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23. PLUMBING, SANITARY AND GAS FITTINGS

23.1 SCOPE

The work shall include, furnishing and supplying as required all labour, materials, fittings, fixtures, accessories, equipment and services for the execution, completion, testing and commissioning of plumbing, sanitary installation & Gas fitting works as shown on drawings, specified herein or as directed by the Engineer-in-Charge.

23.2 PLUMBING & SANITARY INSTALLATIONS

23.2.1 SUBMITTALS

The Contractor shall submit samples of materials such as fittings, fixtures and accessories to be incorporated into the works to the Engineer-in-Charge for approval.

23.2.2 SOIL, WASTE AND VENT PIPES

All cast iron soil, waste and vent pipes and fittings shall be truly cylindrical, of the clear internal diameter as specified of a uniform thickness, smooth with strong and deep sockets and free from flaws, air bubbles, cracks, holes and other defects. They shall not be brittle but shall allow cutting, chipping or drilling without damage. These shall conform withBS-416 and BS-437 or approved equivalent.

Internal Diameter (mm)	Thickness of Metal not less than (mm)	Weight per 2m length including socket & headed spigot or flanges not less than (Kg)
50	7.0	34
75	8.0	50
100	9.5	73
150	9.5	105

23.2.3 SEWER PIPES

23.2.3.1 Cast iron pipes shall conform to BS-78 for spigot and socket for vertically cast pipes; BS-1211 for spigot and socket spun iron pipes of and BS-2005 for flanged pipes.

23.2.3.2 Non reinforced cement concrete pipe shall conform to the requirements of Clause 25.3.2 of Section 25, Sewerage.

23.2.3.3 RCC pipes shall conform to the requirements of Clause 25.3.3 of Section 25 Sewerage. All RCC pipes shall be first class quality truly circular of uniform thickness and free from irregularities, honey combing and other defects. The pipe shall be suitable for sewerage and drainage purposes.

23.2.3.4 Asbestos pipes shall conform and laid according to provisions of Clause 27.3.1.1(b) and 27.3.2.6(d) of Section 27 – Tube well and Water Supply.

23.2.3.5 PVC pipes shall conform and laid according to the provisions of Clauses 27.3.1.1(e) and 27.3.2.6(e) of Section 27 – Tube well and Water Supply.

23.2.4 TRAPS AND CLEANOUTS

23.2.4.1 FLOOR TRAPS

Traps shall be of self-cleaning design, provided with water seal. Traps of the specified size used for underground installation shall be cast iron (C.I) generally in accordance with BS-416 and BS-437 or an approved equivalent. Theaverage thickness of wall shall be 5mm and at no point shall thickness

be less than 4mm. All waste traps shall have grating or cross bars formed integrally. The grating shall be of suitable design so as not to unduly restrict the flow of waste water.

23.2.4.2 GULLEY TRAPS

Base of the gulley traps shall be in plain concrete and walls in brick masonry internally plastered. The top shall be in RCC as shown on the drawings. The C.I gulley trap shall be of specified size and shall have manhole with C.I frame and cover 300 mm square or circular in shape.

23.2.4.3 FLOOR CLEAN OUTS

All cleanouts in the sewerage system shall be closed with brass screw caps. All brass screw caps shall be extra heavy and not less than 3 mm thick. Each screw cap shall have solid square or hexagonal nut not less than 25 mm high, with a minimum diameter of 38 mm. The body of the clean out ferrule shall be at least equal in weight and thickness as of the caulking ferrule for the same size of pipe as shown in the following table: The engaging parts of the screw cap shall not have less than six threads and shall be of cast iron pipe size and tapered.

Nominal pipe size (mm)	Actual pipe size (mm)	Length (mm)	Weight (kg)
50	56	113	0.45
75	81	113	0.79
100	106	113	1.14

The pipe and fittings shall be bitumen coated as per BS-416.

23.2.5 FIXTURES

23.2.5.1 WASH BASINS

a) Basin

The wash basins shall be glazed earthen ware in sizes and colours as specified. The wash basins shall be of specified make and the following shall generally be provided at the time of manufacture;

- A slot for the overflow shall be 6.3 cm (2.5") long and 13 mm (0.5") deep so designed as to facilities cleaning.
- Soap tray or sinking shall be provided as to drain into the basin.
- Tap holes shall be square to fit pillar taps shall be beveled around the opening. They shall be so situated as to allow supply pipes to be clear of waste and vent pipes and shall have enough space to prevent the users striking the head on the tap.
- Waste hole shall have a minimum diameter of 6.3 cm (2.5"). The outlet shall be beveled or rebated. The hole shall be square in shape and each side shall be 2.86 cm (1-1/8") length.
- Plug chain stay hole shall not be lower than the over flow slot. Back skirting shall be true to receive splash back.
- Stud slots shall be monolithically cast with the wash basin. These shall receive the brackets on the inside of the basin, shall be so situated that the brackets remain 5 cm (2") away from the face. These shall not exceed 13 mm (1/2") in dia. 8 mm (5/16") in height and shall be 13.5 cm (12") from the back of the basin to the centre of the side.

b) Brackets

The length of the brackets shall be such as to enable 10 cm (4") embedding in the wall or fixed to the wall with the help of screws. Bracket shall be of painted iron on white porcelain enameled.

c) Pillar Taps

Pillar taps shall be manufactured from gun metal and shall be chromium plated. These shall be of screw type with jam nut. Internal dia of the tap shall be 13 mm (1/2").

d) Plug and Chain

Plug shall be of rubber. The diameter of the plug shall be such as to fit snugly in the waste hole. The chain shall be of brass, chromium plated, one end fixed to the plug and the other held in the chain stay hole.

e) Combined (Mixes) Supply and Waste Fitting

This shall comprise of 13 mm (1/2") combine taps with discharge nozzle and 3.17 cm (1-1/4") pop up waste. Waste outlet shall be screwed 3.17 cm (1-1/4") to B.S pipe male. All of these fittings shall be of gun metal with chromium plating.

f) Waste Pipe

This shall be either of PVC, nickel or C.P Brass and shall have diameter to fit at the bottom of the waste fitting flange. Its length shall extend from the bottom of waste flange to the floor.

g) Pedestal

Pedestal shall conform to the corresponding specifications of wash basin for composition, manufacture and quality. It shall be completely recessed at the back for the reception of supply and waste pipes. It shall be such that the basin is tightly and adequately supported and shall be so arranged that the height from the floor to the top of the rim of basin is 79 cm (31").

