CAWANGAN KEJURUTERAAN
MEKANIKAL

JKR 20500-0048-17

INTERNAL COLD WATER AND SANITARY PLUMBING SYSTEM

STANDARD TECHNICAL SPECIFICATION

REVISION 1/2017

PENGARAH KANAN
CAWANGAN KEJURUTERAAN MEKANIKAL
IBU PEJABAT JKR MALAYSIA
ARAS 24 - 28, MENARA KERJA RAYA
JALAN SULTAN SALAHUDDIN
50480 KUALA LUMPUR

KERAJAAN MALAYSIA
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2017

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TECHNICAL SPECIFICATION

SECTION 1 - TECHNICAL SPECIFICATIONS

1.0 SCOPE OF WORK

The work to be performed under this contract shall comprise, but not limited to the supply, delivery, installation, testing and commissioning and maintenance of the following principal services and the associated works and items:

a) Internal Cold Water Plumbing System

i) Internal Piping system complete with all bends, tees, sockets, valves, plugs, reducers, brackets, supports and other necessary accessories to complete the installation.

ii) Water Tank (Suction and Storage Tank)

b) Internal Sanitary Plumbing System

i) Internal piping complete with all necessary bends, tees, sockets, branches, offsets, and other necessary accessories to complete the installation.

ii) Internal inspection chamber, gully trap and grease trap.

The contractor shall at his own cost be responsible to appoint SPAN certified personnel for the submission, supervision, construction, testing and certification of the completed works.

The Contractor shall prepare and submit working drawings to the S.O for approval within thirty (30) days from the date of acceptance of tender. In preparing these working drawings, the Contractor shall coordinate with the building layout and constructional details of the architectural, structural and electrical drawings.

The drawing shall be fully dimensioned and show all the precise locations, arrangement and loading of the equipment. The drawings shall also indicate location and details of all foundation, supports, chases, core holes, opening in partition wall, floors and roof and any other information required for works or services to be provided by others.

The drawings submitted shall be modified as necessary and, if requested by S.O, re-submitted for final approval. Six (6) sets of drawings shall then be submitted for distribution to all parties concerned.

The contractor shall submit method statement (upon S.O request), samples of materials or execute samples of workmanship (mock-up) for S.O approval, and for further samples as required until the samples submitted or executed are, in accordance with this specification.

Samples, after approval, shall indicate the standard of materials and workmanship to be maintained in the execution of the works.

After connection work is done, the Contractor shall ensure that all system to be operational as required.

The Contractor shall service and maintain the above-mentioned cold water and sanitary plumbing system during Defect Liability Period (DLP) from the date of Certificate of Practical Completion (CPC) in good operating condition until Certificate of Making Good Defect (CMGD).

The Contractor shall submit the as-built drawing, operation and maintenance manual (OMM) complete with Schedule of Maintenance before handing over subject to S.O approval.

Exclusion:

The boundary of scope of work between mechanical works and civil works can be referred from Figure 1 to Figure 4 in the Appendix.

1.1 INTERNAL COLD WATER PLUMBING SYSTEM

1.1.1 GENERAL

All water supply plumbing and installation shall be executed in accordance with the latest edition of the following:-

a) Act 655- Water Services Industry Act 2006 (SPAN)
b) Water Services Industry (Water Reticulation and Plumbing) Rules 2014 (SPAN)
c) BS 8558:2011 – Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages – Complementary guidance to BS EN 806.

The Contractor shall submit method statement of installation if required by the S.O.

1.1.2 PIPEWORK (MATERIAL PIPES STANDARDS)

1.1.2.1 General

Pipework for water supply plumbing shall be to the dimensions shown in the drawings or as specified hereinafter and shall be complete with all bends, tees, sockets, plugs, reducers, brackets, supports and other accessories to complete the installation.

1.1.2.2 Standards

All pipes, fittings and equipment used for water supply plumbing and installation shall be of the type and make approved by SPAN and as mentioned in the drawings.

The standards stated in this specification shall comply with their latest edition issued or relevant standards approved by SPAN.

1.1.2.3 Internal Piping

TABLE 1: Type of Pipes and Their Complying Standards

Type of pipe	Minimum wall thickness & pressure rating	Standard	Fitting
High Density Polyethylene (HDPE)	PN 12.5 at 20°C (equivalent to 10 bar derated working pressure at 30°C)	MS 1058 or BS EN 12201 and marked with SIRIM certification numbers	Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.
Acrylonitrile Butadiene Styrene (ABS)	PN 12 to MS 1419: Part 1: 2007	MS 1419: Part 1: 2007	MS 1419: Part 2: 2007 - Fitting MS 1419: Part 3: 2007 - Solvent cement. All ABS pipes, fittings and solvent cement shall be supplied by the same manufacturers.
Polybutylene (PB)	PN 15 at 20°C (equivalent to 15 bar derated working pressure at 30°C)	MS ISO 15876 or AS/NZS 2642	Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.
Polypropylene random co-polymer (PP-R)	More than 10 bar working pressure: PN 16 or SDR 7.4 at 20°C Less than 10 bar working pressure: PN 10 or SDR 11	MS 2286 or BS EN ISO 15874	Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.
Stainless Steel (SS)	BS EN 10312 (Welded): <Ø 12mm → Series 1 ≥Ø 12mm → Series 1 or Series 2 or ASTM A312/A312M: Ø ½'' – Ø 2'' → Schedule 40S (Threaded) Ø 2½'' – Ø 8'' → Schedule 10S (Welded)	MS 1841: 2010, BS EN 10312 ASTM A312/A312M or JIS G 3448	Stainless steel compression fittings to BS 4368 or Ø15mm, Ø22mm & Ø28mm → Press fittings according to SAS 322: 2003 Ø ½'' – Ø 2'' → (Schedule 40S) Threaded & screw fittings according to ISO 4144:2003 Ø 2½'' – Ø 8'' → (Schedule 10S) Butt weld fittings according to ASTM A 403 / A 403M
Copper Tubing	Type K	BS EN 1057 BS 2871	Brazing according to BS EN 1254: Part 1 or Compression joint according to BS EN 1254: Part 2 or Accelerated 'push fit' according to BS EN 1254: Part 2
Crosslinked Polyethylene (PE-X)	PN 10 at 70°C	MS 1736: Part 2	MS 1736: Part 3 - Fitting Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.

1.1.3 PIPE INSTALLATION

Pipes and fittings shall be cleaned and free from manufacturing burrs and site debris.

The pipes shall be adequately protected against damage during transit. Each delivery of pipes shall be accompanied by the manufacturer's testing certificate.

1.1.3.1 Internal Piping

All installation shall be done according to the approved drawings and pipe manufacturer's recommendation. Plumber shall be competent in various type of installation. Special care shall be taken in the arrangement of piping to ensure a neat finishing and alignment.

Services pipes and distribution pipes except those buried under ground level shall be concealed in wall, ceilings, boxed up or laid within the common trench, services shaft, etc provided where possible. All work shall be executed in such a manner to avoid cutting into finished work in walls, aprons, beam, etc. where practicable as the work proceeds. Pipe work to be buried or concealed shall not be covered or plastered before they are examined, tested and approved by the S.O.

Installation of valves and fittings shall be grouped where this will not affect their operation, to reduce the number of joints to a minimum.

All necessary isolating valves, check valves and other fittings as required are as shown in the approved drawings. Every section of major branch supply piping shall be installed a gate valve at the point of connection to the supply.

Minimum diameter for internal cold water plumbing system shall be 20mm (3/4") except for flush valve system where minimum diameter shall be 25mm (1"). Final branches to fittings shall be 20mm diameters and the sizes of feeders from which these branches are taken shall be as follows:-

TABLE 2 : Diameter of Feeders to No. of Fitting Served

No of Fittings Served	Diameter of Feeders
1	20mm
2	20mm
3, 4	25mm
5, 6 ,7	32mm
8, 9, 10, 11, 12	40mm
13, 14, 15, 16, 17, 18	50mm

1.1.3.2 Threaded Joints

Threaded end connections for plastic (ABS/PE/PB) pipes shall have tapered thread forms complying with **AS ISO 7.1-2008 and AS ISO 7.2-2008** or equivalent approved standard in accordance with manufacturer's instruction.

Where threaded joint is to be made between plastic (ABS/PE/PB) pipes and metal, the plastic (ABS/PE/PB) pipes should be the male component of the joint.

All screwed joints shall be made by using Teflon tape or approved jointing compound.

1.1.3.3 Flanged Joints

Flanged joints or other suitable methods can be used for pipe more than 50mm and working pressure more than 10 bar (PN10).

