

PROPOSED ADDITIONS AND ALTERATIONS WORKS FOR OFFICE OF FOOTBALL ASSOCIATION OF SINGAPORE @ 100 TYRWHITT ROAD, JALAN BESAR STADIUM, SINGAPORE 207542

TECHNICAL SPECIFICATION OF MECHANICAL & ELECTRICAL WORKS

1.0 PLUMBING & SANITARY INSTALLATION

1.1 General

This section sets out the system requirements and standards of workmanship, equipment and materials of the Plumbing and Sanitary Installation for this project.

The Contractor shall allow arranging with Public Utilities Board (PUB) Water Department for an incoming water supply including all related charges. A route for the incoming main shall be established together with a mutually convenient position for the incoming water meter by liaison between the Contractor and PUB.

1.2 Underground Drainage System

a. Installation

Excavation

All excavation shall be carried out as may be necessary for the construction of the works. Excavation for pipe trenches shall not be less than 600 mm wider than the diameter of the pipes and the ground under beds shall be carefully graded. Proper necessary shoring, planking, strutting, or sheet piling strutting shall be constructed and maintained to ensure that the trench will not collapse.

When excavating trenches in existing carriageways, the paving blocks that have already been laid or constructed shall be removed by the Contractor and stacked aside and kept separate from the general trench excavated material for re-use in reinstatement. All existing and/or constructed ground surfaces disturbed shall be reinstated.

Surplus excavation soil shall be removed from the site.

All excavation shall be kept free from water at all times by pumping or temporary drainage. In the event of the excavations being made deeper than necessary they shall be filled to the proper level with lean concrete.

The Contractor shall be completely responsible for the safety of all excavations, trenches, pits, etc. from collapse and for the safety of any surrounding structures which may become endangered by the works and he shall ensure that all safety measures necessary shall apply to any works during any excavations.

The Architect shall have the right to order excavation and construction work to be carried out in such lengths and in such sections of the works as will, in his opinion, minimize the danger of such open excavations affecting the stability of any nearby structures or ground. There shall be no claim for any extra payment on this account.

Trenches shall be left open for the inspection of the Architect and the Local Authority's inspector and shall not be covered up until the drains have been properly tested and approved by the Architect or ENV.

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b. Backfilling

All concrete shall be thoroughly set before refilling is commenced. In refilling the excavations, only selected hard dry material free from lumps exceeding 75 mm in size and from stones shall be used in the initial refilling and shall be carefully placed next to the permanent work and well packed and well rammed in layers of 150 mm. The remainder of the excavations shall be filled in with the best and most suitable portions of the excavated material, in layers of not more than 300 mm deep each layer shall be thoroughly rammed before the next layer is placed. Surplus soil shall be piled on top of the filling to the extent of possible subsidence. All refilled trenches shall be maintained to the satisfaction of the Architect.

c. Pipeline Setting Out

Excavation for trenches shall be to straight lines and gradients required for the pipes and beds as specified. The trench bottom shall be of sufficient width to allow adequate working space for pipe layers and jointers but beyond these requirements, the width must be kept to a minimum.

Before any work commences, the pipe trench shall be set out.

d. Concreting Works

Cement shall be of the approved type and comply with BS No. 12. It shall be fresh when delivered. Cement of different brands shall not be mixed with one another. Sand or fine aggregate shall be cleaned, graded natural sand. Sand with coagulated lumps and having a portion of silt exceeding 10% shall be rejected. Course aggregate shall be clean, crushed stone and shall be free from dust, clay or other detrious materials.

Water shall be that obtained from the supply mains and not from excavation or drains.

Reinforcement used shall be hard drawn steel wire BRC fabric mesh complying with BS 1221 and BS 785 for mild steel rods. BRC mesh and steel bars shall be free from dust or mill scale.

Concrete beds shall be 150 mm thick and shall have at least 150 mm width at each side of the external diameter of the pipe barrels when laid. Unless otherwise specified, the concrete shall be 1:2:4. For pipe to be haunched, the concrete shall be carried up for the full width of the bed to the level of the horizontal diameter of the pipe and shall be splayed from this level and carried upwards to meet the pipe barrel tangentially.

