

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS

CONTENTS

GUIDELINES FOR HIGH - RISE BUILDING

CONSTRUCTION PROJECTS

(SANITAY)

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Professional Engineer (PE) (Water Supply and Sanitation)

All designs on High-Rise Building(HRB) undertaken by a foreign firm/ company shall be duly endorsed/countersigned by a Professional Engineer (PE) (Water Supply and Sanitation) when submitting HRB Project to CQHP.

To qualify for evaluating and endorsing designs by a foreign firm/ company on Water Supply and Sanitation system for a (HRB), a PE (Water supply and Sanitation) must duly registered with CQHP for National Counterpart (NCP) and be of full validity as issued by Myanmar Engineer Council (MEC).

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE I SITE INSPECTION

1. General Requirements at Site (M)

- 1-1 Project Organization Chart
- 1-2 Water and Sanitation Drawings
- 1-3 Quality Control Facilities and Records
- 1-4 Work Schedule
- 1-5 Safety Provisions
- 1-6 Site Sanitation and Basic Health Care
- 1-7 Fire Protection (During Construction Period)

2. Inspection Check List

- 2-1 Preliminary Survey (M)
 - 2-1-1 Property Lines based on Certified Map
 - 2-1-2 Building Dimensions
 - 2-1-3 Building Layout
 - 2-1-4 Sources/ Sources of Water Supply Storage Tank (Ground/Overhead) Layout, Layout of Soil/ Waste Water Disposal System, Water Treatment Plant Layout, Parameter / External drain, Waste Water Treatment Plant Layout, Pipe Layout, Sewer and Manhole Layout
 - 2-1-5 Levels of Each Component
- 2-2 Building Survey (During Construction) (M)
 - 2-2-1 W.C Plan and Level
 - 2-2-2 Wet Area Plan and Level
- 2-3 Detail Checking (M)
 - 2-3-1 Cold Water Supply System
 - 2-3-2 Hot Water Supply System
 - 2-3-3 Soil, Waste and Vent Pipe System
 - 2-3-4 Fixture Installation
 - 2-3-5 Refuse Collection and Disposal System
 - 2-3-6 Deviation From Original Designs and Revision Designs
- M Mandatory
- R Recommended
- S Suggested

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE II GEOTECHNICAL INVESTIGATIONS RELATED TO SANITARY WORKS

- 1. To provide bearing capacity of soil at site of construction, where required, for the design and construction of reservoirs, water treatment plant and waste water treatment plant. (M)
- 2. To provide information on the type of soil at site of construction, preferably with respect to the AASHO soil classification.(R)
- 3. To provide result of Percolation Test where required. (R)

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE III COLD AND HOT WATER SUPPLY

1. Water Demand

- 1-1 Recommended water demand with respect to the inhabitants (Population Equivalent) is given in Table 1, Appendix.
- 1-2 Water requirement of a project shall be calculated with respect to the estimated Population Equivalent (PE).(M)

2. Sources of Water Supply

- 2-1 Where only one source is available, it shall have the capacity of meeting the water demand of the premises. (M)
- 2-2 Where two sources are a available it is recommended that each shall have the capicity of meeting the demand of premises. (R)
- 2-3 Requirements for the utilization of ground water (M)
 - 2-3-1 Where groundwater is to be tapped by using tube wells, location of tube wells (tentative/permanent) should be indicated.
 - 2-3-2 The yield from the tube wells shall meet the demand of the project requirement, both in quantity and quality.
 - 2-3-3 Well logs, including the result of raw water quantity test shall be included in the submission.
 - 2-3-4 Following the water quality test, a proposed water treatment system, if required shall also be included in the submission.
 - 2-3-5 The space required for the water treatment plant shall be provided in the project area.
 - 2-3-6 In case where data on the utilization of ground water system cannot be submitted in time together with the proposed water supply and sanitation system of the project, a written pledge by the developer to meet the requirement of the project shall be submitted.
 - 2-3-7 However, allocation for the water treatment facilities shall be duly provided within the project premises.
 - 2-3-8 A raw water storage tank shall be duly included as a component of the proposed water treatment system.

3. Quality of Water (M)

- 3-1 Drinking-water quality used shall meet the Guideline given inNational Drinking Water Quality.However, reference to updated WHO recommendations for drinking water quality is recommended.
- 3-2 Water treatment unit / plant shall be provided where the source of drinking-water quality does not meet the recommended level mentioned in para 3-1.

4. Water Distribution

- 4-1 Distribution systems
 - 4-1-1 Either a down feed distribution system or up feed distribution system may be used. (Figure 1, Appendix) (R)
- 4-2 Reservoirs
 - 4-2-1 A clear water reservoir shall be provided either at the ground level or basement floor. It shall be duly protected from potential sources of pollution. (M)
 - 4-2-2 For down feed system, a roof tank should also be provided with adequate water storage capacity to meet the 50% of one-day supply. (M)
 - 4-2-3 For up feed system, since no roof tank is provided, the ground tank shall have a capacity of both the ground tank and the roof tank , i.e the minimum capacity of the ground tank shall be of 1-1/2 storage (1-day for ground tank + 1/2 day for roof tank).
 - 4-2-4 Where water treatment plant is not required, the storage capacity of the ground tank should be of a two-day supply (R), with the minimum of one-day supply.(M)
 - 4-2-5 Where a water treatment plant is required, raw water tank having minium capacity of 50% of the one-day demand with a clear water tank having a minium capacity of one-day demand shall be provided .(M)
 - 4-2-6 The guildeline given for the capacity of reservoirs in para 4-2-1,4-2-2,4-2-3 does not include the volume of water required for fire fighting.
 - 4-2-7 Service tanks may also be used at intermediate level in the building if deemed necessary by the designer. (R)
 - 4-2-8 Water supply at all fixture units in the building shall be within the flow pressure between (0.5 and 2.0) bar at the highest point of a floor .(M)
 - 4-2-9 Pressure higher than 2.0 bar shall be used where necessary and appropriate.(M)
- 4-3 Pumps (M)
 - 4-3-1 Water pumps installed shall meet the designer's requirement.
 - 4-3-2 At least one stand-by pump shall be provided for duty pump/pumps.
 - 4-3-3 Characteristic curves for pumps installed showing the relationships between head, discharge, horse power, and efficiency shall be provided by the designer in the design calculations.
- 4-4 Pipe (R)
 - 4-4-1 Risers and transmission pipes should be made of D.I,C.I. or G.I.
 - 4-4-2 Cold water distribution pipes may be C.I, D.I, G.I, uP.V.C or PP-R.
 - 4-4-3 Hot water pipes may be of copper, steel or P-PR with suitable insulation, where required.

