

connection. Under roads where necessary shall suitably protected as shown on the Plans.

Fittings shall be malleable iron Type II, galvanized iron conforming to specification requirements defined in ASTM A338, Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 345°C.

Water pipe and fittings with a lead content which exceeds 8% shall be prohibited in piping systems used to convey potable water.

Where required for large diameter pipes (315 mm up to 800 mm) with elastomeric rubber sealed ring, the Oriented Polyvinyl Chloride (PVC-O) Class 500 shall be in accordance with the applicable requirements defined in ISO 16422:2014, Pipes and Joints Made of Oriented Unplasticized Polyvinyl Chloride (PVC-O) for the Conveyance of Water under Pressure or ISO 1452:2009, Plastics Piping Systems for Water Supply and for Buried and Above-Ground Drainage and Sewerage Under Pressure - Unplasticized Poly(Vinyl Chloride) (PVC-U).

ii. Valves

Valves for water supply shall be bronze body with threaded ends rated 21 kg/cm². All valves shall be gate valves unless otherwise specified. Gate valves shall have solid wedge body and discs conforming to specification requirements defined in ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings. Globe valves shall have plug type discs with ferrule threaded ends and bronze body.

Valves up to and including 51 mm in size shall be brass or other approved materials. Sizes exceeding 51 mm shall be permitted to have cast-iron or brass bodies.

iii. Water Meter

Water meter when required to be furnished by the Contractor shall be of the type tested and approved by Metropolitan Waterworks and Sewerage System (MWSS) or Local Water Utilities Authority (LWUA) or any agency/ (ies) accredited by both.

c. Approved Alternate Pipes and Fittings

Pipes and fittings for sanitary and potable water lines as approved alternate shall be Unplasticized Polyvinyl Chloride Pipes and Fittings (uPVC).

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series) and PNS 65: 1993, Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply. Fittings shall be molded type and designed for solvent cement joint connection for water lines and rubber O-ring seal joint for sanitary lines.

All materials shall bear Philippine Standards (PS) mark for locally manufactured and Import Commodity Clearance (ICC) marks duly issued by Bureau of Philippine Standards (BPS) for imported materials.

i. Unplasticized Polyvinyl Chloride (uPVC) – Potable Water

1. Pipes and fittings for water lines and pressure lines shall conform to PNS 65: 1993: - Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply.
2. Pipes and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
3. Maximum levels of toxic substances shall conform to Table 3 of PNS 65: - Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply.
4. Pipes and fittings for water lines, sizes 20 mm to 63 mm shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.
5. Pipes and fittings for pressure lines, sizes 63 mm and larger shall be designed for manually-installed or machine-installed fixed seal gasket type jointing connection. Gaskets is to be made of Ethylene Propylene Diene Monomer (EPDM) rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced embedded in EPDM rubber gasket.

ii. Unplasticized Polyvinyl Chloride – Non-Potable Water (Sanitary and Sewer Line)

1. Pipes and fittings for sanitary lines shall conform to PNS 1950, Plastic piping systems for soil and waste discharge (Low & High temp.) inside buildings – Unplasticized Polyvinyl Chloride (PVC-U), conforming to specification requirements defined in ASTM D2729, Standard Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings for pipes, and ASTM D3311, Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns for fittings.
2. Pipes and fittings for sewer lines shall conform to Standard Dimension Ratio (SDR) 34 conforming to specification requirements defined in ISO 4435, Plastics Piping Systems for Non-Pressure Underground Drainage and Sewerage – Unplasticized Polyvinyl Chloride (uPVC).
3. Pipes and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass.
4. Pipes and fittings for sanitary and sewer lines, sizes 57 mm and larger shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems and/or machine-installed seal gasket type jointing connection. Gaskets is to be made of Engineered

Natural Rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced NBR (Nitrile Butadiene Rubber).

iii. Chlorinated Polyvinyl Chloride (cPVC)

Pipes and fittings for hot and cold water line shall be designed conforming to specification requirements defined in ASTM 2846 (CTS) SDR 11, Standard Specification for Chlorinated Polyvinyl Chloride (cPVC) Plastic Hot and Cold Water Distribution Systems, with the use of one-step cPVC solvent cement in jointing method.

Pipes and fittings shall be Heavy Metal-Free (HMF) as validated through Inductively Coupled Plasma Optical Emission Spectrometry (ICPOES) method.

iv. High-Density Polyethylene (HDPE) Pipe

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in PNS-ISO 4427, Polyethylene (PE) Pipes and Fittings for Water Supply.

v. Polypropylene Random/ Copolymer (PPR/PPR-C)

Pipes and fittings for hot and cold water line shall be designed conforming to specification requirements defined in DIN 8077- Polypropylene (PP) Pipes- PPH, PP-B, PP-R, PP-RCT- Dimensions and DIN 8078 - Polypropylene (PP) PipesPP-H, PP-B, PP-R, PP-RCT – General Quality Requirements and Testing for pipes and DIN 19560/16962 – Pipes and Fittings made of Polypropylene (PP) 216 for hot water resistant waste and soil discharge systems inside buildings/Pipe Joint assemblies and fittings for types 1 and 2 polypropylene (PP) pressure pipes; tees and branches produced by segment inserts and necking for butt welding; dimensions for fittings or ISO 15874- Plastic Piping Systems for Hot and Cold Water Installations- Polypropylene (PP).

- vi.** Ductile Iron shall be designed conforming to specification requirements defined in ASTM A536:2014 Standard Specification for Ductile Iron Castings, ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe and ASTM A377, Standard Index of Specifications for Ductile-Iron Pressure Pipe.

d. Septic Tank

The septic tank shall be provided as shown on the Plans including all pipe vents and fittings. The various construction materials such as concrete or masonry work shall conform to the corresponding Items of this Specifications. Inlet and outlet pipes shall conform to the latest edition of the Revised National Plumbing Code and Uniform Plumbing Code of the Philippines.

e. Plumbing Fixtures and Fittings

All fittings and trimmings for fixtures shall be chromium-plated and polished brass unless otherwise approved. Exposed traps and supply pipes for fixtures shall be connected to the roughing in, piping system at the wall unless otherwise indicated on the Plans. Built-in fixtures shall be watertight with provision of water supply and drainage outlet, fittings and trap seal. Unless otherwise specified, all plumbing fixtures shall be made of vitreous china complete with fittings.