All drain lines passing under buildings and driveways are to be surrounded with concrete which shall be carried up from the bed in a square section with a minimum of 150 mm thickness over the barrel of the pipes. Traps and gullies shall be properly bedded on and surround with concrete.

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e. Pipe Gradient

Pipe gradient for all sanitary drain lines and waste pipes shall be as shown on the drawings or otherwise indicated below:

<u>Pipe Diameter</u>	<u>Gradient</u>
100 mm	1 in 20 to 1 in 60
150 mm	1 in 30 to 1 in 90
225 mm	1 in 40 to 1 in 150
300 mm and above	1 in 150 to 1 in 250

f. Pipe Laying

The pipe shall be laid singly with the whole length of the barrel of each pipe on a solid concrete bed. No pipes shall be joined together before having been laid.

Flexible jointed pipes shall be laid completely embedded in granular material to a thickness of at least 100 mm all round unless soil conditions and loaders indicate otherwise. Granular material for bedding shall be of such ranging from 3 mm to 12 mm or of a free running coarse sand.

Socket shall face up the gradient. The spigot of each pipe shall be well driven home into the socket of the pipe previously laid and the joint completed as specified and the bore of the pipe cleared of any obstruction before the next pipe is laid. Care shall be taken that there is no irregularity in the invert of the joints.

The level of each pipe shall be tested by a straight edge laid in the invert of the pipe previously laid and in the nearest level peg. If the bottom of the trench has been taken too low, it shall be made up with concrete or cement mortar or other approved granular material.

Where it is required to shorten any pipe it shall be cut off square and cleanly, and cast iron and ductile iron pipes shall be cut only with approved pipe-cutting machines. In the event of any pipe being fractured from any cause whatsoever after having been to all appearances properly laid, the Contractor in every instance shall replace such defective pipe to the satisfaction of the Architect.

Where laid in hard core or fill cast iron and ductile iron pipes subjected to a superimposed load shall be supported from natural ground level throughout their lengths by walls and hunching. Where laid in hard core or fill and not subjected to a superimposed load, or where laid above ground, cast iron and ductile iron pipes shall be supported on piers behind the socket of the pipe and at intervals of not more than 2700 mm.

The soil conditions shall be investigated before laying of pipework. In soft or yielding ground, piles and a bed or reinforced concrete and embedment of pipework in concrete to a thickness of at least 150 mm all round shall be provided as necessary.

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Pipes of 300 mm/225 mm diameter where shown laid through or under walls, shall be protected by means of sleeves in such a manner that the weight of the wall shall not bear on the pipes.

g. Tumbling Bays and Backdrops

Where required or specified, tumbling bays or backdrops are to be constructed in accordance with the details of the ENV standard drawings.

When branch drain pipe is connected directly into an inspection chamber more than 1.5 m deep, then a tumbling bay or backdrop shall be provided.

Special reversed spigot and socket junctions or backdrop junctions shall be used in the junction between two lines of pipes.

The tumbling bay pipes shall be laid on a reinforced concrete foundation of concrete as specified and completely encased in concrete. Backdrop pipes shall be completely encased in 150 mm concrete surround.

h. Inspection Chambers

The maximum distance between inspection chambers shall be as shown on the drawing and shall not exceed 50 meters. Inspection chambers shall be of concrete construction. It shall have minimum internal dimensions of 900 mm in length and 700 mm in width. The size shall be increased accordingly depending on the number of branch drains to be connected and the depth of such inspection chambers.

Only in case where the inspection chamber cannot be constructed in concrete due to site conditions, it shall be constructed in bricks and be 225 mm thick constructed on cement mortar beds. Vertical joints shall be completely filled with mortar as the bricks are laid. Joints shall be flushed cut as the work proceeds.

Inspection chambers shall be rendered internally and externally with cement and sand (1:3) in two coats to a total thickness of 16 mm, trowelled smooth. On firm ground, the inspection chamber shall be constructed on a reinforced concrete base at least 150 mm thick and such base shall extend at least 150 mm beyond the external walls of the inspection chambers.

On soft or yielding ground, the inspection chamber shall be constructed on piles and a base of reinforced concrete.

The depth of the main channels shall not be less than the diameter of the outgoing pipe. Main channel inverts for pipes up to and including 225 mm diameter shall be vitrified clay channels. Main channel inverts for pipes over 225 mm diameter shall be formed in concrete trowelled smooth.

