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Plumbing System in Low Rise Building

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Abstract—.In today's era the potable water distribution systems are nowadays divided into major and minor distribution systems. Mostly the Major water distribution networks system refer to municipal pipe systems which are carried from the treatment plant to city ,suburbs and all parts of the water service line for buildings. Minor water distribution systems, is nowadays given greater importance as plumbing water distribution systems, which run from the upstream point of the water service line to all interior plumbing fixtures and demand points associated with the building. The research papers focus on major systems, but a small number of important documents are needed a concerning the design and analysis of minor systems. This paper presents a comparative statement evaluation of contemporary plumbing water distribution system, Drainage and rain Water systems. All underlying theory is explained and advantages and drawbacks for any building.

Keywords- Watersupply systems, Plumbing lines, Upfeed pipes, Downfeed pipes

I. INTRODUCTION

In 2010, about 56% of the global population (5.9 billion people) had access to piped water supply through house connections or to an improved water source through other means than house, including standpipes, water kiosks, spring supplies and protected wells. However, about 13% (about 900 million people) did not have access to an improved water source and had to use unprotected wells or springs, canals, lakes or rivers for their water needs. A clean water supply—in particular, water that is not polluted with fecal matter from lack of sanitation—is the single most important determinant of public health Destruction of water supply and/or sanitation infrastructure after major catastrophes (earthquakes, floods, war, etc.) poses the immediate threat of severe epidemics of waterborne diseases, several of which can be life-threatening. **Plumbing** – The pipes , fixtures and other apparatus inside a building for bringing in the water supply and removing the liquid water borne wastes and collecting , disposing Rain water. **Plumbing Systems**– The plumbing system shall include the water supply and distribution pipes, plumbing fittings and traps, soil , waste, vent pipes and anti-siphonage pipes, building drains and building sewers including their respective connections, devices and appurtenances within the property lines of the premisesand water treating and water using equipments .It also includes rain water collection and disposal.

II-ABOUT WATER SUPPLY PLUMBING SYSTEMSTUDY

Project which is a cluster of low rise building (Apartments) is selected for Evaluation study of plumbing system (water supply, drainage & rain water), which is situated in Vadodara whose key plan is shown in Figure 1 & its photograph is also shown in photograph No. 1

It is a cluster of low rise building with the combination of 12 towers (Tower no 13 to Tower no 24).

It is a cluster of low rise building with the combination of 12 towers (Tower no 1 to Tower no 12).

I.

Two Towers (A & B) Project is selected for Detailed Evaluation Study of Plumbing system because it is consisting of 56 Flats and 15 Shops on Ground Floor & 15 Shops on 1st Floor .i.e. This Tower is a Combination of Commercial and residential Building.

Tower A consist of 6 Shops on ground floor & 6 Shops on 1st floor, While at ground floor parking is on backside.

It also consist of 3 Flats on 1st floor and 3 flats on 5th floor ,while on 2nd ,3rd. 4th floors it consist of 6 flats/floor.

II.

Tower no B consist of 9 Shops on ground floor & 9 Shops on 1st floor, while at ground floor parking is on backside.

It consist of 4 Flats on 1st floor and 4 flats on 5th floor, while on 2nd, 3rd. 4th floor it consist of 8 flats/floor.

This Whole study includes complete observation of Plumbing systems provided on site Tower (A & B). Also it includes the Calculation of design of plumbing system (Water supply, Drainage & Rain water) and Evaluation w.r.t. plumbing system provided on site

. Fig. 1 layout & Photographic view of Low-rise Building

OBJECTIVES OF STUDY

To study the existing Water supply system of Tower (A & B) of project. To design underground water tank capacity and evaluate with existing capacity of Tower (A & B) of project. To evaluate the existing pumping systems of Tower (A& B)

METHODOLOGY OF STUDY

To achieve objectives of Water Supply Plumbing System study, following methodology was adopted. Detail Study of all information Of water Supply System and plumbing system is provided in building. As per existing layout of Water Supply System design of plumbing system is calculated. Design results are compared with existing plumbing system.