4-5 Fittings (M)

4-5-1 Pipes & Fittings must be made of the same material.

4-6 Valves (R)

4-6-1 Valves may be made of C.I, G.M or Brass.

- 4-7 Bib cocks, taps, faucets (R)
 - 4-7-1 Bib cocks, taps, faucets may be made of brass, stainless steel, NP or CP.

5. Hot Water Supply (R)

5-1 Individual hot water supply system is recommended. However central hot water supply system can also be used.

6. Specifications

- 6-1 Reservoir (R)
 - 6-1-1 Reservoir constructed of R.C.C should follow the ACI CODE.
 - 6-1-2 Reservoir constructed of prestressed steel panel, GRP, FRP, stainless steel panel or masonry should follow any internationally recognized standard or approved make.
 - 6-1-3 Where space is available storage tanks built under the floor slab must have at least 2 feet space around the perimeter of the tank to enable regular inspection and maintenace. It must have at least 3 feet verical clear space between the ceiling and the cover slab (top) of the tank to enable regular inspection and maintance.(M)
 - 6-2 Cold water pipes and fittings (R)

Specifications for the following pipes and fittings of different materials should conform to any internationally recognized standard or approved make.

- 6-2-1 Water pumps
- 6-2-2 Cast iron pipes and fittings
- 6-2-3 Ductile iron pipes and fittings
- 6-2-4 Galvanized iron pipes and fittings
- 6-2-5 Polyvinyl chloride pipes and fittings or unplasticized polyviny chloride pipes and fittings
- 6-2-6 PP-R pipes and fittings
- 6-3 Hot water pipes and fittings (R)

Specifications for the following should conform to any internationally recognized standard or approved make:

- 6-3-1 Copper pipes and fittings
- 6-3-2 Steel pipes and fittings
- 6-3-3 PP-R pipes and fittings
- 6-4 Water tank shall be water-proof both on the inside and outside of the tank.

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE IV SANITATION

Sanitation

1. Spent Water (R)

- 1-1 Spent water contribution should be based on water demand as given in para.
 - 1-1, Guideline III. It is recommended that at least 90% of the water consumed will be discharged as spent water.
 - 1-1-1 Spent water consists of soil and waste water. Table 1, Appendix (R)
 - 1-1-1-1 Soil water is the spent water from WCs and urinals.
 - 1-1-1-2 Waste water is the spent water from basins, kitchen sinks, showers and bath tubs.

2. Soil Water Treatment and Disposal (M)

- 2-1 Soil water shall be treated before being discharged into a water course or public drain or municipal sewer.
- 2-1-1 The effluent quality of the treated soil water shall conform to the following:

	Items of Analysis	Sewer	Watercourse	Controlled Water course
		Units	in milligram po	er litre or
			<u>otherwise sta</u>	ited
1	BOD (5 days at 20 C)	300	50	20
2	COD	450	100	60
3	Total Suspended Solids	300	50	30

Note: BOD value refers to 5-day incubation period at 20°C.

- 2-1-2 Any sewage treatment system meeting the requirement shown in para 2-1-1 can be used.
- 2-1-3 Soil and waste water may be treated separately before final disposal.
- 2-2 Soil water discharged into YCDC sewer, if allowed shall conform to the normal range generally specified for domestic soil water. (para 2-1-1)
- 2-3 A permit shall be obtained from authority concerned for the discharge of treated soil water.
- 2-4 Effluent of treated soil water shall be disinfected with chlorine or by any other approved method where required.
- 2-5 Where effluent is chorinated, residual chlorine shall be between 0.1 and 0.2 mg/l.

3. Waste Water Disposal

- 3-1 Waste water from residences may be discharged directly after undergoing appropriate treatment followed by disinfection into public drain. (R)
- 3-2 However, waste water from kitchen sinks shall first be discharged into a grease trap before its disposal into public drain(M). Undergoing the same treatment as mentioned in para 3-1.
- 3-3 Waste water is prohibited from being discharged into YCDC sewer. However, if allowed the effluent quality shall conform to the normal range generally specified for domestic waste water.(para 2-1-1)
- 3-4 A permit shall be obtained from authority concerned before waste water is disposed into public drain. (M)
- 3-5 Recycling of grey water may be used for purposes other than dometics such as drinking, cooking, washing, bathing etc.....

4. Combined Soil and Waste Water Treatment and Disposal (M)

- 4-1 Combined soil and waste water shall be treated before being discharged into a water course or public drain.
- 4-2 The effluent quality shall conform to that given in para 2-1-1 and disinfected as given in para (2-4, 2-5).
- 4-3 The effluent of the combined treated soil and waste water is prohibited from being discharged into town sewer.
- 4-4 A permit shall be obtained from authority concerned, YCDC, for the discharged of the treated combined soil and waste water.

5. Soil and Waste Water Collection (M)

- 5-1 Horizontal collecting pipes placed in ceilling shall be securely supported by hangers and given a slope with self-cleansing velocity of 3.0 ft/sec.
- 5-2 Sewer laid in ground shall be placed in proper bedding and given a slope with selfcleansing velocity of 3.0 ft/sec.
- 5-3 Sewer shall be laid in straight line.
- 5-4 However, manholes shall be placed where there is either a change of direction or gradient of sewer.
- 5-5 Provision of ducts with adequate space.

6. Sewage Pumps (M)

- 6-1 Pumps used for pumping soil and waste water shall meet the designer's requirement.
- 6-2 At least one stand-by pump shall be provided for duty pump/ pumps installed.
- 6-3 Characteristic curves for the sewage pumps installed showing the relationships between head, discharged, horse power and effciency shall be provided by the designer in the desing calculation.