Branch bends up to and including 150 mm diameter shall be vitrified clay to 3/4 section curved in the direction of flow and set to deliver over the main channel invert. Branch bends over 150 mm diameter shall be curved in the direction of flow and shall be formed in concrete trowelled smooth.

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Spaces between branch bends shall be completely filled with concrete and the faces above the main and branch channel inverts shall be trowelled smooth. Benching shall be formed in concrete trowelled smooth and shall open towards the main channel at a slope of 1 in 6. Pipes passing through inspection chamber walls shall be solidly built in and the walls made watertight throughout.

Precast concrete sections shall be used where the inspection chamber exceeds 2.5 m deep and is located in soil. Precast inspection chamber ring shall be of proprietary make, 1050 mm internal diameter and to be installed to details as shown on the drawings.

In general, inspection chambers shall be provided with covers similar to Gatic, and roofed over with a reinforced concrete slab not less than 150 mm thick and provided with an opening fitted with an air-tight frame and cover. In areas where architectural floor finishes are required, the cover shall incorporate a frame and recess to accommodate the specified finishes. Minimum recess shall be 50 mm.

Covers and frames shall be of the types approved by the local Sewerage Department. They shall be fixed in the positions shown. All frames shall be solidly bedded on cement mortar so that the covers when in position are fair and even with the adjacent surfaces. Heavy duty cast iron frames and covers shall be used in every driveway and car park or in area subject to heavy loading. Medium duty covers shall be used in all other external inspection chamber, sump, etc.

Recessed pattern covers shall be provided and filled and surfaced with materials to match surrounds.

One set of lifting keys for each type of manhole cover shall be provided.

Iron steps shall conform to BS 1247. Round bar corner pattern steps shall be used in brick inspection chambers and shall be built in at 300 mm vertical interval as shown. Iron steps shall be used in precast concrete sections and unless otherwise directed they shall be provided and fixed in the concrete inspection chamber components by the Component Manufacturer before delivery, in accordance with BS 556.

i. Concrete Sumps

Unless otherwise shown on drawings, concrete sumps shall have minimum internal dimension of 900 mm in length and 700 mm in width.

Concrete sumps shall be rendered internally and externally smooth with cement and sand (1:3) minimum 50 mm thick. Concrete screed shall be rendered smooth towards the outlet at the base of the concrete sump and it shall be constructed on a reinforced concrete base at least 150 mm thick and such base shall extend at least 150 mm beyond the external walls of the concrete sump.

Where located in soil, concrete sumps shall be built of 115 mm thick engineering brick rendered internally and externally smooth with cement mortar. Pipes where built into walls shall be 25 mm above the base of the sump at inlet point and always flush with the base of the sump at outlet point. It shall be solidly built in and the walls made watertight throughout.

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Concrete sump frames and covers shall be the same as for the Inspection Chamber.

1.3 Internal Sanitary System

a. General

A complete sanitary and drainage piping system shall be supplied and installed in accordance with the drawings, the latest requirements of the Sewerage Department, Ministry of Environment and the requirements described herein.

All materials such as pipes and fittings, floor traps, jointing materials and components used in the work for sanitary plumbing installation shall be of the type, size, brand, quality and workmanship approved by the Sewerage Department.

The Licensed Plumber shall be solely responsible for the satisfaction and approval of the Sewerage Department until acceptance or handing over of the whole drainage system.

Stainless steel (SS 304) drain trays shall be provided to the underside of all sanitary, soil, waste and vent pipes which are directly above kitchen, dining and any food preparation areas.

Survey and submit as-constructed invert levels, gradient of pipeline, levels at the top of manholes/inspection chambers and horizontal distances between the manholes/inspection chambers.

b. Piping Installation

All pipework shall be fixed at least 50 mm away from the finished surface of the supporting structure. All fixing, hangers, holder bats, brackets, etc., shall be of galvanised steel. Vertical pipes shall be parallel to walls or column lines and shall be straight and plumb. Horizontal pipes shall be graded in the direction of flow as required. Fixings shall be cast in the building structure. If this is not practicable they shall be secured to the structure by means of power driven bolts. Cement grouting or wood fixings shall not be permitted.