In case of water supply Actual pressure on site were measured at critical points and compared with worked out design pressure. It is also compare with minimum required pressure(0.18 Kg/cm²) at critical point as per NATIONAL BUILDING CODE OF INDIA for plumbing system

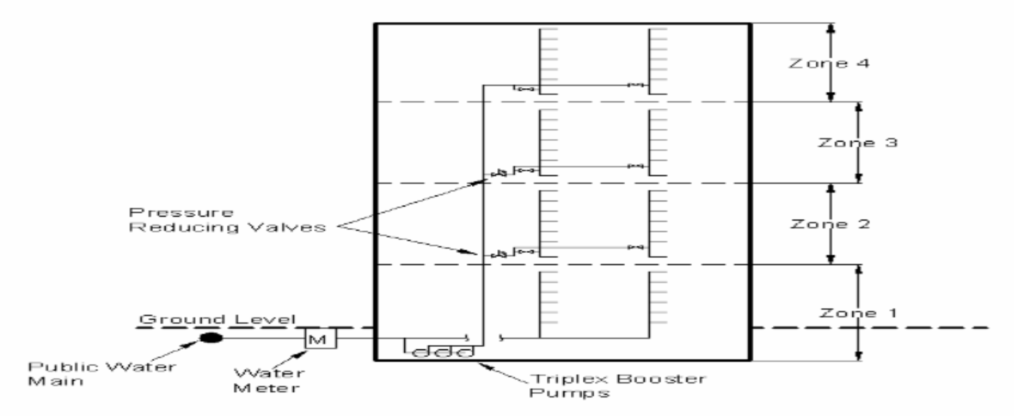
DESIGN OF WATER SUPPLY SYSTEM INDIAN STANDARD: 2065-1983

III. WATER DISTRIBUTION SYSTEM

Direct Pumping Systems Hydra-pneumatic Systems Our Head Tanks Distribution

Direct Supply System –

This system is adopted when adequate Direct Pumping Water is pumped directly into the distribution system without the aid of any overhead tank, except for flushing purposes. The pumps are controlled by a pressure switch installed on the line. Normally a jockey pump of smaller capacity installed which meets the demand of water during low consumption and the main pump starts when the demand is greater. Then start and stop operations are accomplished by a set if pressure switches arc installed directly on the line. Ln some installation, a timer switch is installed to restrict the operating cycle of the pump. Direct pumping systems are suitable for buildings where a certain amount of constant use of water is always occurring. These buildings are all centrally air-conditioned buildings for which a constant make up-supply for air-conditioning cooling towers is required. The system depends on a constant and reliable supply of power. Any failure in the power system would result in a breakdown in the water supply system. The system eliminates the requirements of overhead tanks for domestic purposes (except for flushing) and requires minimum space



Typical Pumped-Up feed Schematic diagram

The diagram shows the first zone being fed by the pressure from the water main. It would be wasteful to utilize pump energy to serve this zone when adequate pressure is available from the municipality.

Zones 2 through 4 are served by the booster pumps. A main riser extends from the pumps and to the inlets of zones 2 through 4.

Here, the taps off the “pumped-cold-water riser” are located at the lowest elevation of each zone, and water is supplied from the bottom and fed up through the supply risers, laterals and branches.

This arrangement produces the largest pressures at the bottom of the pressure zone. Energy is dissipated, in the form of frictional and static pressure losses, as the water flows against gravity to the top of the zone.

Pressure reducing valves (PRVs) are utilized to regulate the inlet pressure values entering each Zone (these can be seen in Figure 3.7.2.1).

The PRV is set at a value that corresponds to the maximum allowable pressure, viz. 80 psi.