1. Water closet shall be vitreous china, free standing toilet combination, round front bottom outlet siphonic washdown bowl with extended rear self and closed coupled tank with cover complete with fittings and mounting accessories. Model make and color shall be submitted for approval prior to delivery at jobsite by the Engineer or unless otherwise specified on the Plans.
2. Plastic toilet bowl shall be a high quality polypropylene virgin material composition, complete with integrated parts and other accessories or unless otherwise specified on the Plans.
3. Lavatory shall be vitreous china, wall hung with rear overflow and cast-in soap dishes, pocket hanger with integral china brackets, complete with twin faucets, supply pipes, P-trap and mounting accessories. Where indicated on the Plans, to be counter top model make and color shall be approved by the Engineer.
4. Urinal shall be china vitreous, wall hung wash-out urinal with extended shields and integral flush spreader, concealed wall-hanger pockets, 19 mm top spud complete with fitting and mounting accessories. Model make and color shall be approved by the Engineer.

i. Prohibited Fixtures

Water closets having an invisible seal or an unventilated space or having walls which are not thoroughly washed at each discharge shall be prohibited. Any water closet that might permit siphonage of the contents of the bowl back into the tank shall be prohibited. Drinking fountains shall not be installed in public toilet rooms.

Trough urinals and urinals with an invisible seal shall be prohibited. Non-water urinals are exception.

f. Bathroom and Toilet Accessories

- i. Shower head and fitting shall be movable, cone type with escutcheon arm complete with stainless steel shower valve and control lever, all exposed surface to be chromium finish.
- ii. Grab bars shall be made of tubular stainless steel pipe provided with safety grip and mounting flange.
- iii. Floor drains shall be made of stainless steel beehive type, measuring 100 mm by 100 mm, and provided with detachable stainless strainer, expanded metal lath type.
- iv. Toilet paper holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent fixture and facing tiles.
- v. Soap holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent tile works.
- vi. Faucet(s) shall be made of stainless steel for interior use.
- vii. Hose-bib(s) shall be made of bronze cast finish.

g. Special Plumbing Fixtures

- i. Kitchen sink shall be made of stainless steel self-rimming, single compartment complete with supply fittings, strainer traps, dual control lever

and other accessories or plastic made of a high quality polypropylene virgin material composition, with stainless steel strainer, lock-nut, rubber gasket and flexible connector unless otherwise specified on the Plans.

- ii. Laboratory sink shall be made of cast iron metal with white porcelain finish with single compartment, flat rim ledge, 762 mm x 533 mm complete with supply fittings, strainer, trap and other accessories.
- iii. Scrub-up sink shall be made of cast iron metal with white porcelain finish measuring 610 mm x 610 mm complete with supply fittings, strainer, trap and wall mounting accessories.
- iv. X-ray developing tank shall be made of cast iron white porcelain finish with three (3) compartment x-ray processing, drain plug, open standing drain, 19 mm IPS inlet spud complete with stand and mounting accessories.
- v. Squat bowl(s) shall vitreous china, wash down squat bowl with integral foot treads, pail flush type or plastic made of a high quality polypropylene virgin material composition, complete with P-Trap fitting and its rubber gasket. Color, make and type to be approved by the Engineer.
- vi. Grease traps shall be made of cast bronze with detachable cover and mounting accessories.

h. Roof Drains, Downspout, Overflow Pipe and Steel Grating

The Contractor shall provide, fit and/or install necessary drains with strainers, where shown on the Plans. Each drain with strainer shall fit the size of the corresponding downspout (or roof leader) over which it is to be installed and in conformity with the following schedule:

- i. Scupper drains (for balconies, parapet) shall be made of bronze base with flashing. Flange threaded outlet and convex with integral flashing clamp bolted to flange.
- ii. Roof drains shall be made of bronze base semi-dome with large free area, flashing clamp and integral gravel stopper. To be used at roof decks, canopies, gutters, and elsewhere indicated on the Plans.
- iii. Downspouts when encased in concrete, unless otherwise shown on the Plans shall be polyvinyl chloride (PVC). Whether indicated or specified to be cast iron or galvanized iron the same shall meet the specification requirement as herein described.
- iv. Overflow pipes shall be made of galvanized iron pipe measuring at least 13 mm diameter and spaced 200 mm on center.
- v. Steel grating shall be made of wrought iron metals of design on shop drawings approved and surfaces to be located with shop finish.

i. Fire Protection System

Firestop materials shall be installed in accordance with Uniform Plumbing Code of the Philippines, the National Building Code of the Philippines, Fire Code of the Philippines and the manufacturer's instructions.

- i. Fire hose cabinets shall be locally available consisting of 38 mm diameter valve hose rack with nipple 30 mm rubber lined hose cable with standing pressure of 4,268 kg/cm², nozzle 38 mm diameter brass, chromium plated. Wet standpipes shall be located so that all portions of the buildings are within 6 m of a nozzle attached to 22 m of hose.
- ii. Fire standpipe system shall consist of risers and hose valves. Pipe shall be extra strong black iron. Valves to be high grade cast bronze mounted

withstanding pressure of 79.40 kg/cm², working pressure as indicated on the Plans.

- iii. Fire extinguisher shall be portable, suitable for Class A, B, C fires, mounted inside cabinet. Cabinet shall be full flush mounting door with aluminum trim for glass plate, frame and box shall be made of gauge 14 galvanized iron sheet with white interior and red exterior baked enamel finish over primer. Cabinet to be wall mounted and size to be able to accommodate the defined components.
 - iv. Yard hydrant where shown on the Plans shall match the Integrated Fire Department requirements. Outlet shall be single 63 mm diameter gate valves with chain connected caps.
 - v. Pipes and fittings for fire sprinkler piping system as approved alternate shall be made out of high grade Chlorinated Polyvinyl Chloride (cPVC) materials conforming to specification requirements defined in ASTM F442 for pipes and ASTM F437, F438, F439 or F1970 for fittings.
 - vi. For Steel pipe and fittings shall conforming to specification requirements defined in ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, ASTM A135 – Standard Specification for Electric-Resistance-Welded Steel Pipe and ASTM A795 – Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - vii. Fire pumps where shown on the approved Plans shall conform to the Integrated Fire Department requirements, wherein the Fire Pump Motor shall be electric-driven and the overall system shall include an integrated Jockey Pump, Controller, and all the necessary accessories.
- j. **Built-in Appliances**
Built-in appliances such as urinal trough, lavatory and slope sink shall be made as indicated on the Plans, exposed surfaces to be tile wainscoting complete with fitting accessories required as practiced in this specialty trade.