The Wash Basin shall be supplied complete with fittings and accessories as specified.

23.2.5.2 MIRROR (Looking Glass)

One beveled edge glass mirror of first class quality and make as specified securely fixed on bard board packing required to be fixed on the wall for wash basin shall be at least 6 mm thick and shall be of requisite dimensions.

23.2.5.3 KITCHEN SINKS

a) Sinks

Kitchen sink shall be stainless steel or glazed earthenware of approved make, single or double bowl with integral drain board. The sizes of the sinks shall be either 61 cm x 45 cm x 25 cm (24"x18"x10") or 51 cm x 101 cm x 25 cm (20"x40"x10") or 51 cm x 122 cm x 25 cm (20"x48"x10") or 82.5 cm x 4.5 cm x 2.5 cm (33”x18”x10”).

b) Brackets

The Brackets shall be either of such a length as to enable 10 cm (4") embedding in the wall or shall be such as to be fixed to the wall with the help of screws. The bracket shall be of painted iron or porcelain enameled.

c) Pillar Taps

Pillar taps shall be manufactured from gun metal and shall be chromium plated. These shall be of screw down type with jam nuts. Internal diameter of the taps shall be 13 mm (1/2").

d) Plug

The rubber or vulcanite plug shall fit in the waste pipe.

e) Waste Fitting Flanges

The waste fitting flanges shall be 85 mm (3-3/8) diameter, the tail 87 mm (3-1/2") long, screwed with 37 mm (1-1/2") B.S parallel thread and the sliding flange of back-nut of 81 mm (3-1/4") diameter.

f) Waste Pipe

This shall be either of PVC,nickel of C.P Brass and shall have diameter to fit at the bottom of the waste fitting flange. Its length shall extend from the bottom of waste pipe flange to the floor.

23.2.5.4 WATER CLOSETS

a) European Type Water Closets

The W.C shall be pedestal type white glazed earthen ware or of color as specified durable non-absorbent material with a water pool of good effective seal not less than 5 cm (2"). There shall be no sharp angles, the surface shall be so rounded as to be easily cleaned. The closets shall be of syphonic action or washed down type or as directed by the Engineer-in-Charge. Four holes 6 mm (0.25") shall be provided in the pedestal for fixing the W.C to the floor.

b) Indian Type Water Closets (Orisa Type W.C)

The water closets shall be of glazed earthen ware of color as specified nonabsorbent durable material. There shall be no sharp angles, the surface shall be so rounded as to beeasily cleaned. The closets shall be embedded below the flow in lean concrete with its stop level with the floor. The foot rest shall be either integral part of the W.C or shall be provided separately in which case shall be of the same material as the pan.

c) Trap

The trap P or S for European type W.C shall be self- cleaning with a minimum water seal of 50 mm (2") and made of the same materials as the pan. For squatting type W.C it shall be of cast iron.

d) Seat

The seat for the European type W.C shall be of approved quality backlite plastic seat with lid hinged and fixed to the closets by pillar bolts. The hinged device and pillar and nuts shall be of non-corrosive material. The pillar bolts shall be 6 cm (2-3/8") long and shall be held securely by the nuts underneath the pan seat plugs. The backlite seat should have rubber buffers securely fixed to the under-side to prevent damage to the pan. The seat cover shall be of the same material as that of the seat. The backlite cover shall have rubber buffers.

e) Flushing Cistern

i) Low Level Flushing Cistern

The low level cistern shall be of 10 liters (2.9 gallons) capacity. It shall be either of glazed earthen ware or PVC as approved by the Engineer-in-Charge, complete with all internal fittings. The bottom of the cistern shall be 30 cm (2.5 feet) above ground level.

The inlet to the cistern shall be controlled by 13 mm (1/2") ball wall and 13mm (1/2") stop cock both made from gun metal or brass. The cistern shall be silent filling with an over flow arrangement.

The cistern shall be supported on M.S or C.I cantilever brackets and painted with approved enamel paint with 10 cm (4") support in the wall or it may be attached to the wall with the help of rowl plugs.

The flush pipe shall be 30 mm (1-1/4") G.I or PVC painted with approved paint. Moulded rubber cone shall be provided for connection with the pan.

ii) High Level Flushing Cistern

High level cistern shall be manufactured from cast iron or pressed steel. It shall be painted with corrosion resisting paint. It shall discharge at the rate of 9 liters in 5 seconds.

The inlet to the cistern shall be controlled by 13 mm (1/2") ball wall and 13 mm (1/2") stop cock both made from gun metal or brass. The cistern shall be silent filling with an over flow arrangement 5 ft. – 6 inches from top of pan to bottom of cistern unless otherwise.

The cistern shall be supported on M.S or C.I cantilever brackets on wall at 5 ft. 6 inches from top of pan to bottom of cistern unless otherwise shown on drawings or approved by the Engineer-in-Charge and painted with approved enamel paint with 10 cm. (4") supports in the wall.

The flush pipe shall be 30 mm (1-1/4") G.I or PVC painted with approved paint. Moulded rubber cone shall be provided for connection with the pan.