Soil waste or vent pipes shall be clamped or fixed at 1.8 m centres split ring or clevis type hangers and clamps. Where applicable, clamps shall be tight against the pipe collar. Where it is necessary to avoid sound transmission, a PVC insert shall be provided between the fixing and the pipe.

Unplasticised PVC pipes not chased into floors or walls shall be fixed with clamps at not more than 1.8 m centres for vertical runs and 1.2 m centres for horizontal runs; or any other spacing recommended by the pipe supplier.

The bend at the foot of the discharge stack connecting to the branch drain line shall be a duck foot bend of large radius and shall be encased in 150 mm thick concrete.

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c. Vent Pipe and Stack

When more than one trap is connected to a discharge pipe or stack, each trap shall be provided with a vent pipe of not less than 50 mm in diameter.

Each vent pipe shall be constructed upwards individually or be connected to a main vent stack. The top end of the vent pipe or main vent stack shall either terminate as high as the discharge stack or connect to the discharge stack at a point not less than 150 mm above the top of the highest soil sanitary appliance or floor trap.

The lower end of each vent stack shall be connected to the discharge stack at a point not less than 225 mm and not more than 750 mm below the entry of the lowest connection to the discharge stack.

The low end of all vertical lines of vent pipes shall be connected full size at not less than 45 degree angle to the horizontal. All offsets shall be at a grade of not less than 45 degree angle to the horizontal.

Waste pipes need not be vented except where the pipe length exceeds 2 m inclined length and/or 5.5 m in vertical length provided that there is only one fixture connected to the waste pipe. Where there is more than one fixture or where the water seal is reduced, a vent pipe shall be supplied to the fixture or traps.

d. Termination of Discharge, Stack and Vent Stacks

The top end of each discharge or vent stack shall project not less than 450 mm above the eaves of a sloping roof or 150 mm above a flat roof without a parapet, or in the case of a flat roof with a parapet to the height of parapet above the roof. If the roof is used for any purpose other than as a covering to the building, the discharge or vent stack shall be extended at least 2.5 m above the roof level. Proper lead over-flashing has been completed.

The top end of a discharge or vent stack above the roof shall be at least 3 m away from any window or opening of adjoining buildings in the horizontal direction.

The top end of a discharge or vent stack above the roof shall be fitted with galvanised wire dome gratings on to the spigot top-most end of the pipes.

Pipes that protrude through walls, floors or roofs shall be made water-tight and details of such shall be approved by the Architect.

e. Cleaning Eyes and Inspection Openings

Inspection and cleaning eyes shall be provided on all soil, waste or soil and waste pipes so as to provide access for the proper inspection and cleaning of the entire length of the pipe. In all cases where the vertical stack of soil or soil and waste pipe extends 1.2 m or more above the ground level, an inspection opening of minimum 450mm by 450mm fitted with a cover shall be provided near the foot of the stack.

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f. Pipe Gradient

Pipe gradient for all horizontal sanitary plumbing pipings shall be as shown on the drawings or otherwise as indicated below:

<u>Pipe Diameter</u>	<u>Gradient</u>
32 mm to 80 mm	1:40
100 mm	1:60
150 mm	1:80
200 and above	1:100

All vent pipes shall have a minimum gradient of 1:100.

g. Pipe Size

Pipe sizes for all horizontal sanitary and waste piping shall be as shown on drawings or otherwise as indicated below:

<u>Connection</u>	<u>Pipe Size</u>
Floor drain to floor drain	75 mm (WC Compartment) 75 mm (Shower)
Floor drain to floor trap	75 mm (WC Compartment) 75 mm (Shower)
Planter to discharge pipe	75 mm (15 m maximum) 100 mm (30 m maximum) 150 mm (over 30 m)

h. Traps

All inlets into a discharge pipe or discharge stack shall be properly trapped to prevent the entry of foul air from the drainage system into the building. Traps for soil sanitary appliances and floor traps shall have a water seal of not less than 50 mm. Traps with outlets of less than 75 mm diameter shall have a water seal of no less than 75 mm.

All traps shall be accessible and so designed as to facilitate cleaning.