C. Construction Requirements

The Contractor before any installation work is started shall carefully examine the Plans and shall investigate actual structural and finishing work condition affecting all his work. Where actual condition necessitates a rearrangement of the approved pipe layout, the Contractor shall prepare Plan(s) of the proposed pipe layout for approval by the Engineer.

For approved alternate pipes and fittings, installation work shall conform to the approved Plans or manufacturer's recommendation.

a. Installation of Soil, Waste, Drain and Vent Pipes

- i. All soil and drainage pipes shall be pitch 6 mm per 300 mm but in no case flatter than 3 mm per 300 mm.
- ii. Horizontal lines shall be supported by well secured length heavy strap hangers. Vertical lines shall be secured strongly by hooks to the building frame and a suitable brackets or chairs shall be provided at the floor from which they start.
- iii. All main vertical soil and waste stacks shall be extended full size to and above the roof line to act as vents, except otherwise indicated on the Plans.
- iv. Vent pipes in roof spaces shall be run as close as possible to underside of roof with horizontal piping pitched down to stacks without forming traps.

Vertical vent pipes may be connected into one main vent riser above the highest vented fixtures.

- v. Where an end or circuit vent pipe from any fixtures is connected to a vent line serving other fixtures, the connections shall be at least 1.20 m above the floor on which the fixtures are located.
- vi. Horizontal waste line receiving the discharge from two or more fixtures shall be provided with end vents unless separate venting of fixtures is noted on the Plans.
- vii. All changes in pipe sizes on soil and waste lines shall be made with reducing fittings or recessed reducers. All changes in directions shall be made by appropriate use of 45 degrees wyes, half wyes, long sweep quarter bends or elbows may be used in soil and waste lines where the change in direction of flow is from the horizontal to the vertical and on the discharge from waste closets. Where it becomes necessary to use short radius fittings in other locations the approval of the Engineer shall be obtained prior to installation of the same.
- viii. Cleanouts at the bottom of each soil stack, waste stack, interior downspout and where else indicated shall be the same size as the pipe up to and including 102 mm, 152 mm, for larger pipes.
- ix. Each fixtures and place of equipment requiring connection to the drainage system except fixtures with continuous waste shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible. Traps installed on threaded pipe shall be recessed drainage pattern.
- x. Overhead horizontal runs of pipes shall be hung with adjustable wrought iron pipe hanger spaced not over 3.04 m apart except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart and located near a hub.

b. Water Pipes, Fittings and Connections.

All water piping inside the building and underground, 100 mm diameter and smaller shall be galvanized iron threaded pipe with malleable iron fittings, PVCU, HDPE, PPR and ductile iron.

- i. The water piping shall be extended to all fixtures, outlets, and equipment from the gate valves installed in the branch near the riser.
- ii. The cold water system shall be installed with a fall towards a main shutoff valve and drain. Ends of pipes and outlets shall be capped or plugged and left ready for future connections.
- iii. Mains and Branches
 - 1. All pipes shall be cut accurately to measurements and shall be worked into place without springing or forcing. Care shall be taken so as not to weaken the structural portions of the building.
 - 2. All piping above the ground shall be run parallel with the lines of the building unless otherwise indicated on the Plans.
 - 3. All service pipes, valves and fittings shall be kept at sufficient distance from other work to permit finished covering not less than 12.5 mm from such work or from finished covering on the different service.
 - 4. No water piping shall be buried in floors, unless specifically indicated on the plans and approved by the Engineer.

5. Changes in pipes shall be made with reducing fittings.

- iv. Drain Cocks Pipe drain indicated on the drawings shall consist of 12 mm globe valve with renewable disc and installed at low points on the cold water piping so that all piping shall slope 100 mm in 30.5 m.
- v. Threaded Pipe Joints All pipes shall be reamed before threading. All screw joints shall be made with graphite and oil or with an approved graphite compound applied to make threads only. Threads shall be full cut and not more than three (3) threads on the pipe shall remain exposed.
- vi. Expansion and Contraction Pipes Accessible contraction-expansion joints shall be made whenever necessary. Horizontal runs of pipe over 15 m in length shall be anchored to the wall to the supporting structure about midway on the run to force expansion and contraction equally toward the ends or as shown on the Plans.
- vii. Pipe Standpipe System Fire standpipe system shall consist of risers and valve. Pipe shall be extra strong black iron. Valves to be underwriter's approval high grade cast bronze mounted.
- viii. Valves and Hose Bibs
 1. Valves shall be provided on all supplied fixture as herein specified.
 2. The cold water connections to the domestic hot water heater shall be provided with gate valves and the return circulation connection shall have a gate and a check valve.
 3. All connection to domestic hot water heaters shall be equipped with unions between valve and tanks.
 4. Valve shall not be installed with its stem below the horizontal. All valves shall be gate valves unless otherwise indicated on the Plans.
 5. Valves up to and including 50 mm diameter shall be threaded ends, rough bodies and finished trimmings, except those on chromium plated brass pipe.
 6. Valves 63 mm in diameter and larger shall have iron bodies, brass mounted and shall have either screws or flange ends.
 7. Hose bibs shall be made of brass with 12.5 inlet threads, hexagon shoulders and 19 mm male.

c. Fixtures, Equipment and Fastenings

All fixtures and equipment shall be supported and fastened in a safe and satisfactory workmanship as practiced.

All fixtures, where required to be wall mounted on concrete or concrete hollow block wall, fasten with brass expansion bolts. Expansion bolts shall be 6 mm diameter with 20 mm threads to 25 mm into solid concrete, fitted with loose tubing or sleeves of proper length to acquire extreme rigidity.

Inserts shall be securely anchored and properly flushed into the walls. Inserts shall be concealed and rigid.