7. Soil, Waste and Vent Pipe System (M)

7-1 Fully ventilated system shall be used. See also guide line VII para 2-1.

8. Fittings (M)

8-1 Pipes and fittings used shall be of the same material.

9. Sanitary Appliances (M)

9-1 All sanitary appliances used shall be of approved make.

10. Specifications

- 10-1 Specifications for the following should conform to any internationally recognized standard or approved make: (R)
 - 10-1-1 Cast iron pipes and fittings for soil, waste and vent piping system.
 - 10-1-2 PVC or uPVC pipes and fittings for soil, waste and vent piping system.
 - 10-1-3 Any other materials other than those given in para 10-1-1 and 10-1-2.
 - 10-1-4 Soil/Waste Water tank shall be water-proof both on the inside and outside of the tank.

11. Installation ($R\,)$

11-1 Installation of soil, waste and vent pipes shall referred to SINGAPORE CODE OF PRACTICE ON SANITARY PLUMBING AND DRAINAGE SYSTEM (1976 or any up dated version) or any other recognized code of practices.

12. Rain Water Collection and Disposal

- 12-1 Neither soil nor waste water shall be discharged into rain water down pipes. (M)
- 12-2 Rain water shall therefore be collected and disposed of in a separate system. (M)
- 12-3 Rain water can be directly discharged into road side drain. (S)
- 12-4 Rain water gutter shall have the capacity of collecting rain water runoff from roof area. (M)
- 12-5 Rain water gutter outlets shall be designed to ensure free discharge into down pipes. (M)
- 12-6 Rain water gutter outlets pipe shall have the capacity of conveying rain water runoff from the gutter through the gutter outlet to the roadside drain. (M)
- 12-7 Materials for rain water down pipe should be of C.I, D.I, G.I, PVC or uPVC, or of any approved material. Fabrication with M.S or G.I sheet should not be used. (R)
- 12-8 An external perimeter drain, shall consist of the volume of rainwater, effluent of soil and waste water from treatment system. The minimum velocity used shall be 0.7m/s.

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE V GARBAGE COLLECTION AND DISPOSAL

Garbage Collection and Disposal

1. Soild wastes generated from the residential premises is classified as follows:

- 1-1 Garbage consists of wastes from preparation, cooking and serving of food, market wastes, waste from handling, storage and sale of produce.
- 1-2 Rubbish consists of combustible materials such as paer, cartons, boxes, wood and tree branches and non-combustible materials such as metals, tins cans, dirt, glass & crockery.

2. Garbage Collection System

- 2-1 Any of the following system is recommended for collection of garbage: (R)
 - 2-1-1 Chute System
 - 2-1-2 Service Lift Handing System
- 2-2 Chute System
 - 2-2-1 Free-standing chute may be used. The chutes are required to have smooth, nonabsorbent and non-combustible surfaces and should be provided with closefitting access hopper. (R)
 - 2-2-2 Not more than six dwellings/ apartments should share one hopper, in which case occupants shall have no more than 100 feet to walk to the point of access to the chute . (R)
 - 2-2-3 A container of adequate volume, placed at grond level for receiving garbage from the chute, shall be housed in an enclosure. (M)
 - 2-2-4 A compactor may be used where required. (S)
 - 2-2-5 For reducing the risk of blockage in the chute the diameter of the chute should not be less than 2 feet. (R)
- 2-3 Service Lift Handling System (Service Lift System) (R)
 - 2-3-1 Service lift may be provided for handling garbage generated from the premises.

3. Bin Center (M)

3-1 Adequate number of bins for a minimum of two-day storage garbage volume shall be provided at bin center which shall be easily accessible to the YCDC solid waste collection vehicle.

4. Garbage Unit Volume (R)

- 4-1 Residential (1.0 lb/ cap / day) at (4.7 5.0) lb / cft density
- 4-2 Restaurant (2.0 lb per meal) at (6.2) lb / cft density
- 4-3 Garbage generated from dwellings shall be collected and tied up securely in garbage sacks only before being disposed of into any collection system.

5. Ventilation and Washing (M)

5-1 Ventilation and washing facility shall be provided for chute, trash room and bin.

6. Disposal of Garbage (M)

6-1 Regular garbage collection service from the bin center of the permises for disposal shall be provided by authority concerned.

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE VI DESIGN CONCEPTS AND CALCULATIONS

DESIGN CONCEPTS AND CALCULATIONS

1. Water Supply

- 1-1 Water demand estimate should be based on the water requirement given in Table-1 Appedix. (R)
- 1-2 If ground water is used as a source of supply, at least two tube wells shall be drilled with each meeting the daily demand of the premises. (M)
- 1-3 The pumping hours for each tube well should not exceed 12 hours a day. (R)
- 1-4 The distance between a tube well and the building should not be less than 50 feet. (R)
- 1-5 A tube well and soil water treatment plant shall be at least 50 feet apart. (M)
- 1-6 The vertical distance between the tip of the deepest pile or the bottom of the shallow foundation and the top of the aquifer from which ground water will be tapped shall not be less than 150 feet. (M)
 There should be at least an adequate thickness of impervious layer between the aquifer from which the ground water is tapped and the tip of the deepest pile.
- 1-7 After compliance with para 1-4, 1-5 & 1-6 a final permit for the drilling of tube wells shall be duly obtained from the authority concerned.
- 1-8 If there is no space in the premises for drilling tube wells to comply with para 1-4 and 1.5 another source of water supply should be explored. (R)
- 1-9 When raw water is to be used for fire fighting ,a separate tank or compartment shall be constructed to store water for fire fighting. (M)
- 1-10 Drinking water not meeting the recommended guideline given in guideline IV para 3-1. shall be treated by a system deemed appropriate by the designer (M)
- 1-11 Clear water reservoir for domestic use should be divided into appropriate number of compartments to facilitate maintenance. (R)
- 1-12 When roof top water storage tank/tanks are used for distributing water, the tank/tanks should have a minimum capacity of not less than 50% of the daily requirement of the premises. (M)
- 1-13 Where several tanks are used to store water on roof level the minimum capacity of each tank should preferably be 1600 gallons. (R)
- 1-14 In case where the designer wishes to install a storage tank in each apartment, the capacity shall not be greater than 400 gallons. The water stored in such tank shall be used only in case when the normal supply is interruped. (M)
- 1-15 A minimum pressure of 0.5 bar and a maximum of 2.0 bar shall be available at every highest fixture outlet.Pressure higher than 2.0 bar shall be used where necessary and appropriate.(M)
- 1-16 A pressure reducing valve shall be installed if the pressure in the main riser/ dropper or cold water supply line is greater than 5 bars. (M)
- 1-17 The system of using a pump and storage tank for each dwelling for individual water supply is not allowed. (M)
- 1-18 The installation of water meter for each dwelling is recommended. (R)