1.1.3.4 Bends

Bends of all piping shall have a radius of not less than 5 times the diameter and shall be of standard type.

1.1.4 PIPE SUPPORTS

Pipe supports, hangers, anchors, guides etc. shall be supplied and installed for proper support.

Vertical riser shall be supported at each floor with galvanized iron (G.I) riser clamps or other material subject to S.O approval.

Horizontal pipe runs shall be supported on hangers of split ring adjustable type or clevis type. Where pipelines run along walls, columns or ceilings, brackets or clamps may be used.

Piping at all equipment, valve positions and at main junctions, shall be adequately supported to prevent any distortion or transmission of strain to connect equipment or valves.

Where pipe lines run in a common group, they shall be supported from a common hanger bar as indicated in the approved drawings.

Pipe supports and hangers shall be spaced at intervals not exceeding the following: -

1.1.4.1 Horizontal Position

TABLE 3: Recommended Maximum Spacing of Support for Horizontal Cold Water Pipe

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
20	0.8	1.5
25	0.85	1.8
32	1.0	2.4
40	1.1	2.4
50	1.25	2.4
80	1.65	3.0
100	1.9	3.0

Source: British Standards Institude. (2010). BS EN 806-4: Specifications for installations inside buildings conveying water for human consumption. Installation

1.1.4.2 Vertical Position

TABLE 4: Recommended Maximum Spacing of Support for Vertical Cold Water Pipe

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
20	1.0	2.4
25	1.1	2.4
32	1.3	3.0
40	1.3	3.0
50	1.6	3.6
80	2.1	3.6
100	2.5	3.6

Source: British Standards Institude. (2010). BS EN 806-4: Specifications for installations inside buildings conveying water for human consumption. Installation

Vertical pipes shall be supported at least at the top and bottom of each riser, at each floor level, and at each isolating valve. In addition, a further support shall be provided between floor levels for pipes smaller than 32mm.

1.1.5 PIPE SLEEVE AND COVER PLATE

Where pipes are required to be laid through structural beams or slabs, G.I/ uPVC pipe sleeves shall be provided. All pipes shall be properly secured in place with brackets.

All exposed piping within occupied rooms shall be boxed up to S.O approval.

Where pipe past through fire break walls or other partitions, clearance between pipes and sleeves shall be tightly pegged with suitable fire rated material to form a sound and fire barrier.

1.1.6 VALVES AND FITTING

All valves shall be of SPAN approved, manufactured and generally constructed in accordance with relevant standard. All valves shall be suitable for system operating pressure.

All valves and fittings necessary for the correct control, operation and maintenance of all services shall be provided and installed to the satisfaction of the S.O. Samples shall be submitted for S.O approval before installation. Valves shall be installed where they are easily accessible for maintenance and operating purposes.

Each valve shall be of the same nominal size as the pipeline in which it is installed, except for control, pressure reducing and similar valves which shall be correctly sized as per specific duty and functionality. Connection between each valve and adjacent piping or equipment shall be made either flange or threaded joints may be applicable.

Before installation, every valve shall be blown out with air to remove any foreign matter lodged in the valve.

1.1.6.1 Stop Valves / Gate Valves

Stop valves / gate valves are generally used as isolation valves.

Full bore copper alloy screw-down stop valves / gate valves of the same diameter as the pipe shall be provided and fixed for control in the following positions:

a) On the service pipe before it enters the building.
b) On each branch of the service pipe.
c) On the inlet to each storage or feed cistern.
d) On the inlet to each flushing cistern.
e) On the outlet of each storage tank or feeder cistern.
f) In other position on the pipe as shown or indicated, other than on overflow/warning pipe.
g) For system with pressure reducing valve (PRV), location of the gate valves shall be as indicated in the approved drawings.

Stop valve of 50mm and below shall be complied with MS 1022 and stop valve of 50mm and above shall be complied with BS EN 1213.

Gate valve of various sizes shall be complied with BS EN 12288 (copper alloy valves) and BS EN 1171 (cast iron valves) (PN12 above).

Gate valve sized from 65mm to 100mm shall be either screwed or flanged end complied with above mentioned standards.

Valves with reduced flow areas shall not be used for water closet flush valves and flushing cistern.

All valves shall have hand-wheel with externally screwed bronze or stainless steel spindle.

1.1.6.2 Pressure Gauges

Dial type with 3-way gauge cock shall be supplied and installed where indicated in the approved drawings.

A pressure gauge shall be installed at every suction pipe, every delivery pipe and at the common header pipe.

Pressure gauges shall be minimum 100 mm diameter dial face type and having ranges suitable for the service pressure encountered. The measuring range of the gauge should be 125% of the maximum pressure.

The gauges shall be industrial type shock proof, liquid filled, stainless steel casing and IP 65 Ingress Protection Rating.

The construction of pressure gauges shall comply with BS EN 837-1.

1.1.6.3 Pressure Reducing Valve (PRV)

Air vent and pressure reducing valve shall be installed at 30 meter intervals along downpipes to restrict the pressure sustained by the fittings to prevent water hammer and other effect.

1.1.6.4 Check Valves

Where shown in the drawings, non-slam-type check valves shall be supplied and fitted.

Valves shall be selected in relation to the velocity of the water in the pipe. In all cases, the valve is required to operate silently on reversal of water flow and if necessary, valves of the double or articulated clack type or the spring assisted type shall be fitted.

1.1.6.5 Water Meter

Suitable water meter approved by SPAN shall be supplied and installed as required.

1.1.7 WATER TANK

1.1.7.1 Water Tank Material

All water tanks for water supply shall be of the type and capacity shown or stated in the drawings. The water tanks shall be watertight and properly supported.

1.1.7.1.1 Fibreglass Reinforced Plastic (FRP) Water Tank

General

The tanks shall be scribbled down and flushed out with clean water and sterilized with chemical containing chlorine before being put into use.

Water tank design shall comply with the following standards:

a) MS 1241 - FRP Water Tank
b) MS 1390 – FRP Sectional Water Tank
c) Any other standards approved by SPAN

Materials for the construction of panels shall conform to MS 1241. The surface of FRP panels shall be manufactured with built-in stabilizer against embrittlement due to ultra-violet radiation.

The panel shall be of hot press moulded and fabricated from fiberglass reinforced plastic (FRP) of dimension 1meter x 1meter square with maximum tolerance of 1.5mm. Each FRP panel will be manufactured with flanges at a right angle of 90° to all sides of each panel. The thickness of the flange for the side wall and base plates will not be less than 10mm and the landed width of each flange will not be less than 70mm for base and side panels.

Water storage tank of 10,000 litres or more shall have internal compartments to facilitate maintenance of the water tank. Alternatively, multiple tank may be employed. An equalizing pipe shall be provided between each compartment or between each separate storage tank supplying water to the same distribution pipe.

Physical Properties

TABLE 5: Physical Properties of FRP Panel

Parameter	Results
Tensile strength	>70 MN/m²
Bending strength	>100 MN/m²
Elastic modulus in bend	>6,000 MN/m²
Hardness	30 % or 90 % of the resin manufacturer specification which ever is higher
Glass content	>25%
Water absorption	1.0%

Source: Malaysian Standard. (2010). MS 1390: Glass-Fibre Reinforced Polyester Panels and Panel Water Tanks – Specification (First Revision)

Jointing Material

The jointing material shall be synthetic rubber as sealant with stainless steel washer, nuts and bolts.

The holes for the bolts will be 12mm± 1.5 to 2.0mm in diameter, suitable for M12 bolts and nuts.

Connections

All holes and pipe connection made in wall, top and bottom of tanks shall be factory fabricated before delivery of tank to site. The positions and type pipe connections shall be carried out strictly in accordance with the manufacturer's recommendations.

Painting

The internal face of the water tank shall be given two coats of non-toxic, non-corrosive paint and external one coat primer and two coats of non-corrosive paint to S.O approval.

1.1.7.1.2 High Density Polyethylene (HDPE) Tank

The HDPE tanks shall be constructed of physiologically safe, non-toxic, inert, visor-elastic, UV-resistant high density polyethylene of one-piece moulded seamless construction to BS 4213 or MS 1225 and SIRIM certified without welding or joint. The tanks shall be manufactured from 100% virgin food grade resins without the additional recycled or reworked material. The resin used must be certified by the resin manufacturer to be food grade compliance and suited for the potable water.

The tanks and all piping connections shall be installed strictly in accordance to manufacturer's instructions and specification and the installation shall be supervised and verified by the manufacturer.

The tanks shall come with a minimum 10 years warranty against defect in materials, manufacture and workmanship by the tank manufacturer. The warranty certificate shall be submitted to S.O before handing over.