The flush shall be operated by pulling a chain handle preferably by a thin rod with as few joints as possible.

a) **Soil Connection**

Ordinarily in case of European type W. C the closet shall have trapabove the floor and the connection with the soil pipe through anexternal wall.

b) **Size of Closet**

Ordinarily the closet shall be 40 cm (16") on shorter side. For schools, nurseries 35 cm (14") 30 cm (12") and 25 cm (10") be adopted as per instructions of the Engineer-in-Charge.

c) **Connection of Water Closet with Soil Pipe**

If the trap is of earthen ware, it shall be connected with the water closet with 1:2 cement sand mortar joint. If the trap is of cast iron, it shall be connected with gaskets and 1:2 cement sand mortar joint.

d) **Connection between Trap and Soil Pipe**

Soil pipe is the pipe leading from trap to manhole.

If the trap is of earthen ware and the soil pipe is of cast iron then it shall be connected through C.I piece the joints between earthen ware and C.I piece beas per para(h) above. If the trap is of C.I it shall be connected with C.I soil pipe with ordinary lead metallic joint through a C.I connecting piece.

23.2.5.5 BIDETS

Bidets is washer for spray cleaning after use of W.C.

Bidets shall be of glazed earthenware of colour as specified of durable, nonabsorbent material with horizontal inlet to flushing rim, standing waste and overflow and ascending spray or jet.

The hot and cold supplies shall be controlled by a mixing valve so that any desired temperature may be obtained from the jet. By passing heated water through the hollow rim it may be warmed.

23.2.5.6 TOILET PAPER HOLDER

The toilet paper roll holder shall be wooden/plastic with either glazed earthenware or CP brass or plastic brackets and screws etc and shall be fixed in the wall adjacent to water closet.

23.2.5.7 URINALS

a) **Squatting Type Urinals**

These shall be glazed channel 10 cm (4" high) for front and side walls in colour as specified. The channel, if separate shall be of superior quality glazed fire clay of colour as specified with circular projection for fitting in trap. The latter shall be 62 mm (2.5") to 75 mm (3"), depending on the number of seats. The inlet end of the trap shall be provided with CP brass discharge of removable type. The urinal slab shall be of the design with back flush. The flushing cistern shall be of C.I plastic automatic type. The capacity of the cistern shall be according to the number of stalls to be flushed. A connection from the flushed pipe shall be provided with spreader (one to each seat) to flush the front.

Traps shall be of self- cleaning design provided with 25 mm (1") puff pipe. The specifications for these shall be the same as for W.C soil waste and vent pipes.

The height of squatting urinal from ground level shall be as required for floor level. The minimum spacing shall be four feet unless otherwise directed by the Engineer-in-Charge.

b) **European Type Stall Urinals**

These shall be in colour as specified and glazed fire clay and of the following dimensions:

Height from treads to top of division - 45 cm (1.5 feet).

Width center to center of divisions - 60 cm (2 feet).

The urinal range shall be provided with automatic or hand pulled flushing cistern in glazed fire clay or PVC in colour as specified of the capacity according to the numbers of stalls to be flushed. The flush pipe and spreader shall be of C.P brass. The trap shall be of C.I 62 mm (2.5") to 75 mm (3") depending on the number of stalls in the range and approved by the Engineer-in-Charge.

23.2.5.8 SHOWERS

A shower head shall consist of corrosion resisting cast or fabricated sheet metal rose having perforations and shall be adjustable to give varying degrees of spray. Shower unit shall be complete with or without hot and cold water mixing arrangements and stainless steel rigid or flexible pipe extension and an additional low down water trap.

23.2.5.9 BATH TUBS

These shall be of porcelain enameled cast iron or fibre glass as specified. The bath tub shall be provided with 27 mm (1-1/2") trap, overflow and anti-syphonic arrangements and connected to the waste and antisyphonic stacks on the outside wall. Waste water may be allowed to discharge through over flow trap, if directed by the Engineer-in-Charge. The bath shall be fitted with two CP pillar cocks and CP chain with a plug. The approximate dimensions of the bath tubs shall be as per table 23.2.5(a).

TABLE 23.2.5(a)
Dimensions of Bath Tubs

Description	Pattern					
	Magna		Rectangular		Parallel	
	cm	inch	cm	inch	cm	inch
Length overall	168	66	183	72	168	66
Width overall	71	28	1	28	71	29
Depth inside at waste	44	17-1/2	4	17-1/2	43	17
Height overall – exclusive feet & waste	46	18	6	18	44	17-1/2
Height overall - with feet for 38mm (1-1/2”) seal trap	58	23	8	23	57	22-1/2
High overall for 76mm (3”) seal trap top holes 35mm (1-3/8”) square centered	62	24-1/2	2	24-1/2	61	24
On-roll-Hole distance part	18	7-1/8	8	7-1/8	18	7-1/8
Waste hole 57mm (2-1/4) clear diameter distance from edge of roll at tap & to centre of waste hole	29	11-1/4	9	11-1/4	25	10
Overflow centre-distance below top edge	10	4	0	4	9	3-1/2
Capacity	118 L	26Gal	127 L	28Gal	122 L	27Gal

The fall along the bottom from head end to outlet should be adequate for complete emptying.The feet shall be suitable for bath tubs with traps having 27 mm (1-1/2") seal or for bath tubs with taps having 75 mm (3") seal.

Bath tub outlets may be rebated or tapered to receive the outlet piece. The later comprises a chamfered flange 7.3 mm (2-7/8) diameter with tail 35 mm (1-3/8") long provided at the end having an

integral grating. A riding flange 7.3 cm (2-7/8") diameter for tightening to the bottom of the bath tub is also provided.

The overflow holes on magna/rectangular bath tubs shall be 10 cm (4") from top of bath tub to centre and on parallel bath tubs 9 cm (3-1/2") from top to centre.

Overflow holes on parallel bath tubs shall be 4.4 cm (1-3/4") in diameter intended for 3.1 cm (1-1/4") overflows.

