orange	
6	Domestic Hot Water	Sea Green	Light Grey	
7	Compressed air upto 15/Kg/Sqcm	Sky Blue		
8	Steam	Silver Grey		
9	Drainage (Storm Water)	Black		
10	Drainage (Sewage Water)	Brown		
11	Gas	Canary Yellow		
12	Fire System	Post Office Red		

LIST OF BUREAU OF INDIAN STANDARDS CODES:

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below as amended upto 30th

All equipment and material being supplied by the contractor shall meet the requirements of IS. Tariff advisory committee's regulation (fire insurance), electrical inspectorate and Indian Electricity rules and other
Codes / Publications as given below:

1. GENERAL:

SP: 6 (1)	Structural steel sections
IS: 27 IS: 325 IS: 554	Pig Lead Three phase induction Motors Dimensions for pipe threads where pressure tight joints are required on the threads.
IS: 694	PVC insulated cables for working voltages unto & including 1 100 V.
IS: 779	Specification for water meters (domestic type).
IS: 782	Specification for caulking lead.
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(part1)	Technical supply conditions for threaded steel fasteners: part 1 Introduction and general information.
IS: 1367(part2)	Technical supply conditions for threaded steel fasteners: part 2 product grades and tolerances.
IS: 1554(part1	PVC insulated (heavy duty) electric cables: part 1 for working voltages unto and including 1 100 V.
IS: 1554(part2)	PVC insulated (heavy duty) electric cables: part 2 for working voltages from 3.3 KV up to and including 11 KV.
IS: 1726	Specification for cast iron manhole covers and frames.
IS: 1742	Code of practice for building drainage.
IS: 2064	Code of practice selection, installation and maintenance of sanitary appliance.
IS: 2065	Code of practice for water supply in buildings.
IS: 2104	Specification for water meter for boxes (domestic type)
IS: 2373	Specification for cater meter (bulk type)
IS: 2379	Color code for identification of pipelines
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 manhole.
IS: 4127	Code 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 installation.
IS: 9912	Coal tar based coating materials and suitable primer for protecting iron and steel pipelines.
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 of 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 were, waste fittings for basins, bidets and baths. General technical specifications.

02. PIPES AND FITTINGS:

IS: 458	Specification for per cast 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 1 mild steel tubes.
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	Vertically cast iron pressure pipes for water, gas and sewage.
IS: 1729	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS: 1879	Malleable cast iron pipe fittings.
IS: 1978	Line pipe.
IS: 1979	High test line pipe
IS: 2501	Copper tubes for general engineering purposes.
IS: 2643 (part –1)	Dimensions for pipe threads for fastening purposes Part 1 basic profile and dimensions.
IS: 2643(part -2)	Dimensions for pipe threads for fastening purposes Part 2 Tolerances.
IS: 2643(part-3)	Dimensions for pipe threads for fastening purposes Part 3 limits of sizes.
IS: 3468	Pipe nuts
IS: 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
IS: 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS: 4346	Specifications for washers for use with fittings for water services.
IS: 4711	Methods for sampling steel pipes, tubes and fittings.
IS: 6392	Steel pipe flanges
IS: 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS: 7181	Specification for horizontally cast iron double flanged pipe for water gas and sewage.

03. VALVES:

IS: 778	Specification for copper alloy gage, globe and check valves for water works purposes.
IS: 780	Specification for sluice valves for water works purposed (50 mm to 300 mm size).
IS: 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
IS: 2906	Specification for surface valves for water works purposes (350 mm to 1200 mm size)
IS: 3950	Specification for surface boxes for sluice valves.
IS: 5312 (part-1)	Specification for swing check type reflux (non return) valves part 1 muilti door

	pattern.
IS: 5312 (part-2)	Specification for swing check type reflux (non return) valves part 1 muilti door pattern.
IS: 12992 (part - 1)	Safety relief valves, spring loaded design.
IS: 13095	Butterfly valves for general purposes.

04. SANITARY FITTINGS:

IS: 771(part to 3)	Specification for glazed fire clay sanitary appliances.
IS: 744	Specification for flushing cistern for water closets and urinal (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 thermo set 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 2 specific requirements of washbasins.
IS: 2556 (part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china) part 3specific requirements of urinals, section 2 half stall urinals.
IS: 2556 (part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china) part 4 specific requirements of urinals, section 4 partition slabs.
IS: 2556 (part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china) part 5 specific requirements of urinals, section 5waste fittings.
IS: 2556 (part 6 Sec 6)	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.
2556 (part -7)	Specification for vitreous sanitary appliances (vitreous china) part 11 specific requirements of shower rose.
IS: 2556 (part -12)	Specification for vitreous sanitary appliances (vitreous china) part 12 specific requirements of floor traps.
IS: 2556 (part -15)	Specification for vitreous sanitary appliances (vitreous china) part 15 specific requirements of universal water closet.
IS: 2692	Specification for ferrule for water services.
IS: 2717	Glossary of terms relating to vitreous enamel ware and ceramic metal system.
IS: 2963	Specifications 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 fiber reinforced polyester resin bath tubs.
IS: 6411	Specification for gel-coated glass fiber reinforced polyester resin bath tubs.
IS: 8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
IS: 9758	Specification for flush valves and fitting for water closets and urinals.

06 WATER QUALITY TOLERANCE:

IS: 3025 (part 1to 44)	Method of sampling and test (physical and chemical) for water and waste water.
IS: 4764	Tolerance limits for sewages effluents discharged into island surface waters.`

IS: 10500	Drinking water

07. PUMPS AND 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 of 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.