1.1.7.1.3 Stainless Steel Tank

Stainless steel tank design shall comply with the following standards:

TABLE 6: Standard for the respective Steel Tank

Type of water tank	Standard
Stainless steel storage tank	JKR 20200-0041-99
Pressed steel sectional rectangular tank panel	BS 1564

Stainless Steel Storage Tank

Material used in the fabrication of this tank shall be of Grade 304 stainless steel ASTM Designation: A240/A240M-94a or equivalent standards and supported by the respective mill certificates.

The finished surface of the materials used shall be of bright annealed (BA) and/or non-shining (2B) finished.

The tank shall be manufactured inclusive of the following components:

a) Top cap
b) Top cover
c) Tank body
d) Bottom cover
e) Stand (for round bottom & spherical types only)

The stands (except for flat bottom type), fittings and accessories such as internal and external ladder, tank cover, screw nut, etc. of the tank shall be made of similar stainless steel materials of the above grade.

Each tank shall be marked / labeled on the external upper part of the tank body according to the following information:

a) Manufacturer's name and/or trade mark
b) Date of manufacture
c) Serial number and model
d) Capacity

Pressed Steel Sectional Rectangular Tank Panel Water Tank

Material for the pressed steel sectional water tank shall be manufactured from 0.8mm thickness Grade 304 stainless steel plate inner surface composite with minimum of 5mm external surface of mild steel plate.

The reinforcement for pressed steel sectional water tank shall be reinforced using suitable support. Detail calculation for internal / external reinforcement design shall be submitted to S.O for record.

All bolts, nuts and washers in contact with water shall be of stainless steel Grade 304. All external bolts, nuts and washers in contact with water shall be of hot dipped galvanized mild steel.

The cover for pressed steel sectional water tank shall be constructed 1.2m x 1.2m / 1m x 1m from 1.2mm thickness Grade 316 stainless steel plate.

Non-toxic PVC foam shall be used for jointing between flanges.

1.1.7.2 Tank Components and Accessories

The installation of storage / domestic tanks shall include but not limited to the following accessories and fitting to the tanks:

a) Overflow / warning pipe, outlet tapping and scour pipes shall discharge outside the building or to a point shown or stated in the approved drawing.

b) Access manholes with cover, the number, locations and details of which shall be approved by S.O.

c) Mosquito-proof air vents to the tank cover at the positions and as per details approved by S.O.

d) Water tanks of two (2) metres depth or more shall be provided with internal and external ladders. The internal ladder and external ladder shall be made of stainless steel grade 304 unless otherwise specified. The ladder width shall not be less than 300 mm and the length shall be suitable for the tank specified. The maximum height from floor finish level to the first ladder step shall be 300 mm.

e) Water level indicators and scales graduated in meters to suit the depth of the tank as shown in the approved drawings.

f) Float Operated / Ball Valves

Float operated valve shall comply with BS 1212. The combination of body pattern, seat number and size of float to suit the required pressure zone shall be as per standard.

All ball valves shall be supplied and fitted complete with back nuts, ball float, arm, etc. Ball floats may be of soldered copper or brass or alternatively polyethylene and PVC.

g) Pilot Operated Valve

Pilot-operated valve shall comply with AWWA C530-07. The configuration and material of main valve, vertical float rod and float shall be as per standard and specification.

h) Drain Cocks

Gunmetal drain cocks shall be provided as necessary to ensure that all sections of the pipework and plant can be effectively drained. The sizes of drain cocks shall be as follows: -

i)	Tanks, plant and pipes above 6” diameter	-	≥ 1” diameter
ii)	Pipes 3” to 5” diameter	-	0.75” diameter
iii)	Pipes up to 2.5” diameter	-	0.5” diameter

1.1.7.3 Water Tank Foundation

1.1.7.3.1 Panel Tank

Unless otherwise shown in the approved drawings, the foundations shall be constructed to provide continuous support to all base panel joints in one direction at 1000 mm nominal centres according to panel sizes. The concrete foundation shall have a width of at least 300 mm and height of at least 600 mm. All foundations shall be constructed according to JKR standard specifications.

If concrete slab is used, dwarf walls or steel beams shall be placed between the tank and the base level to allow a minimum clearance of 500 mm to enable ease of tank installation and subsequent bolts tighten and adjustments after installation.

Whenever recommended by the tank manufacturer, the steel skid base shall be designed and constructed in accordance with manufacturer's instructions, and details. In such cases, the continuous support can be spaced at greater than 1000 mm nominal centers as recommended by the manufacturer.

1.1.7.3.2 Round Tank

The concrete plinth shall have minimum of 100 mm height complete with 5 mm mild steel base plate as per tank size.

1.1.7.4 Flange Joint (Nozzle)

Flange joint used for the inlet, outlet and scour of storage tanks shall be made of stainless steel grade 304 externally and internally. Joint gaskets shall be of 5 mm thick, medium rubber reinforced with two-ply flexible fabric and complying with BS 6956, or approved silica sealant used in the FRP tanks. All bolts, nuts and washer used for flange nozzles shall be made of stainless steel grade 304.

1.1.8 CLEANING, PAINTING AND IDENTIFICATION

1.1.8.1 Cleaning of Pipework

All pipes, fittings, etc. shall be kept closed against moisture and foreign matters when stored on site.

All pipes, fittings, valves and accessories shall be thoroughly cleaned internally and externally before their installation and again where necessary before closing up.

After installation and before putting into service, all pipework including fittings, valves shall be thoroughly cleaned internally.

1.1.8.2 Painting and Identification

All pumping equipments shall be factory painted according to the manufacturer's recommendations.

All thermoplastic pipes, fittings, valves, etc exposed directly to sunlight shall be painted with water based exterior-grade latex paint.

All surfaces to be painted shall be first thoroughly cleaned to remove dirt, scales, grease spots etc. Surface shall be completely dry before painting.

All surfaces shall have minimum one coat primer and two coats finish subject to S.O approval.

1.1.8.2.1 Pipework Identification

All pipes installed shall be identified in accordance with their relevant standards.

Directional arrows shall be painted on the pipework in the plant rooms, tank room and vertical risers. Lettering and the direction of flow must be indicated by painting a black / white arrow on to the pipelines at appropriate intervals. These arrows shall be 3" long on pipes up to 50 mm (2") diameter, 150 mm (6") long for pipes over 50 mm (2") diameter.

1.1.8.2.2 Labels for Valves and Controls

All control valves, relays, switches and instrumentation shall be identified by black or white engraved laminated plastic labels, securely attached to the item by means of non-corrodible screws or rivet or any other method approved by the S.O, or when such item is installed on or within panels or cubicle, the labels shall be located immediately below the item.

---------- END OF SECTION 1.1 ----------

1.2 SANITARY PLUMBING SYSTEM

1.2.1 RULES AND REGULATION BY LAW

All the workmanship and material for the supply, installation, testing, adjusting, balancing & commissioning of all system and accessories shall comply with the following rules and regulation requirements:

a) Drainage, Sanitation and Sanitary Plumbing By-Laws of the Street, Drainage and Building Act. 1974; and

b) Gravity Drainage Systems Inside Buildings - Sanitary Pipework, Layout and Calculation, BS EN 12056 Part 2

c) Code of Practice for Sanitary System in Buildings, MS 1402:2006

d) Local Authority By-Laws in force at time of installation.

e) Other relevant rules and regulations

1.2.1.1 Material Standard

Pipework for sanitary plumbing shall be to the dimensions shown in the drawings or as specified hereinafter and shall be complete with all fittings, brackets, supports and other accessories to complete the installation.

All pipes, fittings and equipment used for sanitary plumbing and installation shall be of the type and make approved by SPAN and as mentioned in the drawings.

The standards stated in this specification shall comply with their latest edition issued or relevant standards approved by SIRIM.

The following standards in their latest edition shall apply: -

TABLE 7: Standard for different types of Sanitary Pipe

Item	Standard
Unplasticized polyvynil chloride (uPVC)	MS 1063 or, BS EN 1329-1, BS 4514, MS 628, BS EN ISO 1452-2:2009
Unplasticized polyvynil chloride (uPVC) (Underground)	MS 979: Part 1 (∅100mm & ∅155mm) MS 979: Part 2 (∅200mm and above) or BS EN 1401-1, MS 1085
Poly propylene (PP)	MS ISO 7671:2012
Cast Iron Pipes	BS 416 for heavy grade pipes BS 437 for spigot / socket drain
Galvanized Iron	BS EN 10255 “Heavy”

1.2.2 DEFINITION OF SANITARY PIPE

1.2.2.1 Soil (Black Water) Pipe

Pipes attached to a building and designed to convey sewage or waste matter from any water closet (W.C) or urinal.