- 1-19 All design calculations shall be provided with graphs, charts, tables and nomographs used in the design. Justification for assumptions shall be clearly stated. If computer software is used, both input and output data shall be submitted and limitations of the program are to be duly stated. (M)
- 1-20 The following should be included in the conceptual design of proposed project for submission to CQHP.
 - (a) Provision of water supply source/sources from YCDC water supply system, ground water, surface water or a combination of any two or more.
 - (b) Calculation of water demand. Sizing of raw water tank, clear water tank and roof tank.
 - (c) Provision of adeguate space for (on-site)domestic water treatment system and the pumping machinery.
 - (d) Calculation of the Sewage (soil and waste water) volume .
 - (e) Provision of adequate space for sewage (soil and waste water) treatment system and the pumping machinery.
 - (f) A separate treatment system for soil and waste water can be used.
- 1-21 With regard to installation of water pumps, tanks, cold and hot water pipes SINGAPORE STANDARD CP 48, 1989 (or any updated version) is recommended. (R)

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE VII DESIGN CONCEPTS AND CALCULATIONS

2. Sanitation

2-1 Either a one-pipe system, a two-pipe system, a single-stack system, fully ventilated system or ventilated two pipe system installating.

(Figure -2, Appendix) can be used for soil and waste pipe. (R)

- 2-2 Treatment System
 - 2-2-1 The system used for the on-site treatment of either soil water or a combination of soil and wast water to meet the recommended effluent quality as given in Guide line IV, para 2-1-1 shall be selected with due consideration to the environment of the premises. (R)
 - 2-2-2 Where space is available WWTP built under the floor slab must have at least 2 feet space around the perimeter of the tank to enable regular inspection and maintenance. It must have at least 3 feet vertical clear space between the ceiling and cover slab (top)of the tank to enable regular inspection and maintanance .Waste water treatment plant constructed in basement floor must be well ventilated.(M)
- 2-3 Rain Water Runoff (R)
 - 2-3-1 For the calculation of rain water runoff a average rainfall intensity of 3.0 inches per hour is suggested (Yangon Division). For other divisions authority concerned should be consulted.
 - 2-3-2 A conical outlet for gutter is preferable for drawing the runoff from the gutter. A box outlet may also be used. However, either should be of appropriate dimension.
 - 2-3-3 Flow in the vertical rain water pipe should not be more than 1/3 full.
- 2-4 Design Calculations (M)
 - 2-4-1 All design calculations must be provided with graphs, charts, tables and nomographs used in the design.Justification of assumptions shall be clearly stated. If computer software is used both input and output data should be submitted and limitations of the program are to be duly stated.
- 2-5 Installation (R)
 - 2-5-1 With regard to installation of pipes and pumps, SINGAPORE CODE OF PRACTICE ON SANTARY PLUMBING AND DRAINAGE SYSTEM, (1976 or any updated version) is recommended.

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE VIII WATER, SANITATION AND PLUMBING-RELATED DRAWINGS

1. Report (M)

- 1-1 A report must be prepared and submitted along with drawings.Designer must explain how the water supply system, sewerage system, fire fighting system, garbage collection and disposal system and storm water collection and disposal systems are planned.
- 1-2 Designer's assumptions, parameters and formulae must be used with justification.
- 1-3 Specification for materials and equipments must also be included.
- 1-4 Minumum size of drawing sheet is A3.
- 1-5 Symbols and abbreviations must be clearly indicated as shown in Table 2, Appendix Internationally recognized symbols and abbreviations can also be used.
- 1-6 Site plan must include all existing sewers, manholes, existing rood side drains, natural drains and water lines within the municipal juridiction (eg. YCDC, MCDC)
- 1-7 Layout plan must include tentative locations of tube wells and water strorage tanks for domestic tank & bin center. Only the approved water treatment plant, waste water treatment plant, pipe lines and drains shall be shown in the drawing.
- 1-8 Detailed drawings with suitable scale must be included where necessary. Isometric drawings shall be used.
- 1-9 Used table -3 for colouring of different piping systems.
- 1-10 Enlarged drawing of WC, wet area must be included. Plan of SWV, CW and HW must be shown in detail.
- 1-11 Symbols, Abbreviations and colour code for piping works can be used as per Table-2.

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING CONSTRUCTION PROJECTS GUIDELINE IX OPERATION AND MAINTENANCE

1. Operation

1-1 The contractor shall provide technical training in system operation and maintenance to the owner's staff members during the commissioning phase and prior to hand-over of the facilities. (M)

2. Maintenance (M)

2-1 The contractor provide maintenance manual to the owner's staff members during the commissioning phase.

3. General (R)

- 3-1 Operation instruction and maintenance manual should be provide in written text.
- 3-2 Operation instruction and maintenance manual should be prepared by experienced and competent representative of the contractor.
- 3.3 Completed pipe works should be painted as given in Table 3, Appendix, to facilitate maintenance.