Bolts and nuts shall be horizontal and exposed. It shall be provided with washers and chromium plate finish.

d. Pipe Hangers, Inserts and Supports

- i. Pipe hangers shall be wrought iron or malleable iron pipe spaced not more than 3 mm apart for horizontal runs or pipe, except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart located near the hub.
- ii. Chains, straps perforated turn-bucklers or other approved means of adjustment except the turn-buckles may be omitted for hangers on soil or waste lines or individual toilet rooms to maintain stacks when spaced does not permit.
- iii. Trapeze hangers may be used in lieu of separate hangers on pipe running parallel to and close to each other.
- iv. Inserts shall be cast steel and shall be of type to receive a machine bolt or nut after installation. Insert may be permitted adjustment of the bolts in one horizontal direction and shall be installed before pouring of concrete.
- v. Wrought iron clamps or collars to support vertical runs of pipe shall be spaced not more than 6 mm apart for as indicated on the Plans.

e. Plates and Flashing

- i. Plates to cover exposed pipes passing through floor finished walls or ceiling shall be fitted with chromium plated cast brass plates or chromium plated cast iron or steel plates on ferrous pipes.
- ii. Plates shall be large enough to cover and close the hole around the area where pipes pass. It shall be properly installed to insure permanence.
- iii. Roof areas penetrated by vent pipes shall be rendered watertight by lead sheet flashing and counter flashing. It shall extend at least 150 mm above the pipe and 300 mm along the roof.

f. Protection and Cleaning

- i. During installation of fixtures and accessories and until final acceptance, protect items with strippable plastic or other approved means to maintain fixtures in perfect conditions.
- ii. All exposed metal surfaces shall be cleaned and polished upon completion.
- iii. Upon completion, thoroughly clean all fixtures and accessories to leave the work in polished condition.

g. Inspection, Warranty Test and Disinfection

All pipes, fittings, traps, fixtures, appurtenances and equipment of the plumbing and drainage system shall be approved by the Engineer and inspected both by the Engineer and the Contractor's duly designated representative (Licensed Master Plumber or Sanitary Engineer) to insure 224 compliance with all requirements of all Codes and Regulations referred to in this Specification.

i. Drainage System Test

1. The entire drainage and venting system shall have all necessary openings which can be plugged to permit the entire system to be

filled with water to the level of the highest stack vent above the roof.

2. The system shall hold this water for a full 30 min during which time there shall be no drop greater than 102 mm.
3. Where only a portion of the system is to be tested, the test shall be conducted in the same manner as described to the entire system except that a vertical stack 3 m highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure or water pump may be used to supply the required pressure.
4. If and when the Engineer decides that an additional test is needed, such as an air to smoke test on the drainage system, the Contractor shall perform such test without any additional cost.

ii. Water Test on System

1. Upon completion of the rough-in and before connecting fixtures the entire cold water piping system shall be tested at a hydrostatic pressure $1 \frac{1}{2}$ times the expected working pressure in the system during operation and remained tight and leak-proofed.
2. Where piping system is to be concealed the piping system shall be separately in manner similar to that described for the entire system and in presence of the Engineer or his duly designated representative.
3. The water test shall be applied to the drainage and vent systems either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 3 m head of water. In testing successive sections at least the upper 3 m height of the preceding section previously tested shall be tested again so that no joint or pipe in the building (except the uppermost 3 m of the system) shall have been submitted to a test of not less than 3 m head of water. The water shall be kept in pipe system or in the portion under test, for at least 15 min before inspection starts. The system shall be tight at all joints.

iii. Defective Work

1. The entire water distribution system shall be thoroughly flushed and treated with chlorine before it is operated for public use.
2. Disinfection materials shall be liquid chlorine or hypochlorite and shall be introduced in a manner approved as practiced or approved by the Engineer into the water distribution system.
3. After a contact period of not less than 16 h, the heavily chlorinated water shall be flushed from the system with potable water.
4. Valves for the water distribution system shall be opened and closed several times during the 16 h chlorination treatment is done.

h. As-Built Drawings

Upon completion of the work, the Contractor shall submit two (2) sets of prints with all as-built changes shown on the drawings in a neat workmanship manner. Such prints shall show changes or actual installation and conditions of the plumbing system in comparison with the original drawings.

D. Method of Measurement

The work done under this Item shall be quantified per length and/or number of units as provided in the Bill of Quantities, tested and accepted to the satisfaction of the Engineer. Plumbing Fixtures shall be measured by set, piece, square meter and/or lump sum

E. Basis of Payment

The quantified items, installed in place shall be the basis for payment, based from the unit bid price for which prices and payments shall constitute full compensation including labor, materials and incidentals necessary to complete this Item.

Payment shall be made:

Pay Item Number	Description	Unit of Measurement
1002 (1)a	Galvanized Iron Pipes with Fittings, 13 mm dia.	Meter
1002 (1)b	Galvanized Iron Pipes with Fittings, 25 mm dia.	Meter
1002 (1)c	Galvanized Iron Pipes with Fittings, 32 mm dia.	Meter
1002 (1)d	Galvanized Iron Pipes with Fittings, 40 mm dia.	Meter
1002 (1)e	Galvanized Iron Pipes with Fittings, 50 mm dia.	Meter

Pay Item Number	Description	Unit of Measurement
1002 (1)f	Galvanized Iron Pipes with Fittings, 65 mm dia.	Meter
1002 (1)g	Galvanized Iron Pipes with Fittings, 75 mm dia.	Meter
1002 (1)h	Galvanized Iron Pipes with Fittings, 100 mm dia.	Meter
1002 (1)i	Galvanized Iron Pipes with Fittings, 150 mm dia.	Meter
1002 (2)a1	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 20 mm dia., PN 10	Meter
1002 (2)a2	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 20 mm dia., PN 16	Meter
1002 (2)a3	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 20 mm dia., PN 20	Meter
1002 (2)b1	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 25 mm dia., PN 10	Meter
1002 (2)b2	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 25 mm dia., PN 16	Meter
1002 (2)b3	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 25 mm dia., PN 20	Meter
1002 (2)c1	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 32 mm dia., PN 10	Meter
1002 (2)c2	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 32 mm dia., PN 16	Meter
1002 (2)c3	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 32 mm dia., PN 20	Meter
1002 (2)d1	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 40 mm dia., PN 10	Meter
1002 (2)d2	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 40 mm dia., PN 16	Meter
1002 (2)d3	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 40 mm dia., PN 20	Meter
1002 (2)e1	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 50 mm dia., PN 10	Meter
1002 (2)e2	Polypropylene Random Copolymer (PPR-C) Pipes with Fittings, 50 mm dia., PN 16	Meter