A grating shall be fixed in the overflow hole. A brass bend 5.7 cm (2-1/4") long shall be attached to the grating. The tail of which shall have threads 3.18 cm (1-1/4") for connection to outflow pipe.

23.2.5.10 TAPS, COCKS AND MUSLIM SHOWER

All the taps, cocks and muslim shower shall be of brass, gun metal or other equally suitable corrosion resisting alloy conforming to BS 1010 and shall be chrome plated. The nominal size specified shall be the nominal bore of the seating. The water area of the way throughout the body shall be not less than the area of a circle of diameter equal to the nominal size of tap/cock/muslim shower. Washers for cold water cocks shall be of specially selected leather, rubber asbestos composition or other equally suitable material.

Washers for hot water cocks shall be of good quality fibre, rubber – asbestos composition or other equally suitable material. Every tap/cock shall be tested, complete with its component parts, to a hydraulic pressure of at least 1.96 MPa (284.4 psi). During test it shall neither leak nor sweat. The connecting pipe of muslim shower shall be of C.P Chain or of make approved by the Engineer-in-Charge.

23.2.5.11 TOWEL RAIL, SOAP DISH, TUMBLER HOLDER AND

Tooth Brush Holder with Tooth Paste Dish

The towel rail shall be ¾ inches round or square C.P brass or stainless steel rod with end brackets and screws of similar material. Soap dish shall be straining type heavy duty glazed earthen ware, chromium plated stainless steel or plastic complete with screws. Tumbler holder shall be of glazed earthen ware, chromium plated, stainless steel or plastic complete with screws. Tooth brush holder with tooth paste dish shall be of glazed earthen ware, chromium plated stainless steel or plastic complete with screws etc.

23.2.5.12 ABLUTION TAP/SPRINKLER

Adjacent to the water closet, a water connection of ½ inch diameter for ablution will be either a C.P brass water tap or a water sprinkler with flexible pipe armoured with stainless steel strip.

23.2.5.13 GLASS SHELVES

Glass shelves may be provided below the mirror above the wash basin. The length of the shelf shall depend on the size of the mirror its width shall be 5 inches (130 mm) & thickness 6 mm and shall be held by 2 Nos. CP brackets. The shelf may be provided with CP railing.

23.2.6 INSTALLATION INSTRUCTIONS

23.2.6.1 GENERAL

i) The contractor shall be responsible for the safety of his work and shall replace any material and equipment that may be damaged or lost without any additional cost to the employer until the works are completed and taken over by the employer.

ii) All openings left in floor for passage of lines of soil, waste, vent etc shall be covered and protected.All open ends of pipes shall be properly plugged to prevent any foreign material from entering the pipe.

iii) Before erectionall pipes, valves, fittings etc. shall be thoroughly cleaned of oil, grease or other material.

All metal fixture trimmings shall be thoroughly covered with non-corrosive grease which shall be maintained until all work completed.

Upon the completion of the work, all fixtures and trimmings shall be thoroughly cleaned polished and left in first class condition.

iv) All pipes shall be properly installed as shown on the drawings and/or as directed by the Engineer-in-Charge and shall be as straight as possible forming right angles and parallel lines with the walls and other pipe lines as far as possible. The position, gradients alignment and inverts shall be 2% for pipes of 200 mm or larger dia or as shown on the drawings and/or as directed by the Engineer-in-Charge.

v) The arrangement, positions and connections of pipe fittings and appurtenances shall be as shown on the drawings. The Engineer-in-Charge reserves the right to change the location etc. Special precautions shall be taken for the installation of concealed pipes as shown on the drawings and/or as required. Should it be necessary to correct piping so installed the contractor shall be held liable for any damage caused to other works in the correction of piping.

vi) A minimum distance between different services shall be maintained as shown on the drawings and/or as approved by the Engineer-in-Charge. Pipes should be installed in such a manner that minimum distance is always maintained between the pipes and the walls, beams, columns etc as shown on the drawingsand/or as approved by the Engineer-in-Charge

vii) Waste-water outlet from each fixture or a battery of fixtures directly connected to the sewerage system shall be equipped with a water-seal trap.

viii) Each vent terminal shall extend to the outer air and terminate in cowl or wire mesh balloon and be so installed as to prevent thepossibilities of clogging and the return of foul air to the building. Vent and waste stacks should extend 300 mm above roof if not used by occupants and 2000 mm if used by occupants.

ix) When the roughing in is completed, the plumbing system shall be subjected to test prior to concealing the roughing-in, in order to ascertain that all threads and connections are gas and watertight.

x) Cast iron soil and drainage fittings for change in direction shall be used as follows:

- VERTICAL TO HORIZONTAL: short sweep or long-turn for diameter 75 mm and larger; long sweep or extra-long-turn for lessthan 75 mm dia.
- HORIZONTAL TO VERTICAL: quarter bend or short-turn.
- VENTING IN ANY DIRECTION: quarter bend or short-turn.

xi) All fittings with hubs shall be aligned so that the hub faces upstream.

xii) No drainage or vent piping shall be drilled or tapped.

xiii) No structural member shall be weakened or impaired by cutting notching or otherwise, except to the extent allowed by the Engineer-in-Charge.

xiv) All exterior openings provided for the passage of piping shall be properly sealed with snugly fitting collars of metal or other approved rat-proof material securely fastened into place.

xv) Joints at the roof around vent pipes shall be made watertight by the use of lead or other approved flashing material. Exterior wall openings shall be made watertight.

xvi) Bolts and nuts for wall hanging fixtures shall be of heavy construction steel to fully carry the weight that will be placed on the carrier by the fixture and users.

xvii) Where different sizes of pipes, or pipes and fittings are to be connected, the proper size reducers or reduced fittings shall be used between the two sizes. Bush fittings shall not be used.