1.2.2.2 Waste (Grey Water) Pipe

A separate waste pipe shall be provided for the following:-

a) Dirty water from baths, basins, wash troughs, ablution, floor trap and other waste containing a small proportion of soap and /or dirt; and

b) Greasy water from kitchen sinks and equipment where grease traps or interceptors are required.

1.2.3 SANITARY DISCHARGE SYSTEM

All main stacks shall be minimum 100mm diameter or subject to S.O approval.

The discharge system can be classified as follows:

1.2.3.1 Single Stack System

In this system, all appliances discharge separately into a single discharge stack. All traps are unventilated and those on pipes 50mm and below must have 75mm water seals (trap). The stack is directly connected to the manhole.

1.2.3.2 Fully Ventilated System

All appliances are directly discharged to a common stack and essential features of this system are the provision of 75mm deep seal traps on baths, basins and sinks as well as the provision of a ventilating pipe to which every appliance connected.

1.2.3.3 The Modified Single Stack System

The modified single stack system basically similar to the single stack system, with the exception that the W.C.'s only are ventilated direct to the main ventilating pipe.

The depth of the water seal to all appliances, except W.C's shall 75 mm.

The depth of the water seal to W.C's shall be 50 mm to the main discharge stack.

1.2.3.4 Ventilated System

The discharge from W.C.'s, urinal and other soil appliances are conveyed via a main discharge soil (soil pipe) and finally to the sewer line.

A separate waste pipe conveys the discharge from waste basins, baths, sinks to the waste water drain through a trapped gully.

1.2.4 PIPEWORK MATERIAL

1.2.4.1 UPVC Soil, Waste and Vent Pipes

All pipes shall run in accordance with layout sizes shown in the approved drawings. The pipes shall be provided, fixed and connected to fittings and sanitary installation complete with all necessary bends, tees, sockets, branches, offsets, inspection pieces, etc. Pipes shall be joined with approved solvent in accordance with the manufacturer's instructions.

Pipes, fittings and the system of unplasticised polyvinyl chloride (uPVC) in the field of soil, ventilation and waste discharge (low and high temperature) inside buildings, for soil and waste discharge systems buried in ground within the building structure and for soil, ventilation and waste discharge for both inside buildings and buried in building structure shall complied to MS 1063 or BS EN 1329 Part 1 or BS 4514 (size ∅82 mm only).

Pipes, fittings and the system of unplasticized polyvinyl chloride (uPVC) piping systems shall comply to MS 1063; or BS EN 1329: Part 1, or BS 4514 (size ∅82mm only)

- For soil, ventilation and waste discharge (low and high temperature) inside buildings (marked with "B")
- For soil and waste discharge systems buried in ground within the building structure (marked with "D")
- For soil, ventilation and waste discharge for both inside buildings and buried in building structure (marked with "BD")

The pipes and the fittings shall be coloured through the wall. The colour of pipes and fittings shall be as follows:

- "B" code - white
- "D" code - brown
- "BD" code - white

All underground sewerage pipe and fittings of ∅ 4" (100mm) diameter and ∅ 6" (150mm) diameter shall be of uPVC Brown complied to MS 979: Part 1; and for size ∅ 200mm and above complied to MS 979: Part 2 or BS EN 1401 Part 1 or BS 4660 (fitting of nominal size 110mm and 160mm only).

Main soil, waste and vent pipes shall be carried up to the roof level and protected by vent cowl and weather apron as per approved drawing.

All Pipes shall be fixed in straight runs and all horizontal runs shall be laid to gradients in accordance with BS EN 12056 Part 2 and in any event not less than 18 mm/m unless otherwise instructed.

1.2.4.1.1 <u>UPVC Waste, Vent and Soil System (Inside building, buried in building structure and buried in ground within building structure)</u>

The uPVC pipes, fittings and system shall comply in all respects with the requirements of MS 1063 or other relevant standard certified by SIRIM / SPAN.

Pipes shall be supplied in plain-ended lengths and the minimum acceptable with thickness of pipe and fittings as below:-

TABLE 8: Minimum Acceptable Thickness of uPVC Waste Pipe and Fittings

Nominal Sizes (mm)	Wall Thickness (mm)		
	Pipes (mm)	Fittings (mm)	Sockets (mm)
32	3.0	3.0	2.0
40	3.0	3.0	2.0
50	3.0	3.0	2.0
63	3.0	3.0	2.0
75	3.0	3.0	2.0
80	3.0	3.0	2.3
82	3.0	3.0	2.3
90	3.0	3.0	2.3
100	3.0	3.0	2.3
110	3.2	3.2	2.4
125	3.2	3.2	2.4
140	3.2	3.2 / 3.5*	2.4 / 2.6*
160	3.2	3.2 / 4.0*	2.4 / 3.0*
180	3.6 / 4.4*	3.6 / 4.4*	2.7 / 3.3*
200	3.9 / 4.9*	3.9 / 4.9*	2.9 / 3.7*
250	4.9 / 6.2*	4.9 / 6.2*	3.7 / 4.7*
315	6.2 / 7.7*	6.2 / 7.7*	4.7 / 5.8*

* For soil and waste discharge systems buried in ground within the building structure and for soil, ventilation and waste discharge for both inside buildings and buried in building structure.

The method of jointing to be employed shall be that solvent welding using the manufacturer's approved cement. Seal ring fittings shall be used where necessary to accommodate thermal movement or the sockets of standard fittings shall be converted to seal ring adaptor.

Access shall be provided where necessary either by means of an integrally moulded door in an access fitting with an externally fitted rubber seal and secured with two-piece clamp type door fitted into the pipe run.

1.2.4.1.2 Underground uPVC Sewerage Pipes and Fittings

The underground uPVC sewerage pipes and fittings shall comply in all respects with the requirement of MS 979: Part 1 (∅100mm and ∅155mm) and MS 979: Part 2 (∅200mm and above) or other relevant standard certified by SIRIM / SPAN.

Pipes shall be supplied in plain-ended lengths.

The minimum acceptable wall thickness of pipes and fittings shall be as below:-

TABLE 9: Minimum Acceptable Thickness of Underground uPVC Pipe and Fittings

Nominal Sizes (mm)	Wall Thickness (mm)		
	Pipes	Fittings	Junctions
100	3.2	3.4	3.4
155	4.1	4.1	4.1
200	4.9	4.9	4.9
250	6.1	6.1	6.1

The method of jointing to be employed shall be strictly to manufacturer's recommendation.

1.2.4.1.3 Expansion Joints (Expansion Coupling for uPVC Pipes)

Where pipework is constructed using solvent welded joints, expansion joints for uPVC pipes shall be carried out in accordance with the manufacture's recommendations.

Expansion joints shall be provided at a maximum of 4 meter centers for soil, 2 meter centers for waste and between fixed points over 1 meter centers.

1.2.4.1.4 Cast Iron/Galvanized Iron Pipe

Where shown or stated in the drawing, 100mm diameter cast iron soil and vent pipes internally coated with anti-corrosive bituminous coating shall be provided, fixed and connected to the fittings and sanitary system.

All main and branch soil pipe and fittings shall be cast iron to BS 416 Heavy grade coated with an approved tar-based composition.

Main and branch vent pipe and fittings shall be cast iron to BS 416 Heavy grade factory coated with an approved certificate tar-based composition.

Branch vent pipe of 2" (50 mm) diameter and below shall be galvanized to BS 10255: Heavy grade.

Cast iron pipes shall be jointed with an approved certificate resin with molten lead and well-sealed. All necessary bends, tees, sockets, branches, offsets, inspection pieces, shall be provided where necessary.

1.2.4.1.5 Other Material

All material not specifically mentioned above shall conform to the latest edition of their respective British Standard and/or Malaysian Standard or equivalent specification and shall be to the approval of SIRIM / SPAN.

1.2.5 WORKMANSHIP & PIPE SUPPORT

The installation, method of jointing and fixing shall comply in all respects to the manufacturer's recommendation and comply with latest relevant standards.

All soil, waste and vent pipes, pipe hooks clamps and clips shall be placed tight up against the head or underside of the collar. Extension clips shall be used where it is necessary to run the pipe clear of the wall.

Use only fixings that are compatible with the materials and system of pipework. Do not exceed the maximum spacing between fixings for sanitary pipes given below.