Floor traps shall be cast iron of internal dimensions 150 mm x 75 mm outgoing pipes complete with an MOE approved 150 mm circular stainless steel grating with hinged cover and hopper inlet connection. The traps shall be installed at a level to enable to the drainage system with 75 mm diameter outlet complete with inspection eye. Any riser to a floor trap shall be of the same size as the opening of the trap and the height of a riser to any floor trap shall not exceed 600 mm from the top of the grating to the bottom of the trap.

All gully traps shall be of internal dimensions 150 mm x 100 mm outgoing pipes and shall be of heavy duty cast iron free from sand holes and cracks and complete with cast iron removable grating.

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i. Grating and Cover for Floor Trap and Floor Waste

The grating and cover shall be constructed of stainless steel or bronze.

The grating and cover shall be of an approved design so as to enable them to be bolted down to the frame or otherwise secured to deter the unwarranted opening of the grating or cover and hence the discharge of garbage or other solid waste into the sewerage system.

The grating or cover shall be installed and located such that they blend in with the surrounding ground levels, do not pose a hazard in causing trip and easily accessible for maintenance, etc.

j. Installation of Sanitary Appliances

General

This section specifies the installation of sanitary appliances.

This Contractor shall take delivery from designated stores within the site, unpack, check, repack, store, install, make all connections to all sanitary appliances including water closets, urinals, flush valves/auto sensing flush valves, waste, sanitary appliances, plumbing fittings and the like including test and commission of the complete sanitary system.

After installation, the Contractor shall take every necessary precautions to protect the sanitary appliances to prevent it from damage until it is handed over to the Employer. The sanitary appliances are supplied under a separate supply contract.

All necessary connectors, adaptors, support and the like required for the proper installation of the sanitary appliance shall be provided by this Contractor.

The Contractor shall provide all waste sanitary appliances, constant flow regulators as required by the PUB (Water Department).

The installation of sanitary appliances and accessories shall be in accordance with the requirement and/or approval of:

- a. Sewerage Department;
- b. Environmental Health Department;
- c. PUB (Water Department); and
- d. Recommended installation procedures of the appliance manufacturer.

For auto-sensing flush valve, the installation of the sensor unit shall be carried out by a PUB licensed electrician who shall ensure compliance with the relevant regulations and Code of Practice.

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k. Installation of Appliances

Water Closet

Joints between spigot cast iron pipe and fixture outlet shall be made with yarn and cement/sand mortar not stronger than 1:2 and not weaker than 1:3. Joints between unplasticised PVC pipes and fixture shall be made with approved rubber seal ring joints. The water closets shall be firmly bedded in cement mortar. Every pedestal water closet pan shall be secured to the floor using stainless steel or non ferrous bolts/nuts.

The joining of the outlet of the water closet pan to the branch drain-line or discharge pipe shall be made by an approved type pan collar.

Wall hung water closet pan shall be fixed with stainless steel bolts and nuts or other approved means to an independent support frame. The support frame shall be either fully or partially fixed within the wall. Fixing details must be submitted to the Architect for review prior to installation.

Every water closets shall be operated by flush valve or auto sensing flush valve.

Urinals

Bowl urinals shall be firmly fixed to walls by means of brackets which are built or screwed into the wall. A group of bowl urinals connected in series shall be connected directly to a branch drain line or stack by means of a trap 75 mm in diameter above ground level and 100 mm in diameter at ground level.

Slab urinals shall be firmly bedded in cement mortar. The channel to urinals shall have a fall of not less than 1 in 100 towards the discharge outlet. Each urinal shall connect directly to a branch drain line or stack by means of a trap 100 mm in diameter at ground floor level and 75 mm in diameter above ground floor level. The outlet to urinals shall be fitted with a chrome plated gunmetal or brass dome-shaped removable grating.

Every urinal shall be operated by an auto-sensing flush valve.

(a) Flushing Cisterns

Flushing cisterns shall be firmly fixed to the wall by means of either bolts and nuts or brackets. The flush pipe connecting a flushing cistern to a water closet shall be fixed as straight as possible and shall not be less than 32 mm in diameter if the bottom of the cistern is fixed 1.5 mm or more above the top of the water closet. The flush pipe shall not be less than 38 mm in diameter if the bottom of the cistern is fixed less than 1.5 mm above the top of the water closet. Flush pipes from the cistern to a squat pan shall be securely fixed to the wall. The Contractor shall apply a 12 mm chromium plated stop cock for each flushing cistern.