xviii) Any fitting or connection, which has an enlargement, chamber or recess with a ledge, shoulder or reduction of pipe area that offers obstruction to flow through the drain is prohibited

xix) The vertical distance from the fixture outlet to the trap weir shall not exceed 600 mm.

xx) Each fixture trap shall have a water seal of not less than 50 mm and not more than 100 mm.

xxi) Full S, bell, crown vented traps and traps depending for their seal upon the action of moveable parts are prohibited. No fixture shallbe double trapped.

xxii) Where fixture comes in contact with wall and floors, the joint shall be watertight.

xxiii) Pipes in ground shall be laid on a firm bed for its entire length.

xxiv) Pipes in the plumbing system shall be installed without undue strains and stresses. Vertical piping shall be securely held to keep the pipe in alignment and carry the weight of the pipe and contents. Horizontal piping shall be supported to keep it in alignment and prevent sagging. Hangers and anchors shall be of metal of sufficient strength to maintain their proportional share of pipe alignments and prevent rattling. Hangers and anchors shall be securely attached to the building. The contractor shall be fully responsible for hangers and supports and shall obtain prior approval of design as to the shape, material, dimensions, spacing etc.

xxv) Pipes in concrete or masonry walls or footings shall be placed or installed in sleeves, which will permit access to the piping for repair or replacement. All holes/slots made in the walls, roofs, ceiling and floors for installation of pipes shall be properly made good and finished to original conditions to the satisfaction of the Engineer-in-Charge.

xxvi) The indirect waste pipes from food handling equipment, water cooler and dish washer etc shall so discharge that the air gap between the indirect waste and the building drainage system is at twice the effective diameter of the drain served.

23.2.6.2 INSTALLATION OF FIXTURES

i) Plumbing fixtures shall be installed in a manner to afford easy access for cleaning. The space between the fixture and the wall shall be closely fitted and painted so that there is no chance for dirt or vermin to collect.

ii) Where practical, all pipes from fixtures shall be run to the nearest wall.

iii) Where fixtures shall be rigidly supported by metal supporting members so that no strain is transmitted to the connections. Flush tanks and similar appurtenances shall be secured by approved non-corrosive screws or bolts.

iv) Fixtures shall be set level and in proper alignment with reference to adjacent walls. No water closet shall be set closer than 400 mm from its center to any side wall. No urinal shall be set closer than 300 mm from its center to any side wall or partition nor closer than1200 mm center to center. No wash basin shall be set closer than 100 mm to the side wall or partition nor closer than 600 mm center to center.

v) The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow.

vi) All cuttings and holes shall be made good.

23.2.6.3 LAYING OF SEWER PIPES

Sewer pipes shall be laid as per Clause 25.3 of Section 25 – Sewerage. The following conditions shall be taken care of particularly.

i) Each length of pipe between manholes shall be in straight line and true to the alignment, position, gradient and levels.

ii) Sewer laying shall proceed in all uphill direction, laying spigot end into already laid bell end.

Reverse laying shall not be allowed and any such work so carried shall be rejected.

iii) Each length of sewer pipe shall be checked for cracks and defects before placing in the line. Each pipe shall be placed carefully to the requisite line and grade and jointed perfectly with connecting pipes.

iv) Pipes shall be cut only where directed by the Engineer-in-Charge in order to complete a length between manholes. All pipes shall be cut neatly and at right angles to the axis of the pipe and the cut of the pipe' shall be smooth and truly circular.

v) The top of bedding material shall be shaped to fit the pipe barrel, with pits left for the bells. When laying is not in progress, the open end shall be closed with a tapered wooden plug to keep out foreign matter.

23.2.6.4 INSTALLATION OF TRAPS, DRAINS AND CLEAN OUTS

i. Floor traps shall have openings for connection of inlet pipes from fixtures. The invert level of inlet pipes shall be at least 25 mm above the trap weir level.

ii. Floor traps shall be well set in position so that there is no leakage at the joint between trap and the floor.

The requirements specified above for floor traps are equally applicable for floor drains except that no water seal is required and it shall be of the specified size.

iii. Roof drain shall have strainers extending at least 10mm above the roof surface immediately adjacent to them when installed on flat part. Bottom of strainer shall be flush with the roof surface when installed on vertical part. Strainer shall have an available inlet area, above roof level, of not less than 1-1/2” times the area of the down-pipe to which the drain is connected. The connection between roof and roof drain shall be made watering by use of proper flashing material.

iv. Clean outs shall be turned up through floors by long sweep fittings, wherever the space so permits. Top finish of clean outs shall be flush with the floor when located in open area. They may not be flush with the floor when installed near wall and levels are not deep enough to make them flush.

Clean out shall be so installed that there is a clearance of at least 300 mm for pipe less than 75 mm diameter and at least 450 mm for pipes of 75 mm and larger diameter for the purpose of rodding. Permanent finishing material shall not be placed over clean out plug.

Clean out in open areas shall be placed in concrete boxes with access cover of heavy duty 300 x 300 mm size. The access cover and frame shall be cast iron.

Clean out near wall shall be embedded in concrete, and excepting cast iron pipe used with cleanout all other work of ferrule, plug, concrete work, frame and cover etc. shall be included under clean out item.

v. Gulleys shall be fixed on concrete foundation 300 mm square and not less than 150 mm thick. A brick curb in cement mortar about 75 mm high from the ground level shall be built round top edge of gulley in such a manner that surface water shall not be allowed to enter the gulley. It shall be used for waste water only before entering into the manhole.

23.2.6.5 INSTALLATION OF SOIL, WASTE AND VENT PIPE

i) All soil waste and vent pipes and fittings shall be installed plumb and true to lines and grades shown on the drawings or as directly by the Engineer-in-Charge.

ii) Where installed vertically, pipes shall be supported from wall by metal clamps of approved type and make at each floor just below the Horizontal branch pipe connection and at intermediate levels.