Maximum intervals between pipe supports shall be: -

1.2.5.1 Horizontal Position

TABLE 10: Recommended Maximum Spacing of Support for Horizontal Sanitary Pipe

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
32	0.5	2.1
40	0.5	2.4
50	0.6	2.7
80	1.0	3.0
100	1.0	3.0
150	1.2	NA

Source: British Standards Institude. (2000). BS EN 12056-2: Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation

1.2.5.2 Vertical Position

TABLE 11: Recommended Maximum Spacing of Support for Vertical Sanitary Pipe

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
32	1.2	3.7
40	1.2	3.7
50	1.2	4.6
80	2.0	4.6
100	2.0	5.5
150	2.0	NA

Source: British Standards Institude. (2000). BS EN 12056-2: Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation

The work shall be inspected and tested during installation at agreed stages subject to S.O. approval.

All work, which will be concealed, shall be tested before it is finally enclosed.

A final test shall be made upon completion for soundness and performance in accordance with BS EN 12056-2: Gravity Drainage Systems Inside Buildings: Sanitary Pipework, Layout and Calculation or MS 1402 – Code of Practice for Sanitary System in Buildings.

1.2.6 VENTILATING PIPE

Main ventilating stack pipe shall be discharge to the open air or connected to the discharge stack above the spillover level of the highest appliance on the stack. (Soil pipe or single stack system shall in all cases be vented by upward extension of the soil or combined pipe).

The upward vent pipe shall be straight and free from any bends or angles except where unavoidable. It shall be extended through the roof to the required height with the open end protected by means of copper wire globe or approved cowl. The distance of outlet is not less than 900mm above the head of any window or other opening into a building and within a horizontal distance of 3 m.

All vent and branch vent pipes shall be graded 18 mm/m (minimum 1^{o}) to drip back to the soil or waste pipe by gravity. A branch vent must rise vertically or at an angle of not more than 45˚ from the vertical to a point 150 mm above the fixture it is venting before running horizontally.

Main ventilating pipe shall not be less than 50 mm dia. or 2/3 of the diameter of the main soil/waste pipe whichever the larger diameter is.

1.2.7 ANTI-SYPHONAGE

An anti-syphonage pipe shall be carried up from each fixture to the branch or main vent pipe above the level of the fixture to prevent the loss of the water seal in traps.

No fixture shall be connected to the soil, waste or combined pipe at any point between the trap and the anti-syphonage pipe, which it serves.

In special cases, anti-syphonage vent pipe could be connected to the waste, combined pipe or soil pipe on the opposite side of the water seal to the fixture at a point, which should be between 75 mm to 300 mm from the crown of the trap. In the case of bath and closet pan, the vent pipe shall not exceed 1.2 m from the crown of the trap.

Before connecting to the main vent pipe all anti-syphonage pipework shall rise above the floor level of the sanitary appliances.

Anti-syphonage pipework shall not be less than 32 mm diameter.

1.2.8 TRAPS

Each sanitary appliance shall be fitted with a trap either as an integral part of the appliance or attached to and immediately beneath its outlet. All traps shall be accessible and provided with adequate facility for cleaning. The internal surface of the trap shall be smooth throughout. Generally, the trap shall be of the same material as the soil/waste pipe.

1.2.9 FLOOR TRAPS

Floor trap in all areas, unless otherwise specified, shall be 100 mm diameter similar materials to the pipe traps complete with grating and self-tapping screw.

1.2.10 TESTING TEES

Testing tees shall be located on the vertical stacks between floors to enable each floor to be tested independently as specified hereafter. Upon completion of testing, the tees shall be sealed up with lead joint or solvent joint where uPVC pipe is specified.

1.2.11 GREASE INTERCEPTORS/WASTE DRAIN TRAP (WHERE SPECIFIED)

The body of the interceptor and baffles shall be made of Stainless Steel Grade 316. The baffles shall be of removable type.

Grease interceptors shall be certified by relevant authority. It shall be of floor mounted or fully recessed manual type complete with extension collar or extension piece to suit the structural requirement where required.

1.2.12 REDUCING FITTING

Wherever reduction in pipe sizes takes place, reducing fitting shall be used.

1.2.13 CLEANING EYES AND INSPECTION OPENING

To provide access for the proper inspection, cleaning and testing of the entire length of pipe, inspection openings and cleaning eyes shall be provided on all soil, waste and combined pipes at:-

a) Each change of direction of piping; and
b) Based on each soil, waste or vent stack.

1.2.14 TEMPORARY CLOSING OF PIPEWORKS (INGRESS OF CONTAMINANTS)

As soon as pipes have been installed, all openings shall be capped or plugged to prevent the entrance of materials that would obstruct or choke the pipes. It is the responsibility of the Contractor to ensure that caps and plugs are left in place until removal is necessary for completion of installation.

1.2.15 INSPECTION CHAMBER

The works shall include the construction of all inspection chambers generally as shown in the civil/tender/working drawings and specification.

1.2.16 UNDERGROUND/BURIED PIPE (FOR SANITARY)

All underground/buried pipes shall be carefully laid on beddings free from rocks, stones and other broken materials. Unless otherwise stated, all direct buried pipework shall be installed in open trench.

1.2.16.1 Excavation and Trenching for Piping

The Contractor shall perform all excavation to the depths indicated in the drawings or as specified in conformance with local authority requirements.

All excess excavation materials shall be removed from the site. The contractor shall prevent surface water from flowing into trenches or the excavations by using sheeting and shoring method thus ensuring the safety of personnel. Any water accumulating therein shall be removed.

1.2.16.2 Trench Excavation

Trenches shall be of necessary width for the proper laying of the pipe, and the banks shall be as nearly vertical as practicable. The bottoms of the trenches shall be accurately graded to provide uniform bearing and supports for each section of the pipe on undisturbed soil at every point along its entire length, or may be over excavated 100 mm below depth indicated and filled with well tamped salt free coarse sand or other approved materials. Layers or brick, concrete base and angle blocks shall be used support for the laying of piping.

TABLE 12: Trenches Width for different Pipe Diameter

Pipe Diameter Inches	Trenches Width Inches
3 and under	15 - 24
4 - 6	19 - 28
8	20- 30

1.2.16.3 Depth of Trench's Cover

The minimum depth of trenches covered with concrete slab shall be 450 mm from top of pipe to finished ground level and trenches without concrete slab shall be 750 mm.

1.2.16.4 Protection of Existing Utilities

Existing utility lines or other completed utility lines if damaged by the Contractor shall be repaired at his own expense.

When connecting to existing utility lines, no section of the existing piping shall be abandoned unless it is specifically indicated on the drawings.

1.2.16.5 Backfilling of Trenches

Trenches shall not be backfilled until all required pressure and other tests have been performed. Backfill and compaction shall comply to Civil & Structural Engineer's requirements.

---------- END OF SECTION 1.2 ----------

SECTION 2:

SPECIFICATION FOR TESTING, ADJUSTING, BALANCING AND COMMISSIONING (TABC)

SECTION 2 - SPECIFICATION FOR TESTING, ADJUSTING, BALANCING AND COMMISSIONING (TABC)

2.0 GENERAL

All work to be performed shall be in accordance with this specification and the commercial practice.

2.1 INTERNAL COLD WATER PLUMBING SYSTEM

The Contractor shall allow for the cost of all tests to the plumbing system to the satisfaction of the S.O. The completed plumbing system shall be tested for hydraulic performance.

The cost for providing all testing, adjusting, balancing and commissioning as well as calibrated measuring equipment, all materials and consumables such as fuel, electricity, water etc. shall be borne by the Contractor.

All pipework which is to be encased or concealed shall be tested, approved and recorded before it is finally enclosed.

The Contractor shall give the S.O a minimum of full seven (7) days' notice of his readiness to carry out acceptance tests, completed testing sheet and schedule for S.O approval.

Before the commencement of acceptance tests, the Contractor shall have completed all of his preliminary testing and adjusted the equipment to its proper running order.

During the testing period, no modification, adjustment or other work on the installation shall be carried out without the permission of the S.O. Should there be any contravention of this requirement, the results of all tests completed may be rejected and a retest shall be carried out.

No acceptance test shall be carried out except in the presence of the S.O, the State Water Authority's representative (if required) and the Contractor or their respective representative appointed for the purpose.

If the installation fails to perform during testing in accordance with the requirements of the Specification or acceptance criteria, the S.O may reject the whole or any part of it. The Contractor shall bear all costs and expenses for all retests and remedial works.

2.1.1 Testing of Internal Pipework

2.1.1.1 Pressure Test

Internal reticulation and main distribution pipes shall be slowly and carefully charged with water in order that all air is expelled from the system. The system shall be allowed to stand full for 24 hours. An air relief valve should be provided at the highest point in the system to bleed off any air that is present.