Pay Item Number	Description	Unit of Measurement
1002 (6)	Water Closet, Elongated, Automatic Flush Valve, Complete, Sensor Type	Set
1002 (7)a	Water Closet, Round Front, Complete, Tank Type	Set
1002 (7)b	Water Closet, Round Front, Complete, Flush Type	Set
1002 (8)	Water Closet, Round Front, Automatic Flush Valve, Complete, Sensor Type	Set
1002 (9)a	Urinal, Flush Valve, Complete, Push Button Type	Set
1002 (9)b	Urinal, Flush Valve, Complete, Lever Arm Type	Set
1002 (10)	Urinal, Automatic Flush Valve, Complete, Sensor Type	Set
1002 (11)a	Kitchen Sink, Complete, Stainless	Set
1002 (11)b	Kitchen Sink, Complete, Aluminum	Set
1002 (11)c	Kitchen Sink, Complete, Plastic	Set
1002 (12)	Scrub Up Sink, Complete	Set
1002 (13)	Slop Sink, Complete	Set
1002 (14)a	Lavatory, Wall Hung, Complete, Manually Operated	Set
1002 (14)b	Lavatory, Wall Hung, Complete, Sensor Type	Set
1002 (15)a	Lavatory, Counter Top/Under Counter, Complete, Manually Operated	Set
1002 (15)b	Lavatory, Counter Top/Under Counter, Complete, Sensor Type	Set
1002 (16)a1	Floor Drain Plates, 50 mm dia., Stainless	Set
1002 (16)a2	Floor Drain Plates, 75 mm dia., Stainless	Set
1002 (16)a3	Floor Drain Plates, 100 mm dia., Stainless	Set
1002 (16)b1	Floor Drain Plates, 50 mm dia., Brass	Set
1002 (16)b2	Floor Drain Plates, 75 mm dia., Brass	Set
1002 (16)b3	Floor Drain Plates, 100 mm dia., Brass	Set

Pay Item Number	Description	Unit of Measurement
1002 (17)	Bidet	Piece
1002 (18)	Stainless Steel Grab Bar, 40mm dia.	Linear Meter
1002 (19)	Shower Head/Shower Valve	Set
1002 (20)	Facial Mirror	Square Meter
1002 (21)	Faucet	Piece
1002 (22)	Hose Bibb	Piece
1002 (23)a	Water Meter, 20 mm dia.	Piece
1002 (23)b	Water Meter, 25 mm dia.	Piece
1002 (23)c	Water Meter, 32 mm dia.	Piece
1002 (24)	Cold Water Lines	Lump Sum
1002 (25)	Hot Water Lines	Lump Sum
1002 (26)	Cistern	Lump Sum
1002 (27)	Plumbing Works	Lump Sum
1002 (28)a	Squat Bowl, Complete, Ceramic Porcelain	Set
1002 (28)b	Squat Bowl, Complete, Plastic	Set
1002 (29)	Toilet Bowl, Complete, Plastic	Set

XXI. STORM DRAINAGE AND SEWERAGE SYSTEM

A. Description

This item shall consist of furnishing all materials, equipment and labor for the complete installation of the storm drainage system which include all pipings, gutters, canals, catch basins, junction boxes, handholes, manholes and other appurtenant structures, and sewerage system which include all sanitary sewer piping and septic vault/tank where no public sewer exist, from the building to the point of discharge.

B. Material Requirements

a. Storm Drainage System

Materials for storm drainage system shall meet the requirements specified in the following Standard Specifications:

Material	Standard
Portland Cement	ASTM C150M, Standard Specification for Portland Cement
Fine and Coarse Aggregate	ASTM C33M, Standard Specification for Concrete Aggregates
Reinforcing Steel	ASTM A615M, Standard Specification for Reinforcing Steel
Non-reinforcing Concrete Pipes	AASHTO M 86/ASTM C14, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
Reinforced Concrete Pipes	ASTM C76/AASHTO M 170M, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
Cast Iron Pipes (for conductors and downspouts)	ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings
Galvanized Iron Pipes Schedule 40 (for conductors and downspouts)	ASTM A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
Polyvinyl Chloride (PVC) (for conductors and downspouts)	ASTM D2729, Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
	AASHTO M 278, Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe
	AASHTO M 304, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
	PNS 1950:2003, Plastic Piping Systems for Soil and waste Discharge (low and high temperature) inside buildings - Unplasticized Polyvinyl Chloride (PVC-U)
High Density Polyethylene Pipes (HDPE)	ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
	ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
	PNS ISO 4427, Polyethylene (PE) Pipes for Water Supply - Specifications

b. Sewerage System

Materials for sewerage system shall meet the requirements specified in the following Standard Specifications:

Material	Standard
Cast Iron Pipes and Fittings	ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings
Pig Lead (for securing and sealing joints)	ASTM B29, Standard Specification for Refined Lead
PVC Pipes and Fittings (where called in Plans)	ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds PNS 1950:2003, Plastic Piping Systems for Soil and waste Discharge (low and high temperature) inside buildings – Unplasticized Polyvinyl Chloride (PVC-U)
Solvent Cement (for Securing PVC joints)	ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
High Density Polyethylene Pipes (HDPE)	ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
	ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
	PNS ISO 4427, Polyethylene (PE) Pipes for Water Supply - Specifications

Where PVC pipes and fittings are used, joints shall be secured with rubber "O" ring or solvent cement, as the case may be. Oakum for joints in bell and spigot pipes shall be made from hemp fiber, braided or twisted and oil-impregnated, free from lumps, dirt and extraneous matter.

c. Structure Materials

All storm drainage structures such as manholes, inlets, junction boxes and catch basins shall be constructed of either brick, solid block or precast concrete.

- i. Clay Brick shall be solid, rough, sound clay brick conforming to ASTM C32, Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale). The brick shall be laid with full shove joints, filling up the joints with mortar. The thickness of the joints shall not exceed 9.53 mm.
- ii. Concrete Block or brick shall be solid and conforms to ASTM C139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes as to design and manufacture. The block or brick shall be embedded in a mortar bed to form a 12.70 mm mortar joint.
- iii. Precast concrete manhole shall conform to ASTM C478, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections. Fabricate precast concrete manhole to the sizes indicated on the Plans. 4. Concrete for drainage structures shall meet the applicable requirements of Item 900, Structural Concrete.

d. Frames, Covers and Gratings

Metal units shall conform to the Plan dimensions and to the following specification requirements for the designated materials:

Material	Standard
Gray Iron Castings	ASTM A48M/AASHTO M 105, Standard Specification for Gray Iron Castings
Carbon Steel Castings for General Application that require up to 485 MPa minimum tensile strength.	ASTM A27M/AASHTO M 103M, Standard Specification for Steel Castings, Carbon, for General Application
Hot-Dip Galvanized Coatings on Iron and Steel Products	ASTM A123M/AASHTO M 111M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
Reinforcing Steel	ASTM A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
	AASHTO M 31M, Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement

Samples of the material in casting shall be taken during the casting of the units and shall be separate casting poured from the same material as the casting they represent.

Metal gratings and covers which are to rest on frames shall bear on them evenly. They shall be assembled before shipment and so marked that the same pieces may be reassembled readily in the same position when installed. Inaccuracy of bearings shall be corrected by machining, if necessary. A frame and grating or cover to be used with it shall constitute one (1) pair.