The spacing of vertical and horizontal pipe supports shall be 1.5 mm to 3 mm respectively and dia of steel support shall be 13 mm.

iii) Pipes passing through walls, floors or roof shall be placed in metal sleeves of approved design. The annular space between thesleeve and pipe shall be at least 15 mm. The space shall be packed with

approved filler (Oakum or Hemp) and shall be sealed at both ends with approved sealant (Bituminous material ormastic).

23.2.7 MANHOLES

i) The type, size and shape of the manholes shall be as shown in the drawings, invert and other shall be directed by the Engineer-in-Charge.

ii) The manhole shall be constructed according to the provision of Clause 25.4 Section 25 – Sewerage.

23.3 WATER & GAS UTILITY SERVICES

23.3.1 SCOPE

The work for piped utility services in buildings shall include furnishing of all labour, plant, equipment, materials and services and supplying, installing, testing and commissioning of cold and hot water supply and gas supply systems in the buildings as shown in the drawings, required as per specifications and or directed by the Engineer-in-Charge.

The gas pipeline and fittings shall be carried out strictly complying with the regulations of Gas Authority. Where required, the Contractor shall be responsible for their acceptance certificate for gas connection.

23.3.2 SUBMITTALS

The Contractor shall submit samples of fittings, fixtures and accessories to be incorporated into the works.

23.3.3 G.I. PIPES

i) The galvanized iron pipes shall conform to BS specifications No. 1387 for “Steel tubes and Tubulars, suitable for screwing to BS-21 pipe threads”.

ii) All screwed tubes and sockets shall have threads in accordance with BS-21. In order to prevent damage to the leading thread, the end of the sockets shall be chamfered internally.

iii) A complete and uniform adherent coating of zinc shall be provided for galvanized iron pipes.

iv) Every tube shall be tested at the manufacturer's works to a hydraulic test pressure of 5 MPa and shall be maintained at the test pressure sufficiently long for proof and inspection.

v) The threads of all tubes shall be effectively covered with good quality grease or other suitable compound, and each tube above 50 mm nominal bore shall have a protecting ring affixed to the un-socket screwed ends.

23.3.4 FITTINGS AND SPECIALS

23.3.4.1 G.I FITTINGS

i) Malleable Iron Galvanized Fittings (i.e. coupling, elbows, tees etc.) for G.I pipes of diameter lower than 75 mm shall conform to BS-143/BS-1740 and shall be at least same thickness and quality as G.I. pipe.

ii) Cast Iron Threaded Flanges for joining G.I pipe of dia 75 mm and above shall conform to BS-4504.

iii) Cast Iron Flanged Fittings for G.I. pipe 75 mm and above shall conform to BS-2035, Class 8 and a working pressure 122 meters of water.

23.3.4.2 VALVES

- Sluice Valve shall have (i) cast iron body; (ii) gunmetal spindle; (iii) cast iron gate with gunmetal sealing wings for size 75 mm and above; (iv) solid gunmetal gate for size lower than 75 mm and (v) shall pass a test pressure of 1.5 MPa or equivalent to NP-16 (16 kgs/sq. cm).
- Peet Valve threaded/flanged shall be of copper alloy and shall pass a test pressure of 1.5 MPa or equivalent to NP-16.

- Cast Iron Check Valves size 75 mm and above shall have cast iron body, gun- metal door and a test pressure of 1.5 MPa or equivalent to NP-16 (16 kgs/sq. cm).
- C.I. Globe Valves size 75 mm and above shall be similar to Cast Iron Sluice Valves.
- Copper Alloy Globe Valve size lower than 75 mm threaded shall pass a test pressure of 1.5 MPa or equivalent to NP-16(16 kgs/sq. cm).
- The working pressure on valves shall not be less than the working pressure of the system on which they are installed, but in no case it shall be less than NP-6 (6kgs/sq.cm) or 0.6 MPa.\

23.3.4.3 FIRE HYDRANTS

Fire hydrants shall confirm to BS-750 with a body of cast iron and spindle of manganese-bronze. The direction of closing shall be by clockwise rotation and the outlet shall have screwed joints for accommodating hose connections.

23.3.4.4 PIPE STRAINERS

The strainer flange shall confirm to the specification of BS-4504. The pipe strainer shall have cast iron or bronze bodies suitable to withstand the working pressure, removable screens of copper, brass, nickel or stainless steel, flanged bodies with taping for size 37mm above and of such a design as to allow blowing out of accumulated dirt and easy removal and replacement of straining screen without disconnecting the main piping.

23.3.4.5 PUDDLE FLANGE

Puddle flanges of specified dia. Shall be provided where the pipe crosses RCC wall, retaining water or soil. For metal pipes a 10mm thick MS square plate of size shown on plan, cut with a hole equal to external dia. Of pipe, shall be welded with the pipe with both ends of G.I pipe provided with flanges, and the whole assembly shall hot-dipped galvanized before being cast in RCC wall.

23.3.4.6 FLOAT VALVE, LEVEL CONTROLLER, FLOW SWITCH

Float Valves, Level Controllers and Flow Switches shall conform to the specimens submitted by the Contractor and approved by the Engineer-in-Charge and shall be the best quality available locally.

23.3.5 FIXTURES AND EQUIPMENTS

23.3.5.1 TAPS AND STOP COCKS

All bib, pillar and stop cocks and mixers shall be of high quality screw down, made of CP brass and shall comply with BS-1010 or any other requirements as specified. Spindles, glands, crutches, washer plates and nuts shall be of brass or manganese. Taps shall have crutches orcap-stab leads as required by the Engineer-in-Charge. The waterway shall not be less than the area of a circle equal to the nominal size of the tap. Working pressure of taps, stocks shall not be less than pressure in the system but not less than 0.6 MPa or NP-6 in any case.