APPENDIX

No.	Type of Premises/Establisment	Population Equivalent (recommended) PE
1.	Residential	5-6 per apartment
2.	Commercial:	
	(includes entertainment/recreational centres, restaurants, cafeteria, theatres)	3-5 per 1000 square feet gross area
3.	Shopping Centre.	3-5 per 1000 square feet gross area
4. 5. 6. 7.	Schools/Education Institutions: -Day schools/institutions -Fully residential -Partial residential Hospitals Clinic Hotels (wit dining and laundry facilities) Hotels (without dinning & laundry) Market (wet type)	 0.3 per student 1 per student 0.5 per student 4 per bed 0.5 per patient 4 per room 2.0 per room 5-7 per 1000 square feet gross area
0. Q	Market (dry type)	3-5 per 1000 square feet gross area
9. 10.	Beauty Saloon	0.5 per clinet

TABLE (1) - POPULATION EQUIVALENT

Note:

- 1 PE is equivalent to 40 gallons per capita per day (gpcd) or (180 lit/cap/day)
- 30% of water supply is generally taken as soil water.

APPENDIX

OK OOLD WATER PIPE V AR VENT PIPE S SOL PIPE N WASTE PIPE N NASTE PIPE N ASTE STEAM SUPPLY PIPE S STEM SUPPLY PIPE N RESER UP NOW CONSCION JONIT NOW CONSCIN JONIT	MBOLS ABBREVI	ATION DESCRIPTION	SYMBOLS	ABBREVIATION	DESCRIPTION
Y NR YENT PIPE S SOL PIPE W WASTE PIPE W UW LAUNDRY MASTEWATER W WASTE STEWATER WMS HOT WATER STEPLY PIPE MMS HOT WATER STEPLY PIPE S STEAM CONDEX RETURN PIPE S STEAM CONDEX RETURN PIPE S RESER UP S STEAM CONDEX RETURN PIPE S RESER UP S RESER UP S RESER UP S RESER UP CONNECTION W	CH.	COLD WATER PIPE.		FCD	FLOOR CLEAN OUT
S SOIL PIPE W WASTE PIPE W WASTE PIPE UW LAUNDRY WASTE PIPE UW LAUNDRY WASTE PIPE W WASTE PIPE W NASTE PIPE WMR HOT WATER SUPPLY PIPE WMR HOT WATER SUPPLY PIPE WMR HOT WATER SUPPLY PIPE S STEMA CONDENSE RETURN PIPE S RESER UP S RESER UP OR DOWN S SHAACH-BOTTON CONNECTION S RESER UP OR DOWN	V	AIR VENT PIPE		FD	FLOOR DRAIN
W WASTE PPE M RECETED RASTEMATER UW LAILORY MASTEMATER UW LAILORY MASTEMATER F FRE PROTECTION PIPE MMS HOT WATER SUPPLY PIPE MMR HOT WATER RETURN PIPE MMR HOT WATER RETURN PIPE G LIPG GAS PIPE G RISER UP G RISER UP OR ODOWN G RISER UP OR ODOWN <t< td=""><td> S</td><td>SOIL PIPE</td><td></td><td>RC</td><td>ROOF DRAIN OR CANOPY DRAI</td></t<>	S	SOIL PIPE		RC	ROOF DRAIN OR CANOPY DRAI
IM INFECTED INSTEMATER UM LAUNDRY WASTEMATER F FINE FORCECTION WASTEMATER IMM HOT WATER SUPPLY PIPE IMM HOT WATER SUPPLY IMM HOT WATER SUPPLY IMM HOT WATER SUPPLY IMM HOT WATER SUPPLY IMM HOT WATER SUPPLY PIPE IMM HOT WATER SUPPLY PIPE IMM HOT WATER SUPPLY IMM BISEB DOWN IMM IMACON FREE GEOWN IMM RESEB DOWN IMM BISEB DOWN IMM RESEB DOWN IMM RESEB DOWN IMM RESEB DOWN IMM RESEB DOWN <td< td=""><td> W</td><td>WASTE PIPE</td><td>Tr.</td><td>VIR</td><td>VENT THROUGH ROOF</td></td<>	W	WASTE PIPE	Tr.	VIR	VENT THROUGH ROOF
LW LUNDRY WATER STEATER P PIRE PROTECTION PIPE WMS HOT WATER SUPPLY PIPE MMR HOT WATER SUPPLY PIPE SS STEAM SUPLY SS STEAM SUPLY SS S		INFECTED WASTEWATER	H	MH	MANHOLE
F FIRE PROTECTION PIPE MWS HOT WATER SLIPLY PIPE MWS HOT WATER SLIPLY PIPE S STEAM CONDUCTS RETURN PIPE S RESER UP S RESER UP OR DOWN S RESER UP OR CONNECTION S RESER UP OR CONNECTION S RESER UP OR ONSERTION S STRAMER S READINGTON S RESER UP OR CONNECTION S RESER UP OR ONSERTION S STRAMER S STRAMER S STRAMER S STRAMER	LW.	LAUNDRY WASTEWATER	1 10	SMH.	SANITARY MANHOLE
HWS HOT WATER SUPPLY PIPE HWS HOT WATER RETURN PIPE SS STEAM CONDENSE RETURN PIPE SH STEAM CONDENSE RETURN PIPE C LPG. GAS PIPE SH STEAM CONDENSE RETURN PIPE SH SHOCK ABSON SH SHOCK ABSON SH BRANCH-BOTTOM CONNECTION Q STR STRAMER Q NATER CLOSE STR STRAMER Q MARE CLOSE STR STRAMER Q B URINAL STR STRAMER Q S MARE REDUCTOR STR STRAMER Q S WARE REDUCTOR STR STRAM	-F	FIRE PROTECTION PIPE		KWIMH.	KITCHEN WASTE MANHOLE
HMR HOT WATER RETURN PIPE	HWS	HOT WATER SUPPLY PIPE		FDC	FIRE DEPARTMENT CONNECTION