A test pressure of 1.5 times the maximum working pressure shall be applied for 24 hours.

No pipework shall be covered or concealed until it has been tested to the satisfaction of the S.O or his representatives. Where arrangement of work makes necessary, the piping system shall be tested by sections to prove joints between sections.

The completed system shall be inspected for leaks during the test. Should any signs of leakage occur in the tanks or pipework, their positions shall be marked and the Contractor shall carry out remedial measures. The pressure tests procedure shall be repeated until the whole water system passes. The pipe installation is considered to have passed the pressure test if no visible leak and no drop in the pressure reading are observed during the test.

All equipment not designed to withstand test pressure shall be disconnected during test, but shall be reconnected and tested under actual working pressure.

The permanently installed pumps shall not be used for pressure testing of the water system.

2.1.1.2 Flow Test

During the flow test, all pumps shall be run with all valves fully open and the following data shall be recorded:-

a) Flow at pump outlet into storage tank
b) Head at pump discharge outlet
c) Current consumed
d) Voltage

2.1.1.3 Flushing of Cold Water System

After completion of the pressure tests to the satisfaction of the S.O, the whole piping and water storage system shall be thoroughly flushed with potable water before they are put into use.

The Contractor shall ensure the system is fit for purpose and the water in the pipeline is safe for consumption after flushing.

The Contractor, at his own expense, shall use water supply for cleaning and flushing out of all the plumbing system that he had installed as per Contract.

Control valves and all equipment liable to damage, shall be disconnected before cleaning out. All strainers shall be thoroughly cleaned out during and at the completion of the clean out operation.

2.1.1.4 Balancing

Prior to balancing, all isolation/gate valves shall be checked to be in the fully open position for the pumping system.

2.1.1.5 Records

All pressure, flow and balancing tests shall be recorded by Contractor and certified by S.O or S.O representatives.

The S.O reserves the rights to order a re-test if the Contractor fail to produce authentic test record.

2.1.2 Testing of Storage Water Tank

After flushing, the tank shall be filled with water to maximum operating capacity level and the level of water surface shall be carefully recorded. The tank shall be accepted as satisfactory if after a period of 48 hours there is:-

a) No measured reduction in water level, due allowance being made for evaporation from the surface of water
b) No visible sign of leakage from any part of tank: and
c) No deformation of any part of the surface

If the test results do not satisfy the above conditions of test, the Contractor shall locate and rectify all defects and leakages and the test shall be repeated. The Contractor shall bear all costs and expenses for all tests and remedial works.

2.1.3 Testing of Pump (If Applicable)

All pumps and motors shall be checked for flow rates, pressures and RPM. The input signal device sensors and controllers shall be checked to ensure the pumps cut-in and cut-out at predetermined water levels.

2.1.4 Post Occupancy Testing, Adjusting, Balancing and Commissioning

Further adjustments to the system controls such as re-balancing, re-tuning, re-checking and re-adjustment etc. shall be made whilst the building is occupied and the installation is in use during the defects liability period. The cost of the adjustment shall be included in the tender.

2.2 SANITARY PLUMBING SYSTEM

The S.O reserves the right to request for water, air or smoke tests as well as for hydraulic performance to be performed by the Contractor at his expense including the furnishing of the necessary equipment. The testing procedure shall be in accordance with MS 1402: Part 3.

2.2.1 Water Test

There is no justification for a water flood test to be applied to the whole of the plumbing system. The part of the system mainly at risk is that below the lowest sanitary appliances and this may be tested by inserting a test plug in the lower end of the pipe and filling the pipe with water up to the flood level of the lowest sanitary appliances, provided that the static head does not exceed 6 m. This is a visual inspection.

2.2.2 Air Test

Air test may be performed by inserting expanding rubber testing plugs in the lower and upper ends of the main soil pipe and main ventilating pipes and sealing the plugs with water necessary. The water seals of all sanitary appliances shall be fully charged.

The testing plug at the upper end of the ventilation pipe should be fitted with a tee-piece with cock on each branch. A flexible tube manometer should be fixed to one branch while air pressure is being introduced into the system through the other branch until the desired pressure is indicated on the manometer scale.

The air test applied shall be 3.8 mbar (38 mm water gauge) in period not less than 3 minutes without loss.

2.2.3 Smoke Test

Smoke can be introduced into the system by a small machine under the source pressure as for the air test. The whole system shall be filled with smoke before the openings are sealed with plugs.

The pressure on the smoke shall be maintained for three (3) minutes after the last opening has been sealed.

Smoke test is not recommended if UPVC pipe material is adopted. Rubber jointing components can also be adversely affected.

Smoke testing shall normally only be used instead of air test when an undetectable leak in the system occurs.

2.2.4 Hydraulic Performance

Hydraulic performance discharge tests shall be made from all appliances singly and correctively. Obstruction in any of the pipe lines shall be traced and the whole system examined for proper hydraulic performance including the retention of an adequate water seal in each trap.

---------- END OF SECTION 2 ----------

SECTION 3:

SPECIFICATION FOR SERVICE AND MAINTENANCE

SECTION 3 - SPECIFICATION FOR COMPREHENSIVE SERVICE AND MAINTENANCE FOR INTERNAL COLD WATER AND SANITARY PLUMBING SYSTEMS

3.0 GENERAL

All work to be performed shall be in accordance with this specification and the commercial practice.

3.1 WORKMANSHIP AND MATERIALS

The work described in this specification shall be performed by skilful workmen in the service, maintenance and repair of the internal cold water and sanitary plumbing system and shall be executed in accordance with the good engineering practice.

All materials to be supplied in connection with work under this Specification shall be new, unused, genuine, and shall generally be the best quality in manufacturing and performance.

3.2 SUPERVISION

The Contractor shall have a competent Plumber in charge of the service, maintenance and repair work to be carried out under this Specification and shall be in the direct employ of the Contractor, and acceptable to the S.O.

The Contractor shall have in his direct employ workmen who are skilled in the service, maintenance and repair of internal cold water and sanitary plumbing system.

3.3 SCOPE OF WORK

The work covered under this Specification is to service and maintain all equipment comprising the complete internal cold water and sanitary plumbing system strictly accordance with the servicing and maintenance schedule as set out in Clause 3.5 below.

The Contractor shall rectify of any defects in any parts of the complete internal cold water and sanitary plumbing system observed during routine inspection and service, and shall repair such defects if required to do so by the S.O.

The Contractor shall also provide emergency repair service at any time if required to do so by the S.O.

3.4 CONSUMABLE MATERIALS

The Contractor shall include in his service and maintenance contract for the supply of the following consumable materials as and when required.

a) All oils and greases required for the lubrication of motor bearing, packing, pivots and other moving parts.

b) All cotton waste, soap detergent and other cleaning materials required for cleaning purpose.

c) All consumable filter elements.

d) All tap washers.

e) All electric contact points required to replace worn electric contact points in switchgears, electric control gears and electric relays.

f) All electric fuses required to replace blown or defective fuses.

g) All indicator lamps required to replace blown lamps.

The cost of these consumable materials shall not be charged for separately, but shall be included in the schedule quoted by the Contractor for the service and maintenance of the complete internal cold water and sanitary plumbing system.

3.5 SERVICING AND MAINTENANCE SCHEDULE

The Contractor shall inspect and service all equipment comprising the complete internal cold water and sanitary plumbing system periodically as scheduled in the approved check list except where otherwise directed by the S.O.

The Contractor shall report in writing to the S.O any defect/s observed in any part or parts of the complete internal cold water and sanitary plumbing system. The technical report shall state the causes of the defects observed, and shall include the estimate of repairs required for non-consumable material or any part or equipment damaged by catastrophic event or vandalism.

3.6 CHECK LIST (MONTHLY REPORT)

3.6.1 Pumps (If Applicable)

a) Check all seals, glands and pipe line for leakage

b) Check all pump bearing and lubricate with oil or grease

c) Check the alignment and condition of coupling

d) Check all bolt and nut for tightness

e) Clean pumps casing and shaft

f) Check and record pump running pressure

3.6.2 Electric Motor Pumps (If Applicable)

a) Check motor bearing and rewinding

b) Check carbon brush and slip rings and clean as necessary

c) Check and record motor running amperes, voltages and resistance of cable

3.6.3 All Electrical Starters, Electrical Control Gears, and Ancillary Electrical Apparatus (If Applicable)

a) Clean and adjust all bearings, pivots and other moving parts as necessary.

b) Clean or renew electric contactors as necessary.

c) Renew electric fuse as necessary.

d) Check the performance of the complete pumping and associated equipment as necessary.