All castings shall be uniformly coated with asphalt-based emulsion meeting the requirements of ASTM D1187, Standard Specification for Asphalt – Base Emulsion for Use in Protective Coating for Metal.

e. Trench Drains and Downspouts

Trench drains and downspouts shall conform to the applicable requirements of ASTM A36M, Standard Specification for Carbon Structural Steel. Trench trough, overlap splice, anchors and downspout pipe shall be steel, galvanized after assembly of each trench section. Fabricate trench drain corners using mitered sections of trough, then weld. Trench drain trough and trench gate shall be as shown in the Plans.

Cast iron trench grates shall conform to ASTM A48M. Grates shall be cast iron unless indicated as cast aluminum in the Plans.

Cast aluminum trench gates shall conform to ASTM B26M, Standard Specification for Aluminum-Alloy Sand Castings.

f. Concrete Gutters and Canals

Concrete gutters and canals shall be constructed to the profile indicated on the Plans. Concrete materials and steel reinforcement shall comply with the applicable requirements of Item 900, Structural Concrete and Item 902, Reinforcing Steel.

Forms shall comply with the applicable requirements of Item 903, Formworks and Falseworks.

g. Septic Tank

- i. Materials used in constructing a septic tank shall be in accordance with the latest Unified Plumbing Code of the Philippines.
- ii. The minimum wall thickness of a steel septic tank shall be 2.77 mm and each such tank shall be protected from corrosion both externally and internally by an approved bituminous coating or by other acceptable means.
- iii. Septic tanks constructed of alternate materials shall be permitted to be approved by the Engineer in accordance with approved application standards. Wooden septic tanks shall be prohibited. Sizes, dimensions, reinforcing, structural calculations and such other pertinent data as required for septic tank shall be indicated on the Plans.

C. Construction Requirements

a. Installation of Pipes

Under no circumstances shall pipes be laid under water and when the trench condition or the weather is unsuitable for such work.

i. Bedding

Materials such as sand, sandy soil or any approved material shall be used to provide a firm foundation of uniform density. The bedding shall have a minimum thickness equivalent to 1/4 of the pipe's diameter.

ii. Laying of Pipes

Proper facilities shall be provided for lowering and placing pipes into trenches in order to preclude damage. Laying of pipes shall start upgrade with the spigot end of bell-and-spigot pipe, or the tongue end of tongue-and-groove pipe, positioned towards the direction of the flow. The pipes shall be laid in accordance with the grades and alignments shown in the Plans.

The spigots or tongues shall be adjusted in bells or grooves to provide uniform space around joints to receive mortar. Blocking or wedging between spigot and bell or between tongue and groove to attain proper spacing shall be allowed provided such blocking/wedging shall not interfere with the caulking and shall not affect the water tightness of the joint.

No building sewer or other drainage piping or part thereof, which is constructed of materials other than those approved for use under or within a building, shall be installed under or within 610 mm of any building or structure, or part thereof, not less than 305 mm below the surface of the ground. The provisions of this subsection include structures such as porches and steps, whether covered or uncovered; breezeways; roofed portecocheres; roofed patios; carports; covered walks; covered driveways; and similar structures or appurtenances.

Septic tanks shall have not less than two compartments or as shown on the Plans.

Warning tape shall be laid above main pipes. The tapes shall be flexible and subject to the Engineer's approval. Width of the tape should be at least 150

mm. The text on the tape shall be permanent ink bonded to resist prolonged chemical attack by corrosive acids and alkaline with message repeated at a maximum interval of 2 m. The tapes shall be laid 300 mm above the pipeline. The tape shall be continuous over pipelines and at joints there should be a minimum of 1 m over lapping.

iii. Bell and Spigot Joint for Drain Pipe

The first pipe shall be properly bedded at the required grade. Just below the spigot of the first unit, a sufficient space shall be provided for engaging the bell end of the second pipe.

The spigot shall be carefully cleaned with a wet brush and the upper exterior portion applied with mortar to such a thickness as to bring the inner surfaces of the abutting pipes flush and even. The bell end of the second pipe shall be cleaned with a wet brush and uniformly matched with the spigot of the first pipe so that the sections are closely fitted. After the second pipe is laid, the remainder of the joint shall be fitted with mortar, and a bead shall be formed around the outside of the joints with sufficient amount of additional mortar. The inside of the joints shall be wiped and finished smooth. The mortar bead on the outside shall immediately be protected with a cover of wet burlap or wet earth for at least 3 days for curing.

iv. Tongue and Groove Joint for Concrete Pipe

The first pipe shall be properly bedded. A shallow excavation shall be made underneath the joint and filled with mortar to provide a bed second pipe. The tongue end of the first pipe shall be carefully cleaned with wet brush and soft mortar applied around the upper half of the tongue. After cleaning and positioning the second pipe close to the first, mortar shall be applied around the lower half of the groove. With just sufficient thrust, the second pipe shall be brought in close contact with the first until mortar is squeezed out of the joint. Sufficient mortar shall be used to fill the joint and to form a bead on the outside.

v. Mortar for Joint

Mortar shall be a mixture of Portland cement, sand and water mixed in the proportion by volume of one (1) part cement to two (2) parts of clean sand with just sufficient amount of water for plasticity.

vi. Leaded Joints of Cast Iron Pipes

Joints of cast iron pipes shall be packed with braided or twisted oilimpregnated hemp or oakum, properly caulked around the joint. The packing shall be at least 20 mm below the rim of the hub or bell and this space be filled with molten pig lead in one (1) continuous pouring. The "ring" of pig lead formed around the joint shall be properly caulked by appropriate caulking tools to render the joints watertight.

b. Concrete Structures

Concrete structures such as catch basins, canal gutters, junction boxes and manholes for the drainage system, and septic vault for sewerage system shall be constructed in accordance with the Plans and Specifications on Concrete Work.

c. Sewer Connections and Clean-Outs

- i. The outlet of the septic vault shall be connected to the street drain or to other discharge point where sanitary sewer exists. Connection with the sanitary sewer shall not be made without the permission of the proper authorities, but shall be made in such a manner that any and all the service water, as well as house and other liquid wastes, will flow to the sanitary sewer. Provided that isolated faucets used exclusively for garden purposes, may in the discretion of the proper authorities, be allowed not to flow into the sanitary sewer.
- ii. Clean-outs or rodding holes consisting of cast iron extensions with long sweep elbow fittings shall be provided at the ends of the runs and at every change of directions. Clean-outs shall be capped with cast brass ferrules with threads and screwed on removable brass plugs. Clean-outs extended outside the building and raised to the level of finished grade shall be terminated with the same cast brass ferrule with brass plug set in to a concrete slab shall be 150 mm thick and 300 mm square, finish flush with grade.
- iii. Additional building sewer cleanouts shall be installed at intervals not to exceed 30,480 mm in straight runs and for each aggregate horizontal change in direction exceeding 135 degrees. When a building sewer or a branch thereof does not exceed 3,048 mm in length and is a straight-line projection from a building drain that is provided with a clean out, no cleanout will be required at its point of connection to the building drain.