S STEAM SUPPLY PIPE SR STEAM CONDENSE RETURN PIPE SR Riser DOWN SR Riser DOTON	HWE	HOT WATER RETURN PIPE	-0		PUMP
PA STEAM CONDENSE RETURN PIPE PG BALL COCK C LPC, CAS PIPE HA HOSE BIBB C LPC, CAS PIPE HA HOSE BIBB C RISER UP - PLOUDOR BUL C RISER UP OR DOWN L SA SHOCK ABSON C RISER UP OR DOWN L SA SHOCK ABSON C BRANCH-TOP CONNECTION P PG PRESSURE GA C BRANCH-BOTTOM CONNECTION _P PG PRESSURE GA C RIVE ONNECTIOR _P PG PRESSURE GA C RIVE ONNECTIOR _P PG PRESSURE GA C RIVE ONNECTIOR _P PG PRESSURE GA STIR STRANER CD WG WATER VALVE D B M OTTERLY VALVE B UNATORY B B UNATORY G STRANER GO D S A Y GV O S A Y GV SC A Y GV SC A Y GV SC A Y GV UNATORY<	-s \$\$\$	STEAM SUPPLY PIPE	4	H	HALON FIRE EXTINGUISHER
C LPG. GAS PIPE -0 - RSER UP -0 - RSER DOWN -0 - RSER UP OR DOWN -1 - RISER UP OR DOWN -1 - BRANCH-TOP CONNECTION -1 - BRANCH-BOTTOM CONNECTION -1 BRANCH-BOTTOM CONNECTION - -1 DEAPAASIGN JOINT -1 EXPANSION JOINT -1 DEAPAASIGN JOINT -2 FIR -3 STRANER -4 -4 -5 STRANER -6 RV -7 BUTTERFLY VALVE -6 RV -7 BUTTERFLY VALVE -8 -7 -7 RODAMING BUTTERFLY VALVE -8 -7 -9 PHW -9 -7 <t< td=""><td></td><td>STEAM CONDENSE RETURN PIPE</td><td>+0+</td><td>BC I</td><td>BALL COCK</td></t<>		STEAM CONDENSE RETURN PIPE	+0+	BC I	BALL COCK
→0 - RISER UP →0 - RISER DOWN →0 - RISER DOWN →1 - RIANCH-TOP CONNECTION →1 - RIVE OR DOWN →1 - FLOAT MODULATING VALVE →1 - FLOAT MODULATING VALVE <td> C</td> <td>LPG. GAS PIPE</td> <td>+04-</td> <td>16</td> <td>HOSE BIBB</td>	C	LPG. GAS PIPE	+04-	16	HOSE BIBB
→0 - RSER DOWN → RSER UP OR DOWN ↓ - RSER UP OR DOWN ↓ - BRANCH-TOP CONNECTION ↓ - BRANCH-TOP CONNECTION ↓ - BRANCH-TOP CONNECTION ↓ - BRANCH-TOP CONNECTION ↓ - BRANCH-BOTTOM CONNECTION ↓ - BRANCH-BOTTOM CONNECTION ↓ FC FLXBER CONNECTOR ↓ - EXAMPLE ↓ - ↓ -		RISER UP		-	PLUG OR BLIND FLANGE
P REFERUPOR DOWN - BRANCH-TOP CONNECTION - BRANCH-TOP CONNECTION - BRANCH-BOTTOM CONNECTION - EXPANSION JOINT - EXPANSION JOINT <tr< td=""><td>+0 +</td><td>RISER DOWN</td><td></td><td>SA</td><td>SHOCK ABSOMBER</td></tr<>	+0 +	RISER DOWN		SA	SHOCK ABSOMBER
- BRANCH-TOP CONNECTION - BRANCH-BOTTOM CONNECTION - BRANCH-BOTTOM CONNECTION - RUBBLE CONNECTOR - FC - EXPANSION JOINT - BIT - BIT - BIT - BALL WALVE - FLOAT MODULATING BUTTERFLY VALVE - FLOAT MODULATING VALVE		RISER UP OR DOWN	Ŷ	15	LEVEL SWITCH
- BRANCH-BOTTOM CONNECTION BRC RUBBLE PIPE CONNECTOR FC FLEXBLE CONNECTOR - EXPANSION JOINT - BITTERTY VALVE - BITTERTY VALVE - BITTERTY VALVE - BAN - BAN - FLOAT MODULATING VALVE - <		BRANCH-TOP CONNECTION	- 9	PG	PRESSURE GALKE
RPC RUBBER PIPE CONNECTOR FC FLOUBLE CONNECTING VALVE FF FLOUB COLD WATER FC FLOUE FUNCTION FC FLOUE CONTROL VALVE FC FLOUE COLD WATER FC FLOUE COLD W		BRANCH-BOTTOM CONNECTION	CHE	FHC	FIRE HOUSE CABINET
PC FLEXIBLE CONNECTOR - EXPANSION JOINT STR STRANSION JOINT STRANSION JOINT BUTTERFLY VALVE STR BUTTERFLY VALVE STR PROV PHW PRESSURE REDUCING VALVE STR STRANSING LOADED CHECK VALVE STR SUBJOINT CARLER VALVE CV SWING CHECK VALVE SCV SPRING LOADED CHECK VALVE SCV SPRING LOADED CHECK VALVE SCV SUBJOINT CA	RPC	RUBBER PIPE CONNECTOR		SH	SHOWER
- EXPANSION JOINT STR STRANER M GV GATE VALVE M GV GATE VALVE M GV GATE VALVE M GV GATE VALVE M BUTTERFLY VALVE M PRESSURE REDUCING VALVE M GUDE SCHECK VALVE M GUDBE VALVE M GUDBE VALVE M AVV AVV AURMATICER VENT M </td <td>+++ FC</td> <td>FLEXIBLE CONNECTOR</td> <td>D</td> <td>WC</td> <td>WATER CLOSET</td>	+++ FC	FLEXIBLE CONNECTOR	D	WC	WATER CLOSET
STR STRANER W GATE VALVE W GATE VALVE W O S & Y GV W O S & Y GV W O S & Y GV W BITTERFLY VALVE W BUTTERFLY VALVE W BUTTERFLY VALVE W BUTTERFLY VALVE W BUTTERFLY VALVE W BALL VALVE W BALL VALVE W BALL VALVE W PRESSURE REDUCING VALVE AC ALR COMPRESS CO PRV PRESSURE REDUCING VALVE CRUF COU PRESSURE REDUCING VALVE COU PRC PCV PUMP CONTROL VALVE SCV SPRING LOADED CHECK VALVE CV SWING CHECK VALVE CV SWING CHECK VALVE CWP COLD WATER CU OLSEL FIRE CU SUDIONID VALVE CWP COLD WATER MOTOR OPERATED VALVE DFP <		EXPANSION JOINT	B	UR	URINAL