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Bidets

Every pedestal bidet shall be secured to the floor using stainless steel or non-ferrous fixing screws. Provision shall be made in the floor to receive the fixing screws.

Wall hung bidet pan shall be fixed with stainless steel bolts and nuts or other approved means to an underground support frame such that no strain is transmitted to the bidet pan connection or any other part of the plumbing system. The support frame, depending on the design, shall be either fully or partially fixed within the structure of the building.

Every bidet shall be provided with a spray nozzle fixed above the spill over level of the bidet pan.

Every bidet shall be provided with a fitting trap of at least 40 mm in diameter. The connection by means of a bidet trap of at least 75 mm in diameter shall be made directly to an individual branch drain line to an inspection chamber on the 1st Storey level or to a discharge pipe on the upper story level.

Water for flushing of the bidet shall not be supplied directly from the water main unless through an approved vacuum breaker and check valve or other approved means for preventing back flow or back siphonage and controlled by an approved stop-valve.

I. Auto Sensing Flush Valves

Each sensor unit shall only operate one flushing unit for a sanitary appliances. The sensor unit when installed should not be affected by the operation of adjacent sensor unit.

The sensor unit's stable sensing areas shall be adjusted for an activating distance that is as follows:

- a 600 mm for a urinal; and
- b 900 mm for a water closet.

The sensor unit and wiring connections shall be installed according to the manufacturer's recommendation including electrical wiring work commencing at the isolator which is provided by others.

The Contractor shall execute all necessary wiring connection works.

m. Waste Sanitary Appliances

Every waste sanitary appliance which is suspended shall be fixed to the wall by means of brackets which are built or screwed into the wall. Every floor mounted waste sanitary appliance shall be provided with pedestal, foot and leg. Any sink and wash basin may be mounted on a cabinet or mounted on wall. Refer to architectural drawings for detail.

All fixing screws shall be corrosion resistant.

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All joints between any waste sanitary appliance and the abutting wall shall be water-tight.

Every waste sanitary appliance shall be provided with a waste filling trap for connection to the waste pipe. The waste pipe shall connect to the floor trap above the water seal of the trap.

The waste pipe for waste sanitary appliance fixed on first storey level outside the building may be connected directly to a gully trap above the water seal.

Where a group of 3 or more wash basins are connected in series, loop venting is required. However, the loop venting shall be terminated separately to the atmosphere. The minimum diameter of loop venting pipe shall be 25 mm. The minimum internal diameter of waste pipe for each type of waste sanitary appliance and the maximum number of waste sanitary appliances allowed a common waste pipe for waste sanitary appliances connected in series shall be as follows:

Minimum Internal Diameter of Waste Pipe For each type of Waste Sanitary Appliance			
Type of Appliance	Minimum Internal Diameter Of Waste Pipe in mm		
Wash Basin	32		
Sink (Single or double bowl)		40	
Laboratory	40		
Long bath/Shower Tray		50	
Foot Bath		50	
Wash Tub	50		
Wash Trough/Custom-Made Sink		50	
Drinking Fountain	50		
Minimum Number of Waste Sanitary Appliance Allowed on each Diameter of Common Waste Pipe for Waste Sanitary Appliances Connected in Series			
Type of Waste Sanitary Appliances Connected in Series	Maximum No. of Waste Sanitary Appliances Allowed on Common Waste Pipe		
	Minimum Internal Diameter of Common Waste Pipe in mm		
		50	75
Wash Basin		3	10
Sink (Single or double bowl)		2	6
Laboratory Sink		2	6
Drinking Fountain		12	40
Wash Trough/Custom-Made Sink		2	6
Wash Tub		2	6

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n. Plumbing Fittings

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, compression fittings, etc., as required.

1.4 Cold Water and Hot Water Supply

a. General

A complete cold water supply system shall be supplied and installed in accordance with the drawings, CP 48, the latest requirements of the local water supply rules and the requirements described hereunder.

The Contractor shall make all necessary application and arrangements for his work to be inspected by the PUB Water Department.