d. Septic Tank Construction

Septic tanks shall be constructed in accordance with the Plans and requirements of the latest Uniform Plumbing Code.

e. Incidental Earthwork

Incidental earthwork for the storm drainage and sewerage systems, such as excavation and backfilling shall be undertaken in accordance with applicable requirements of Item 803, Structure Excavation.

f. Inspection and Quality Control

1001.3.6 Inspection and Quality Control Materials shall be inspected and accepted as to quality before same are installed. Piping installed in trenches shall first be inspected, tested and approved by the Engineer before these are covered or backfilled. All defects/leaks disclosed by the water test shall be remedied to the satisfaction of the Engineer and any extra cost shall be at the expense of the Contractor.

i. Building Sewer Test

Building sewers shall be tested by plugging the end of the building sewer at its points of connection with the public sewer or private sewage disposal system and completely filling the building sewer with water from the lowest to the highest point thereof, or by approved equivalent low-pressure air

test. Plastic 208 drain, waste, and vent piping systems shall not be tested by the air test method. The building sewer shall be water-tight at all points.

ii. Testing for Storm Drainage Systems

Except for outside leaders and perforated or open-jointed drain tile, the piping of storm drain systems shall be tested upon completion of the rough piping installation by water or air, except that plastic pipe shall not be tested with air, and proved tight. The Engineer shall be permitted to require the removal of any cleanout plugs to ascertain whether the pressure has reached parts of the system. One of the following test methods shall be used:

1. Water Test

After piping has been installed, the water test shall be applied to the drainage system, either to the entire system or to sections. If the test is applied to the entire system, all openings in the piping shall be tightly closed except for the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except for the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 3,000 mm head of water. In testing successive sections, not less than the upper 3,000 mm of the next preceding section shall be tested so that no joint of pipe in the building (except the uppermost 3,000 mm of a roof drainage system which shall be filled with water to the flood level of the uppermost roof drain) shall have been submitted to a test of less than a 3,000 mm head of water. The water shall be kept in the system or in the portion under test for not less than 15 min before inspection starts. The system shall then be tight at all points.

2. Air Test

The air test shall be made by attaching an air compressor testing apparatus to any suitable opening after closing other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 34.5 kPa or sufficient pressure to balance a column of mercury 250 mm in height. This pressure shall be held without introduction of additional air for a period of not less than 15 min.

D. Method of Measurement

Pipes, culverts, gutters, canals and gratings installed in place and accepted by the Engineer, shall be measured by the meter along their axes.

Catch basins, junction boxes, manholes and septic vault/tank shall be measured by the number of units or lump sum, completed and accepted by the Engineer.

Sewer Line works, Storm drainage and downspout and Pipes w/ Fittings connection shall be measured by lump sum, completed and accepted by the Engineer.

E. Basis of Payment

The quantities as determined in Section 1001.4, Method of Measurement shall be paid at the Contract Unit Price for each of the Items which shall constitute full compensation for all

materials, labor, tools and equipment and all other incidentals necessary to complete the item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (1)a1	Pipe and Fittings, 50 mm dia., PVC, Series 600	Meter
1001 (1)a2	Pipe and Fittings, 75 mm dia., PVC, Series 600	Meter
1001 (1)a3	Pipe and Fittings, 100 mm dia., PVC, Series 600	Meter
1001 (1)a4	Pipe and Fittings, 150 mm dia., PVC, Series 600	Meter
1001 (1)a5	Pipe and Fittings, 50 mm dia., PVC, Series 1000	Meter
1001 (1)a6	Pipe and Fittings, 75 mm dia., PVC, Series 1000	Meter
1001 (1)a7	Pipe and Fittings, 100 mm dia., PVC, Series 1000	Meter
1001 (1)a8	Pipe and Fittings, 150 mm dia., PVC, Series 1000	Meter
1001 (1)a9	Pipe and Fittings, 200 mm dia., PVC, Series 1000	Meter
1001 (1)a10	Pipe and Fittings, 250 mm dia., PVC, Series 1000	Meter
1001 (1)a11	Pipe and Fittings, 300 mm dia., PVC, Series 1000	Meter
1001 (1)b1	Pipe and Fittings, 150 mm dia., Concrete	Meter
1001 (1)b2	Pipe and Fittings, 200 mm dia., Concrete	Meter
1001 (1)b3	Pipe and Fittings, 250 mm dia., Concrete	Meter
1001 (1)b4	Pipe and Fittings, 300 mm dia., Concrete	Meter

Pay Item Number	Description	Unit of Measurement
1001 (1)b5	Pipe and Fittings, 350 mm dia., Concrete	Meter
1001 (1)c1	Pipe and Fittings, 50 mm dia., High Density Polyethylene (HDPE)	Meter
1001 (1)c2	Pipe and Fittings, 75 mm dia., High Density Polyethylene (HDPE)	Meter
1001 (1)c3	Pipe and Fittings, 100 mm dia., High Density Polyethylene (HDPE)	Meter
1001 (1)c4	Pipe and Fittings, 150 mm dia., High Density Polyethylene (HDPE)	Meter
1001 (1)c5	Pipe and Fittings, 200 mm dia., High Density Polyethylene (HDPE)	Meter
1001 (1)c6	Pipe and Fittings, 250 mm dia., High Density Polyethylene (HDPE)	Meter
1001 (1)c7	Pipe and Fittings, 300 mm dia., High Density Polyethylene (HDPE)	Meter
1001 (2)	Concrete Gutter	Meter
1001 (3)	Concrete Canal	Meter
1001 (4)	Wrought Iron Grating	Square Meter
1001 (5)a	Catch Basin, Concrete	Each
1001 (5)b	Catch Basin, CHB	Each
1001 (6)	Catch Basin	Lump Sum
1001 (7)a	Junction Box, Concrete	Each
1001 (7)b	Junction Box, CHB	Each
1001 (8)	Sewer Line Works	Lump Sum
1001 (9)	Storm Drainage and Downspout	Lump Sum
1001 (10)	Pipes with Fittings Connection	Lump Sum
1001 (11)	Septic Vault/Tank, Concrete/CHB	Lump Sum
1001 (12)	Septic Vault/Tank, PVC	Lump Sum
1001 (13)	Septic Vault/Tank, PVC	Each
1001 (14)	Manhole, Concrete/CHB	Lump Sum
1001 (15)	Manhole, Concrete/CHB	Each