23.3.5.2 WATER HEATER

Electric and gas water heater shall be of specified capacity and of storage type with adjustable thermostatic range of 40^0C to 80^0C. It shall be of approved manufacturer. All controls are to be automatic.

It shall automatically shut off (electric) or come to pilot (gas) when temperature of hot water reaches 80^0C and restart when temperature drops below 40^0C.

The vessel of water heater shall be constructed of steel with welded joints. The vessel shall be lined with copper on the inside and painted with baked stove enamel on the outside. The annular space between the copper and steel cylinders shall be filled with insulation material of thermal conductivity not more than 0.045 Watts/Sq.m^{0}C. The heater vessel shall be rated for a working pressure of 0.6 MPa and test pressure of 1 MPa.

In electric water heater the electric heating elements shall be withdraw-able, mineral insulated, metal clad copper rods. In gas water heater the gas supply shall be controlled by a regulator allowing at least 4 volumes of gas supply including arrangements for a pilot.

The capacity of the heating equipment shall be sufficient to raise the temperature of water from +10 ^{0}C to + 70 ^{0}C in not more than one hour.

Water Heater shall be provided with the following accessories and control:

- Thermostat
- Pressure Relief Valve
- Thermometer
- Pressure Gauge
- Drain Valve
- In electric water heaters Automatic High Temperature Cut-off
- In Gas Water Heaters, a Regulator & a Pilot.

23.3.6 LAYING OF PIPES IN TRENCHES

23.3.6.1 EXCAVATION OF TRENCHES AND REFILLING

The trenches shall be set out to suit alignment of the pipe lines. The trenches shall be carefully trimmed on sides and bottom so that pipe lines when laid shall rest on the firm bed throughout the length. Shallow joint holes shall be left for the joints, where necessary. Where pipe line is to be laid in plains the depth of cover, i.e. the normal distance from ground level to the top of the pipe be kept at about 800 mm and shall not be less than 750 mm except due to special reasons where the Engineer-in-Charge directs in writing to the contrary.

Backfilling of trenches shall be carried out in accordance with the provisions of Sub-Section 3.8.4(ii).

23.3.6.2 FLANGES

Flanged joints shall be provided at intervals of not more than 150 m or as directed by the Engineer-in-Charge. Each flanged joint shall be made by inserting an accurately cut disc of tough multiply rubber insertion about 3 mm thick of approved quality between the flanges. The bolt holes in the rubber insert as well as in the flanges shall be drilled to template. The bolts and nuts for all flanged joints shall conform to British Standard 10 and shall be of mild steel, hexagonal, round and diagonal. The bolts shall be pulled up gradually and evenly by the use of standard spanners of the approved make, so as to ensure a perfect joint.

23.3.6.3 BENDS, TEES AND OTHER SPECIALS

Bends, tees, reducers and other specials shall be provided and jointed at points as shown on the drawings or as directed by the Engineer-in-Charge. All changes in direction shall be effected by means of bends wherever practicable and the use of elbows shall be restricted only to cases where there is no room for bends. In such cases only round elbows will be allowed.

23.3.7 PIPES ANCHORED TO WALLS OR CEILINGS

Suitable and substantial hangers or fixings shall be provided for all horizontal and vertical lines of approved types and special vibration eliminating and flexible hangers shall be provided for all pipe work affected by moving machinery or expansion and contraction including building expansion joints.

Hot and cold horizontal piping shall be supported in accordance with the schedule given as under:

Pipe dia. in mm.	Maximum spacing of Fixings in meters		Rod size for Hangers dia. in mm.
	In Vertical run	In Horizontal run	
G.I and Flexible			
15 – 25	3.0	2.5	10
31 – 50	3.6	3.0	10
62 – 75	4.5	3.6	13
100 – 150	4.5	4.0	13
Cast Iron			
All sizes	3.0	1.5	13

One fixing shall be provided for each fitting.

iii) Hanger shall be supported from approved concrete inserts in concrete slabs for all pipes 50 mm and above. Insert shall be as approved by the Engineer-in-Charge and shall have space for nuts of all size. All inserts shall have a reinforcing rod of specified diameter to be installed through slot provided for this purpose, and the Contractor shall be responsible for its being in place when concrete is poured.

If any pipe has to be hung where no inserts have been provided, the Contractor shall drill holes from below through concrete slabs and provide rods and hangers attached to not less than two approved type expansion shield each one capable of taking full maximum load. The rods and complete hangers shall be of adequate size to support the load, which they carry.

iv) Approved roller supports, floor stands, wall brackets, masonry, etc. for all lines running above the floors, and which can be properly supported by the walls shall be provided. Pipe lines near walls may also be hung by hangers, carried from approved wall bracket at a higher level than the pipe.

v) Pipes shall not be hung from the pipes of other trades or other pipes except for small water branches in toilet where no other practical means support can be found, in which case specific approval for the installation shall be obtained from the Engineer- in-Charge. Hangers shall not be fastened by means of vertical expansion bolts. Hanger shall be of heavy construction suitable for the size of pipe to be supported. All materials, except roller shall be a malleable iron or steel. Rollers shall be cast iron. Hanger shall be swivel split ring, wrought pipe clamp, or adjustable type or as approved.

vi) Special cares shall be taken in the placing of hangers at the top, bottom and in offsets of hot water risers so as to allow forexpansion of the vertical piping. Vertical risers shall be securely supported from the building construction by means of pipe clamps at every floor.

vii) For cast iron hub and spigot pipe and fittings hangers shall be provided on not more than 1.5 meters centers or a minimum of one hanger for each length of pipe. Where excessive number of fittings are installed between hangers, the Contractor shall provide additional hangers or reinforcing as required to the satisfaction of the Engineer-in-Charge. Fittings shall be securely anchored to the building construction at changes of direction to eliminate all horizontal movement. The Contractor shall furnish and install steel channels and angles for piping support. These supports will be required where there is not roof slab or where the building structure is not directly usable for pipe support.