Image: Second	STR.	STRAINER	0	80	BIDET
B 0 S Å Y GV 0 S Å Y GATE VALVE G BV BUTTERFLY VALVE G BV BUTTERFLY VALVE AC AR COMPRESS BL - AC AR COMPRESS AC AR COMPRES AC	-04 - OV	GATE VALVE	10	L0/	LAWATORY
Image: Second	- OSA	O S & Y GATE VALVE	D	SH	SHOWER HEAD
INDUST INDICATING BUTTERFLY VALVE AC AR COMPRES 3 BW BALL VALVE CNOF COLD WATER 45 PRV PRESSURE REDUCING VALVE CNOF COLD WATER 45 RV PRESSURE REDUCING VALVE CNUF COLD WATER 45 RV PRESSURE REDUCING VALVE GSP GALVANIZED S 46 - FLOAT MODULATING VALVE GSP GALVANIZED S 46 - FLOAT MODULATING VALVE PRC POLYMINT, CH 40 SCV SPRING LOADED CHECK VALVE PR POLYMIT, CH 40 SCV SPRING CONTROL VALVE PE POLYMIT, CH 41 - GLOBE VALVE PE POLYTHYLEN 42 - GLOBE VALVE CH CAST IRON P 44 - MOTOR OPERATED VALVE GNP COLD WATER 44 - FOOT VALVE GNP DESEL FRE 45 - FOOT VALVE A/C ABOVE CELIN 46 <	-6 IV	BUTTERFLY WALVE		87	BATH TUB
BALL VALVE CNOF COLD WATER S PRV PRESSURE REDUCING VALVE CNUF COLD WATER S RV PRESSURE REDUCING VALVE CSP CAUVE COLD WATER S RV PRESSURE REDUCING VALVE GSP CAUVE COLD WATER S - FLOAT MODULATING VALVE GSP CAUVE PRC POLYNINTL CH S - FLOAT MODULATING VALVE PR POLYNINTL CH S - FLOAT MODULATING VALVE PR POLYNINTL CH S SCV SPRING LOADED CHECK VALVE PR POLYNINTLEN S CV SWING CHECK VALVE PE POLYETHYLEN S ADV ALARM CHECK VALVE CMP COLD WATER B - MOTOR OPERATED VALVE CMP COLD WATER B - SOLENOID VALVE OFP DESEL FRE B - FOOT VALVE JP JOCKEY PUW B - FOOT VALVE A/C ABOVE CELIN	- NO.5	V INDICATING BUTTERFLY WILVE		AC	AIR COMPRESSOR
Image: Second State State PRV PRESSURE REDUCING VALVE CNUF COLD WATER Image: Second State FLOAT MODULATING VALVE GSP GALVANIZED S Image: Second State FLOAT MODULATING VALVE FRC POLYSUTRIC D Image: Second State FLOAT MODULATING VALVE FRC POLYSUTRIC D Image: Second State FLOAT MODULATING VALVE FR POLYSUTRIC D Image: Second State FLOAT MODULATING VALVE FR POLYSUTRIC D Image: Second State SCV SPRING LOADED CHECK VALVE FR POLYSUTRICEN Image: Second State SCV SPRING CADED CHECK VALVE CMP COLD WATER Image: Second State GOUBE VALVE CMP COLD WATER COLD WATER Image: Second State ADV ALRW CHECK VALVE CMP COLD WATER Image: Second State GOUBE VALVE CMP COLD WATER WMTP Image: Second State GOUBE VALVE GPP DIESEL FIRE Image: Second State GOUBE VALVE GPP DIESEL FIRE Image: Second State GOUBENT SPRINGLER HEAD F/A FROM ABOVE CEILIN Image: Second State GOUBENT SPRINGLER HEAD F/A FROM ABOVE Image: Second State GOUBENT SPRINGLER HEAD	-ā BÁV	BALL WALVE		CNDF	COLD WATER DOWN FEED
RV PRESSURE RELEF VALVE GSP GALVANIZED S GI - FLOAT MODULATING VALVE PVC POLYMINT. CH CI SCV SPRING LOADED CHECK VALVE PE POLYTHYLEN CI CV SWING CHECK VALVE CI CAST IRON PI CV SWING CHECK VALVE CI CAST IRON PI CV SWING CHECK VALVE CI CAST IRON PI CV SWING CHECK VALVE CWP COLD WATER CV SWING CHECK VALVE CWP COLD WATER CI CAST IRON PI COLD WATER WWTP WATER - GLOBE VALVE DFP DIESEL FIRE JIP JOCKEY PUWI JIP SOLENOID VALVE JIP JOCKEY PUWI AAW AUTOMATIC AIR VENT RL RAIN LEADER CI - FOOT VALVE A/C ABOVE CELIN CI - PENDENT SPRINKLER HEAD F/A FROM ABOVE CI - UPROHT SPRINKLER HEAD F/A FROM ABOVE CI - UNION T/A TO ABOVE	ato PHN	PRESSURE REDUCING WILVE		CNUF	COLD WATER UP FEED
Image: Second	The HV	PRESSURE RELIEF VALVE		659	GALVANIZED STEEL PIPE
2 PCV PUMP CONTROL VALVE PB POLYBUTYLEN CO SCV SPRING LOADED CHECK VALVE PE POLYBUTYLEN CV SWING CHECK VALVE CI CAST IRON PI ADV ALARM CHECK VALVE CWP COLD WATER WIT - GLOBE VALVE DFP DESEL FIRE WIT WATER METER JP JOCKEY PUMI MOTOR OPERATED VALVE JP JOCKEY PUMI JIP JOCKEY PUMI IL RAIN LEADER SOLENOID VALVE JP JOCKEY PUMI JIP JOCKEY PUMI IL RAIN LEADER SOLENOID VALVE SPRINGLER HEAD B/F BELOW FLOOR SOL - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE SOL - UNION T/A TO ABOVE	51 -	FLOAT MODULATING VALVE		PVC	POLYMINTL CHLORE