Pay Item Number	Description	Unit of Measurement
1001 (16)a1	Inlets, 150 mm dia., Concrete	Meter
1001 (16)a2	Inlets, 200 mm dia., Concrete	Meter
1001 (16)a3	Inlets, 250 mm dia., Concrete	Meter
1001 (16)a4	Inlets, 300 mm dia., Concrete	Meter
1001 (16)a5	Inlets, 350 mm dia., Concrete	Meter

XXII. ELECTRICAL WORKS

A. Scope of Work

- a. The work of the contractor consists of furnishing of all tools, labor, equipment, and materials and performing all operations in connection with the electrical and fire alarm system shown on the drawing, their test and inspection, complete and in accordance with these specifications and drawings and subject to the terms and conditions of the contract, and all other labor and materials not specifically mentioned under sections, to bring the electrical system to operating conditions and be ready for use by the Owner.

B. Applicable Documents

- a. The works covered by these specifications shall be governed by the requirements of the Philippine Electrical Code, US Federal Specifications, NEMA standards.

C. Materials

- a. Rigid steel conduit shall be hot-dipped galvanized mild steel pipe and shall 3m lengths including coupling.
- b. PVC electrical conduit shall be supplied in standard effective lengths of 3.0m.
- c. Wires and cables shall be insulated for 600 volts. Feeder and branch circuit wires and cables shall be type TW or THHN as manufactured.
- d. Conduits fittings shall be US Underwriters Laboratories (UL) listed or approved local equivalent.
- e. Outlet boxes shall be hot-dipped galvanized or case metal as required. Thickness of pressed steep boxes shall be less than gauge #16.
- f. Circuit breakers for panel boards shall be molded case circuit breaker with quick-made, quick-break, trip-free mechanisms. They shall meet US Federal Specifications and NEMA standard.
- g. Panel board shall be as manufactured by bolt-on type NEMA or approved equal.
- h. Wiring devices such as switches and convenience outlets shall have ratings of 15 amperes, 250V and 16 amperes, 250V, respectively.

D. Installation

a. Grounding

The following shall be grounded in accordance with the drawings and the requirements of the Philippine Electrical Code with standards grouping practices:

Metallic conduit and raceway system including gutters, cabinets and boxes.

Non-current carrying metal parts of all electrical equipment including fixtures and motors.

b. Feeders

Distribution voltage shall be 230V, 1-phase, 3-wire feeder conductors and conduit shall be installed as shown on the drawing and no change in size shall be made without consent of the Owner. Feeder conductors shall be continuous and without splices between terminals.

c. Branch Circuit

The drawing indicates the general methods of installations of all circuit wiring and the outlet which are to be supplied from this circuit. Branch circuit conduits shall be run from outlets to panel boards as directed as the building conditions will allow. Circuit allocations shall be indicated on the drawings where it becomes necessary to correct any outlet to circuit other than shown on the drawings. This shall be done without extra charge and only upon written consent of the Owner. No wire smaller than 2.0mm² (#14AWG) and 3.5mm² (#12 AWG) shall be used for any lighting and power circuits, respectively.

d. Panel boards and cabinets

Panel boards shall be mounted with their centers at 1.40m above the floor unless otherwise indicated by field conditions.

e. Locations of outlets and switches

The approximate location of each fixture receptacle, special purpose outlet and switch is indicated on the drawings. The exact location is to be determined later at the site as the work progresses.

f. Wires and boxes

No wire shall be drawn into the raceway until works, which may cause injury to the wires, is completed and until permission is given by the Owner in writing. Only powdered lubricant not injurious to cable insulation and raceways shall be used only when lubrication is necessary.

g. Splices

Branch circuit splices shall be soldered or joined by used insulated splicing device (wire nuts). All soldered joints shall be made mechanically strong before soldering and shall be carefully soldered without the use of acid, then taped with rubber tape to a thickness equal to that of the insulation and with a covering of friction tape of two layer. . Where solid conductors are to be connected directly to devices without the use of lugs, such as lighting switches and plug receptacles, the wires shall be formed into a clockwise loop fitted around the screws.

h. Outlets, switches and junction boxes

The contractor shall install standard boxes at all outlets for lights, appliances and switches and other point as required by the constructions.

i. Conduit System

Not more than four 90 degrees bend shall occur in any run. When it becomes necessary to have more than four 90 degrees bends in any run, an intermediate pull box shall be installed to facilitate pull-in wires. All conduits run shall as called for on the drawings.

Conduits shall be installed in such manner as not to weaken or interfere with the structure or the building. No horizontal runs embedded conduit shall be permitted in solid wall and partitions. Conduits below grade line shall be encased in concrete enveloped with minimum thickness of 50mm (2") or embedded in floor slab. Exposed conduit shall run parallel or at right angles with lines of the buildings and shall be securely fastened in place by means of approved fastening. Conduits support shall be fastened to walls by means of screws or bolts with expansion sleeves. The use of wooden or lead plug is not permitted. Conduits shall be cut by hacksaw, the ends shall be reamed after being firmly attached to cabinets or boxes by means of locknuts.

j. Lighting Fixtures

The Contractor shall furnish and install all lighting fixture as indicated on the drawings, including mounting channels and supports.

k. Testing

i. Ground test

The entire installation shall be free from improper ground and from short circuits. Each panel shall be tested with means connected. Lamps removed or omitted from the sockets and all switches closed. Each individual power equipment shall be connected for proper and intended operation. In no case shall the resistance be less than that allowed by the Regulations for electrical equipment of building. Failures shall be corrected in any manner satisfactory to the Architect and Engineer.

ii. Performance test

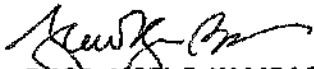
The electrical contractor shall test all system of entire electrical installation for proper operational conditions. These conditions shall apply to the power and lighting installation, voltage drop, grounding defects.

Prepared By:



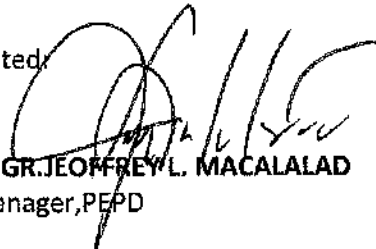
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