The Contractor shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the whole water reticulation system to the Owner.

b. Water Service Connection

The Licensed Plumber shall apply for and make all necessary arrangements/ inspections with the PUB Water Department for the installation of bulk meter.

c. Piping Materials

- All piping materials shall be of type/brands found in the list of approved fittings and pipes for water service installation.
- Refer to the Schedule of Pipework materials for water supply piping.
- All exposed hook-up lengths to fixtures shall be heavily nickel plated or bright chromium plated and be completed with matching plated brass screws.

d. Piping Joints

Pipe joints for the various pipe shall be as follows:

- | | | |
|-------|----------------------|---|
| (i) | Ductile Iron Piping: | Flanged joints or rubber ring |
| (ii) | Steel Piping: | Screwed or flanged joints. |
| (iii) | Copper Piping: | Brazed or silver soldered or flanged joints. However for pipe less than 50 mm diameter, screwed compression joints shall be used. |

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e. Pipe Supports

- (a) Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor with galvanized steel clamps. Where necessary to permit free movement for common group they shall be supported from a common hanger bar fabricated from galvanized steel sections.
- (b) Care shall be taken to isolate copper pipes from steel brackets with timber sleeving or other approved materials.
- (c) Underground water mains shall be supported on continuous concrete benching and thrust blocks.
- (d) Pipe hangers shall be provided at the following maximum spacings:

Pipe Dia (mm)	Hanger Rod Dia (mm)	Copper Pipe Max Spacing (m)	Steel Pipe Spacing (m)
Up to 25	6	2	2
32 to 50	10	2.5	2.7
80 to 100	12	2.5	2.7
125 to 150	16	3	3.6
200 to 300	19	3.6	5.3

f. Testing of Pipe installation

Before any pipework is concealed, it shall be tested for leak to twice its normal working pressure or 600 kpa, whichever is higher. Should leakages be found, the Contractor shall immediately remove and replace the defective pipes and the section of pipe to be re-tested as above.

The Contractor shall notify the Architect three days in advance of any test so that the Architect can witness the tests if he so wishes.

g. Sterilisation of Installation

After the installation has been tested and approved, but before putting into use, it shall be sterilized by Licensed Plumber, according to recommendations of CP 48.

Upon completion of sterilization, water samples shall be taken for bacteriological and chemical testing by authorised laboratories to substantiate the successful completion of sterilization process.

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h. Chasing of Pipework

Cold water distribution pipes to fixtures and equipment exposed to view in the bathrooms, kitchens, and sanitary compartments shall be chased into walls or floors or placed in wall cavities.

The Contractor shall be responsible for cutting all notches, chases, and recesses in walls and floors and only a diamond cutter shall be used. The maximum size of conduit or pipe permitted to be concealed in floor slabs shall be 32 mm diameter unless otherwise approved by the Architect.

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

i. Cleaning Out of Pipework

All pipes shall be cleaned out thoroughly after installation and before hydrostatic tests are carried out. Piping shall be disconnected from tanks, control valves and equipment before being washed out. The washing out shall be carried out to the satisfaction of the Architect and shall continue until all foreign matter is removed.

j. Valves

All valves shall be suitable for the working pressure involved but not less than 1 MPa. Valves up to 50 mm diameter shall have bronze bodies and trim with screwed connections. Valves greater than 50 mm diameter and above shall have cast iron or cast steel bodies, bronze trim with flanged connections. All valves shall be approved and stamped by the Water Department, Public Utilities Board.

Stop Valves

Stop valves shall be gate valves with non-rising stems, renewable seats and cast iron or plastic handwheel.

Stop Cocks

Stop cocks shall be chromium plated with renewable rubber disc seats to British Standard. A stop cock shall be provided to each water outlet point like basin, water cistern, bath tub and sinks.

Strainers

Strainers shall be Y-type with removable stainless steel basket.

Sluice Valve

Sluice valve shall be of heavy water works type complying with BS 3464 and be of the rising spindle type.

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Check Valve

Check valve up to 50 mm shall comply with BS 1953 Class 125 or BS 5154 (M).
Check valve above 50 mm shall comply with BS 4090 Class 125 or BS 5153 (M).

k. Schedule of Valves

The Contractor shall supply and install all valves to all fixtures as specified below:

(a) WC Pan

25 mm ball valve, similar to Ballofix, with suitable 25 mm union piece for connection to flush valve or 12 mm ball valve and 12 mm union piece for connection to cistern.