23.3.8 PIPE SLEEVES

Pipe line laid through any wall, floor, ceiling or roof may be arranged to pass through proper hot dipped galvanized steeve pipes of ample diameter embedded therein to enable the pipe lines to pass easily and freely. The length of every such sleeve pipe shall be of the full width or thickness of the wall and in the case of roof, ceiling or floor, shall be at least 40 mm longer than the thickness thereof and shall project to that extent abovethe upper surface thereof unless the Engineer-in-Charge orders to

the contrary. Inside diameter of sleeves shall be at least 25 mm greater than the outside diameter of pipe passing through it. Space between pipe and sleeve shall be lead caulked and made water tight wherever required.

23.3.9 HOT WATER SYSTEM

All Hot Water supply piping shall be insulated as specified herein. Prior to insulation the pipes shall be thoroughly cleaned of all rust, scales and other containments by wire brushing, sand blasting etc and by using aromatic solvents complying with ASTM D-3734 to remove oil, grease etc. Subsequent to the cleaning operation the pipe, shall be coated with two coats of approved, temperature resistant, anti-corrosion paint. Insulation shall be applied to the painted pipe only after hydraulic testing as specified and shall be of a thickness shown as under:-

Nominal pipe dia mm	Insulation thickness (mm)
15 – 20	20
25 – 40	25
50 – 100	32

The insulation, covering and jacket canvas shall be suitably fixed and an approved temperature resistant adhesive shall be used. The circumferential and longitudinal joints for the kraft covering and canvas jacket shall be lapped at least 40 mm.

Further reinforcement shall be provided by the use of 20 mm wide soft aluminum bands, generally spaced at 450 mm and on either sides of elbows, tees, valves and other piping specialties. All butt joints shall be sealed with self -adhesive type of approved quality adhesive tape.

All valves, fittings and other specials shall be insulated with plain glass fibre wool blanket of thickness equal to the adjoining pipe insulation and shall be covered by kraft paper and canvas jacketing as specified earlier. Two coats moisture proof approved paint shall also be applied. The adjoining insulation near these fittings shall be trimmed into suitable sections to fit closely around the valves, flanges and fittings. All trimmed sections shall be secured by wrapping of approved type of self -adhesive tape to form a complete waterproof seal. All work shall be done in a neat and workmanlike manner, and must reflect recommended practice.

23.3.10 EMBEDDED PIPELINES

Chassis shall be left in concrete or masonry walls where pipe lines are to be embedded. The cavity shall be deep enough so that after installation of pipes sufficient space is available for cover. Pipes shall be laid before plastering walls or laying of concrete floors so that no joint or cover is visible. Hot and cold lines shall be laid in separate chassis or cavities and wherever specified shall be painted with two coats of bitumen and wrapped in hessian cloth or polythene sheet.

23.3.11 INSTALLATION OF GAS PIPES

All pipes from gas regulator to the consumption point shall be laid as G.I pipes for water supply. Two coats of hot bitumen shall be given all around to the entire length of pipe and hessian cloth wrapped around it. There shall be no pressure on the joints to obviate the possibility of leakage later on.

23.3.12 PAINTING OF EXPOSED PIPES

All exposed pipes for cold, hot and mixed water and gas supply shall be painted if required in different colours as specified. One coat of red oxide primer and two coats of synthetic paint shall- be given to all M.S hangers, brackets and pipes.

23.3.13 DISMANTLING OF GI PIPES SYSTEM

Whenever dismantling of GI pipe system is required all the joints shall be carefully opened and the components such as pipes, sockets, specials, valves & fittings and holder bats etc. shall be carefully removed, cleaned, all the usable materials shall be sorted out and stacked properly for subsequent use.

23.3.14 INSTALLATION OF FIXTURES

23.3.14.1 TAPS, STOP COCKS AND VALVES

All taps, stop cocks and valves shall be eased and greased before fixing. The washers and gland packing shall be equally suitable for hot & cold water.

23.3.14.2 CHAMBERS FOR STOP COCKS AND VALVES

Chambers for stop cocks and valves shall be of brick mortar and plaster as specified and shown on drawings. The work shall be carried with applicable provisions of Section 11, Brickwork & Section 5, Plain and Reinforced Concrete.

23.3.14.3 GAS ROOM HEATERS & GAS LAMPS

The gas room heaters & gas lamps shall be of type and make as specified and shall be provided and installed as approved by the Engineer-in-Charge.

23.4 MEASUREMENT AND PAYMENT

23.4.1 COMPOSITE RATE

The measurement and payment for the items of the work of Plumbing, Sanitary Installations & Gas Fittings hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

23.4.2 LABOUR RATE

The measurement and payment for the items of the work of Plumbing, Sanitary Installations & Gas Fittings hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

23.4.3 QUANTIFICATION

The unit of measurement shall be measured as mentioned below in accordance with corresponding CSR items.

1. For surface area items, the quantity of work shall be measured by surface area. The unit of measurement shall be Square meter or Square foot. Following item of CSR are measured according to this criteria;
   Item No.: 23-15
2. For linear items, the quantity of work shall be measured linearly along centre line of structure. The unit of measurement shall be running meter or running foot. Following items of CSR are measured according to this criteria;
   Item No.: 23-45 and 23-52
3. The following Item of CSR shall be measured as Weight units i.e. Kilogram or Pound
   Item No.: 23-46
4. The following items shall be measured as Each

Item No.: 23-1 to 23-14, 23-16 to 23-44, 23-47 to 23-51 and 23-53 to 23-66

5. The following item shall be measured as %age Increase
   Item No.: 23-68
6. The following items shall be measured Per Point.
   Item No.: 23-67