3.6.4 Cold Water Piping

a) Check water leakages in piping and rectify accordingly.

b) Check water leakages in valve and rectify accordingly.

c) Check excessive vibration of piping during pumping.

d) Clean strainer baskets.

e) Check all water taps for leakages and replace rubber washer as necessary.

f) Check ball float valves and adjust as necessary.

g) Check water level control indicator.

h) Check water leakage at any part of jointing of panel water tank.

3.6.5 Internal Sanitary Plumbing System

a) Check access covers, caps and cleaning eyes.

b) Check any water leakage at any part of jointing of internal sanitary pipe system.

c) Check discharge pipe systems:

i) It shall be kept in a clean and sound condition.

ii) Any blockages shall be removed by using hand operated rods and capable passing through the system without damaging the internal surfaces of pipes and fittings.

3.7 INSPECTION AND RECORDS

a) Inspect and check all other equipment under this Contract, whether or not these are specifically mentioned in the check list.

b) The Contractor is responsible for the operation of the plant and equipment on correct methods of operating the plant and equipment and on the maintenance points to be watched.

c) Report in writing to the S.O any defects observed in any part or parts of the complete internal cold water and sanitary plumbing system. The report shall state the cause/s of the defect/s observed and shall include an estimate of the cost of repairs required.

d) Service and maintenance records shall be properly updated and kept by Contractor or as instructed by S.O.

3.8 SAMPLING OF STORAGE WATER

The Contractor shall have deemed to have included the sampling and testing of water in storage tanks.

The Contractor shall be responsible for ensuring that water quality testing is regularly done on the cold or domestic water supply network to monitor the water quality provided to the end user against the most current revision of the State Water Authority guidelines for domestic and drinking water.

Samples for testing to be performed every six months shall include:

a) Chemical Analysis
b) Bacteriological Analysis

In the event the cold or domestic water quality does not meet the most recent revision of the State Water Authority guidelines for domestic and drinking water (the most current revision at the time of sampling), the Contractor shall immediately notify the S.O and recommend appropriate action for approval.

The above mentioned tests shall be performed again until the approval of S.O is obtained.

3.9 REPAIRS

The Contractor shall repair any defects in the complete internal cold water and sanitary plumbing system on the instruction of the S.O.

All repairs on the complete internal cold water and sanitary plumbing system shall be guaranteed by the Contractor against defects in workmanship and materials for a period of one year to take effect from date of completion of the repairs. During the guarantee period, the Contractor shall rectify defects in repairs carried out by him with no additional charge to the government.

3.10 SERVICE AND MAINTENANCE RECORDS

The Contractor shall provide a service and maintenance record book for the complete internal cold water and sanitary plumbing system being serviced and maintained by the Contractor. This record book shall be kept in the plant or maintenance room of internal cold water and sanitary plumbing system being serviced and maintained, and brief details of all services, maintenance and repairs carried out The address and telephone number of the Contractor's personnel and person in charge shall also be recorded into this record book to facilitate emergency service call.

The Contractor shall also keep an accurate detailed record in duplicate of all service, maintenance and repair work carried out by him on the complete internal cold water and sanitary plumbing system as well as ancillary equipment. This record shall be in the form of a Maintenance/Repair Sheet, and shall be countersigned by the S.O. each time the internal cold water and sanitary plumbing system as well as ancillary equipment is attended to by the Contractor.

---------- END OF SECTION 3 ----------

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Appendix

Limit Of Mechanical Scope Of Design (Civil and Mechanical)