(b) Urinal

19 mm ball valve as above to flush valve or 12 mm ball valve to cistern.

(c) Basin/sink

Ball valve of size to suit distribution pipe for multi-basin arrangement and 12 mm ball valve for single-basin arrangement.

(d) Kitchen

Ball valve of size to suit each branch pipe.

l. Common Areas

(a) WC Pan

25 mm approved check valve to BS 5154:1974 and 32 mm approved stop valve to SS 75:1978.

(b) Urinal

25 mm approved stop valve SS 75:1978.

(c) Basin/Sink

Ball valve of size to suit distribution pipe multi-basin arrangement and 12 mm ball valve for single-basin arrangement.

(d) Taps

All taps for the garden, planters and in each plant rooms shall be of the brass type.

Unless otherwise mentioned, all taps for the sinks in kitchens, utilities rooms shall be of chrome plated type.

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m. Hot Water Piping Installation

- (a) All hot water pipework, except where chased in walls, shall be insulated with 25 mm thick fibre glass sectional pipe insulation.
- (b) The insulation material shall have a density of 80 kg/m³ and a maximum thermal conductivity of 0.03 W/m degree K at 20 degree C mean temperature.
- (c) The insulation material shall be sheathed with aluminium foil. In locations exposed to weather, the insulation materials shall be covered with aluminum sheathing.

n. Testing of Pipelines

All cold and hot water supply pipework shall be subjected to a hydrostatically test pressure of 12 bar or 1½ times the maximum working pressure, whichever is greater. The test period shall be two (2) hours during which no leakage is allowed.

o. Schedules of Materials and Equipment for Sanitary Plumbing, Hot and Cold Water System

1. Underground Drainage & Vent Systems

Pipes Heavy duty, cement-lined ductile iron pipe to BS 4772 (Class K9) at drive-way and car porch.

2. Internal Sanitary Drainage Systems

Pipes UPVC to SS213 (soil, combined soil and waste, waste and vent, above ground).

UPVC to SS 272 (soil, waste pipes below ground) for turfed areas.

VCP to BS 65/BS 540 for sewer connection.

Check Valves Swing check valve, cast iron body

Gate Valves Cast iron body.

Floor Trap Stainless Steel

Grating in

Toilets/Kitchen

Inspection Cast iron and / or complete with frame and recess to

Chamber Cover accommodate architectural finishes.

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p. Cold and Hot Water Reticulation Systems

Pipes	Cement mortar-lined ductile iron pipe to BS 4772 K9 (underground water supply pipes 80mm dia. and above).
	Copper tubing to BS EN 1057 (above ground water supply pipes).
	Copper tubing to BS EN 1057 (underground water supply pipes below 80mm dia.).
Insulation	Fibreglass 25mm thick.

q. Electrical Work

The standard of electrical wiring work shall comply with PowerGrid Ltd / Power Supply Ltd and Singapore Standard CP 5: Wiring of Electrical Equipment of Buildings. The Contractor shall refer to the Electrical Specification (Section 7) for the standard of electrical wiring.

Electrical supply for these Pumps/Equipment mentioned in Scope of Work and the associated control shall be obtained from isolators/distribution board (provided by the Electrical Contractor) inside the relevant Pump/Equipment Room as shown on the drawings.

The Contractor shall supply and install all electrical wiring from the electrical supply termination points to his pump/equipment, including controls panel, final sub-circuit wiring and accessories.

The Contractor should coordinate with the Electrical Contractor for exact location of the isolators/distribution board.

All pump/equipment control panel shall be complete with all detailed and necessary components and accessories including motor starters, busbar, relays, contactors, meters, switches, fuses, indicators, alarms, timers, push buttons, etc. and connection to power supply point.

If in the opinion of the Architect, the standard of electrical wiring in the installation does not comply with the specified standard, the cost of subsequent rectification shall be fully borne by the Contractor. If such sub-standard wiring work should affect the timing of the electrical inspection/testing work by the power supply company, the Architect may instruct that such rectification work be carried out by another Contractor and such electrical variations shall be fully borne by the Contractor.

Ambiguities and inadequacies in the electrical supply or demarcation shall be the sole responsibility of the Contractor who shall bear the full cost of rectifications to such situations.