SCV SPRING LOADED CHECK WILVE PE POLYETH/LEN SC CV SWING CHECK WILVE CI CAST IRON PI ADV ALARM CHECK WILVE CWP COLD WATER WITP WASTEMATER WWTP WASTEMATER BI - MOTOR OPERATED WILVE DFP DIESEL FIRE BI - MOTOR OPERATED WILVE DFP DIESEL FIRE BI - SOLENDID WILVE JP JOCKEY PUWI BI - FOOT WALVE A/C ABOVE CELIN BI - PENDEENT SPRINKLER HEAD B/F BELOW FLOOR BI - UPRIGHT SPRINKLER HEAD F/A FROM ABOVE BI - UNION T/A TO ABOVE	Z PCV	PUMP CONTROL VALVE		PB	POLYBUTYLENE PIPE
CV SWING CHECK VALVE CI CAST IRON P ADV ALARM CHECK VALVE CWP COLD WATER CI CAST IRON P CWP COLD WATER CI CAST IRON P WATER CWP COLD WATER CI CAST IRON P COLD WATER WATER CUD WATER CI CAST IRON P COLD WATER COLD WATER COLD WATER CI CAST IRON P COLD WATER COLD WATER COLD WATER CI CAST IRON P COLD WATER COLD WATER COLD WATER CI CAST IRON P WATER WETER A/C ABOVE CELIN CI CAST IRON P PROMENT SPRENGLER HEAD F/A FROM ABOVE CI COLD WATER WETER F/A FROM BELOW F/A FROM BELOW CI COLD WATER COLD KATER T/A TO ABOVE	A SCV	SPRING LOADED CHECK WALVE		PE	POLYETHYLENE PIPE
ACV ALARW CHECK VALVE CWP COLD WATER COUP GLOBE VALVE WMTP WASTEMATER DI - MOTOR OPERATED VALVE DFP DIESEL FIRE DI - SOLENDID VALVE JP JOCKEY PUWI Image: Coup Water - SOLENDID VALVE JP JOCKEY PUWI Image: Coup Water - JP JOCKEY PUWI Image: Coup Water - - JP JOCKEY PUWI Image: Coup Water - - JP JOCKEY PUWI Image: Coup Water - - - - Image: Coup Water - - -	CV CV	SWING CHECK VALVE		a	CAST IRON PIPE
Image: Solution of the soluti	ACV	ALARM CHECK VALVE		CWP	COLD WATER PUMP
B - MOTOR OPERATED VALVE DFP DESEL FIRE - SOLENDID VALVE JP JOCKEY PUWI - - SOLENDID VALVE JP JOCKEY PUWI - - FOOT VALVE A/C ABOVE CELIN - - PENDENT SPRINKLER HEAD B/F BELOW FLOOR - - UPRGHT SPRINKLER HEAD F/A FROM ABOVE - - UPRGHT SPRINKLER HEAD F/B FROM BELOW - - UNION T/A TO ABOVE		GLOBE WALVE		WWTP	WASTEMATER TREATMENT PLAN
- SOLENOID VALVE JP JOCKEY PUWI AAV AUTOMATIC AIR VENT HL RAIN LEADER - - FOOT VALVE A/C ABOVE CELIN - - PENDENT SPRINGLER HEAD B/F BELOW FLOOR - - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE - - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE - - UNION F/B FROM BELOW - - UNION T/A TO ABOVE	里 -	MOTOR OPERATED VALVE		DFP	DIESEL FIRE PUMP
AAV AUTOMATIC AIR VENT RL RAIN LEADER - FOOT VALVE A/C ABOVE CELLIN - - PENDENT SPRINGLER HEAD B/F BELOW FLOOR - - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE - - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE - - UNION F/B FROM BELOW - - UNION T/A TO ABOVE		SOLENOID VALVE		JP	JOCKEY PUMP
- FOOT VALVE A/C ABOVE CELIN - PENDENT SPRINGLER HEAD - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE F/A FROM ABOVE F/B FROM BELOW T/A TO ABOVE T/A TO ABOVE	T AAN	AUTOMATIC AIR VENT		RL	RAIN LEADER
O - PENDENT SPRINGLER HEAD B/F BELOW FLOOR • - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE • - UPRIGHT SPRINGLER HEAD F/A FROM ABOVE • - UNION F/B FROM BELOW • - UNION T/A TO ABOVE		FOOT WALVE		A/C	ABOVE CEILING
	-0 -	PENDENT SPRINKLER HEAD		B/F	BELOW FLOOR
Image: WMT WATER METER F/B FROM BELOW Image: WMT Image: WMT Image: WMT Image: WMT Image: WMT Image: WMT Ima		UPRICHT SPRINKLER HEAD		F/A	FROM ABOVE
		WATER METER		F/B	FROM BELOW
		UNION		T/A	TO ABOVE
UC CLEAN OUT PLUG	+ 00	CLEAN OUT PLUG		T/B	TO BELOW
- LANDING VALVE W/ WITH	* •	LANDING VALVE		W/	WITH

TABLE -2 SYMBOLS & ABBREVIATIONS

APPENDIX

	Type of Pipes	Colour Names (to BS 4800)
1.	Soil pipe	Blank
2.	Waste pipe	Grey
3.	Vent pipe	Yellow
4.	Cold water pipe	Light Blue
5.	Hot water pipe	Orange
6.	Fire fighting pipe	Red
7.	Rain water pipe	Dark Blue

TABLE (3) - COLOUR SCHEME FOR PAINTING PIPE WORKS

- * Rain water pipe should be painted only if it is located in the duct.
- * Preferably pipes should be painted through out the entirely length.



APPENDIX

FIGURE.1 TYPICAL COLD WATRE DISTRIBUTION SYSTEM



FIGURE.2 TYPICAL SOIL, WASTE & VENT PIPING SYSTEM