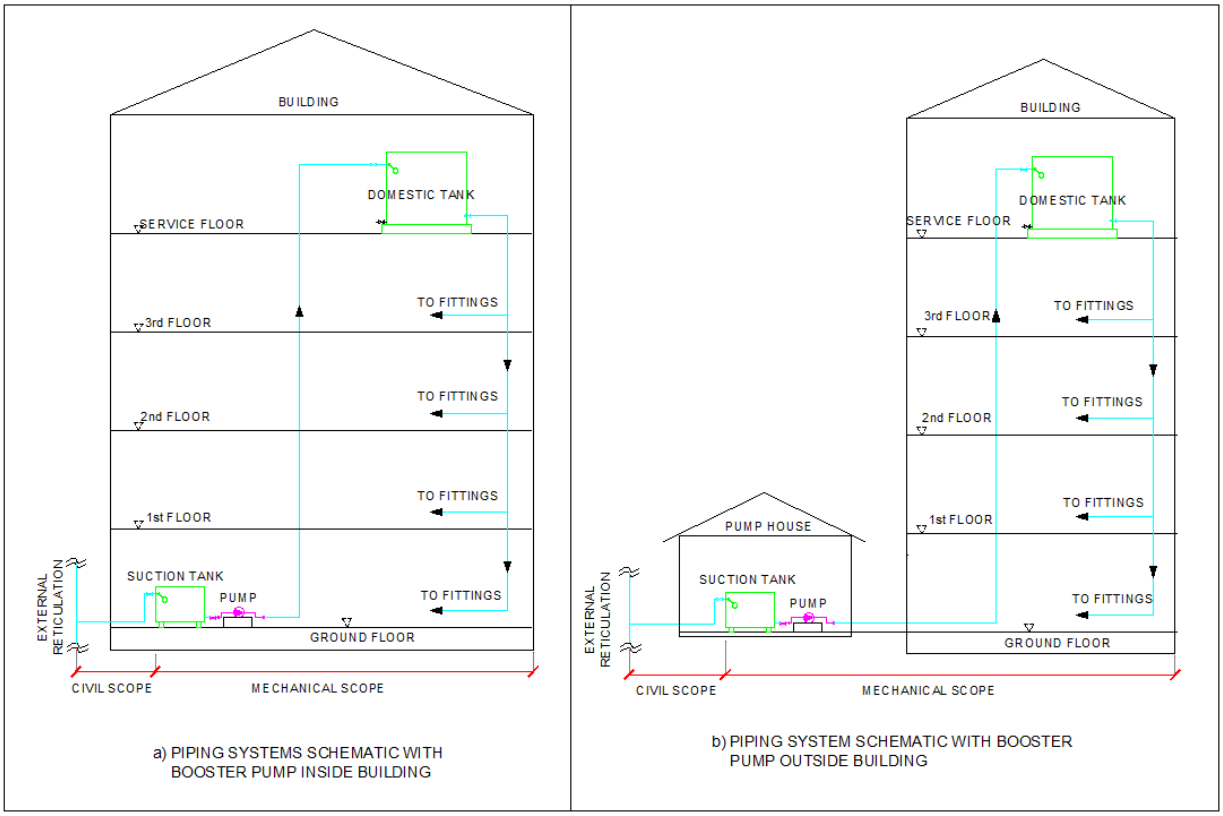

FIGURE 1: Indirect Feed System

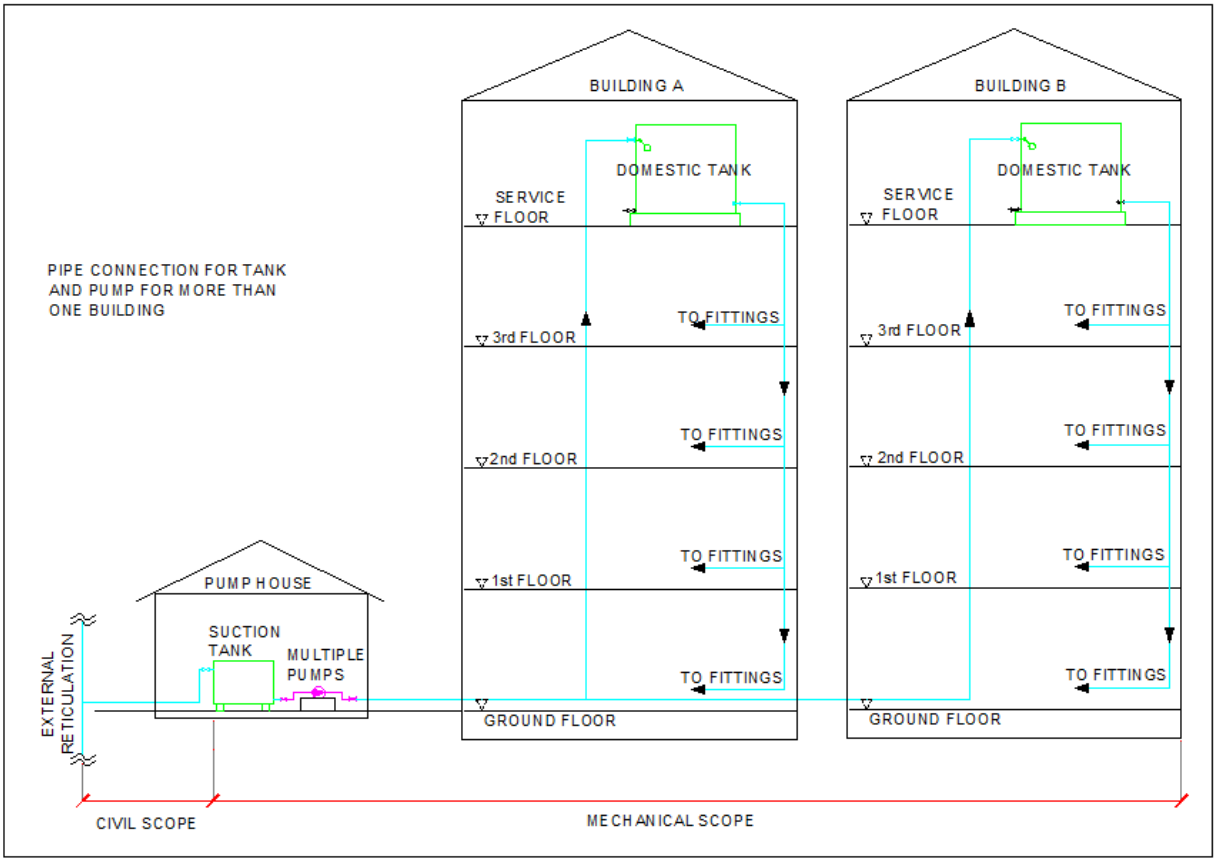

FIGURE 2: Pumping To Multiple Building Blocks

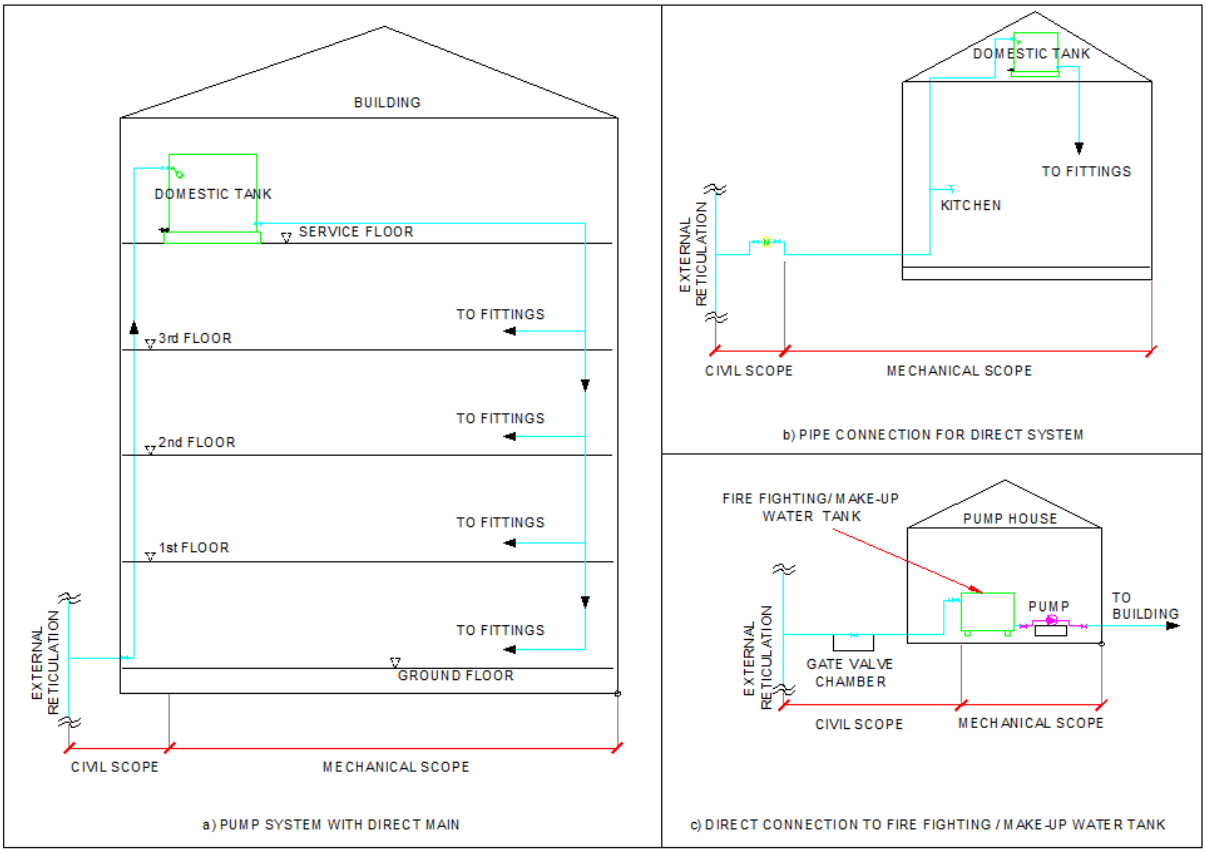

FIGURE 3: Direct Feed From Main Water Pipe

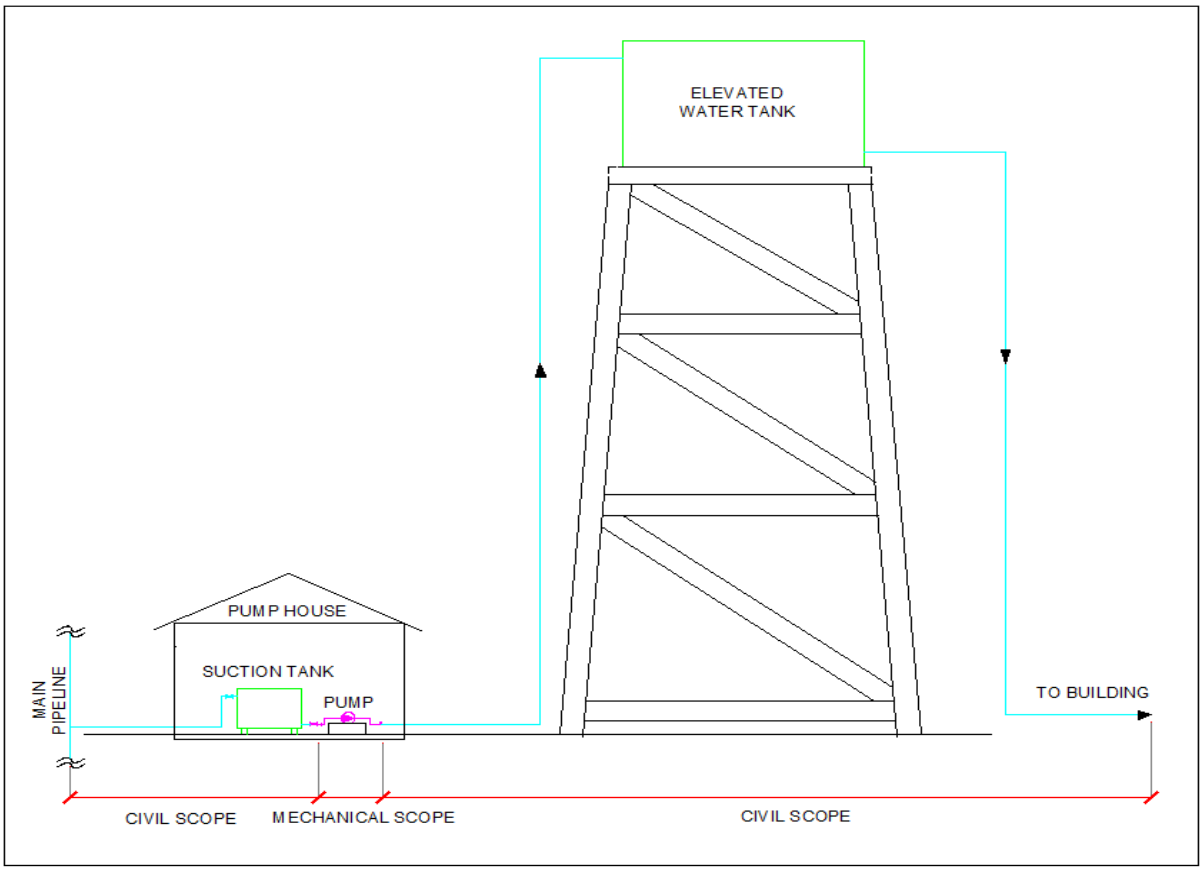

FIGURE 4: Pumping To Elevated Water Tank

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