Downfeed System

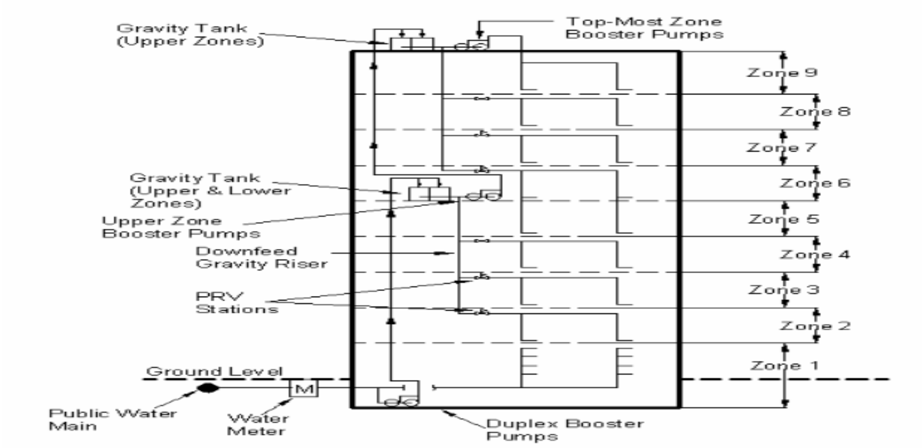
Down feed distribution configurations, often referred to as “gravity tank” systems, consist of an elevated water

tank(s) supplied by pumps.

Down feed distribution is based on lifting water to an elevated tank, then allowing that water to flow down through the distribution network under the force of gravity.

Cold-water down feed applications are configured using branched-networks. Unlike pumped-up feed systems, gravity-tank systems do not connect pumps directly to the plumbing fixtures.

The gravity tanks (or “house tanks”) serve as intermediary buffers between the house pumps and the fixtures. This attribute is displayed in Figure 3.7.3.1, which has been adapted from Harris (1990).



Typical Down feed Schematic

Figure exhibits a typical pressure zoning arrangement for a down feed configuration.

Zone 1 is shown being served by the public water main pressure, and is independent of the down feed network. Pressure zones 2 through 9 are arranged in a similar fashion to the pumped-up feed system, but vertically inverted.

Water is transmitted from the "house pumps" in the basement to the gravity tanks located in zone 6, which serve water demands in zones 2 through 4.

The zone 6 pumps displace water from the adjacent tanks to the cisterns located in the penthouse.

The upper tanks supply water to zones 5 through 9. By configuring the system with two independent supply tanks, the high-rise system is effectively cut in half.

The zone 6 gravity tanks are the only common connection between the upper and lower halves. Both sections are designed completely independent of one another

PLUMBING SYSTEM DESIGN

Design of Delivery Pipe:

Design of Pipe w.r.t. site provided underground tank Tower A

Actual Capacity = 18,410 litres

Time taken to fill the Tank = 1.75 hrs. i.e. 105 minutes

Velocity can be considered as 1.2 to 2.4 m/sec.

Therefore, we will consider velocity as 1.8 m/sec.

Q =2.92 litres/sec.

=175.33 litres/min.

= 10520 litres/hr

Q = AV

D = 0.033 ≈ 38 mm

i.e. we can provide 40 mm Diameter which is available in market.

Design of pipe W.r.t. Design Capacity of Underground tank Tower no A

Capacity Required = 20,000 litres

Time to fill the tank = 90 minutes

Q = 3.7 litres/sec.

= 3.7×10^{-3} m^3/sec.

= 222 litres/min.

= 13333 litres/hr.

Q= AV

D = 50 mm

Design of Pipe w.r.t. site provided underground tank Tower no B

Actual Capacity = (15914+15914) litres = 31828 litres (2 tank Capacity)

Time taken to fill the Tank = 3 hrs. i.e. 180 minutes

Velocity can be considered as 1.2 to 2.4 m/sec.

Therefore ,we will consider velocity as 1.8 m/sec.

Q =2.94 litres/sec.

=176 litres/min.

= 10609 litres/hr

Q = AV

D = 38 mm

i.e. we can provide 40 mm Diameter which is available in market.

Design of pipe W.r.t. Design Capacity of Underground tank Tower no 13 B

Capacity Required = 26,500 litres
Time to fill the tank = 3 hrs i.e. 180 minutes

Q = 4.9 litres/sec. (i.e. Dividing Capacity of 2 Tank)
= 294litrs/min.
= 17666.6 litres/hr.

Q= AV

D = 42 mm

i.e. we can provide 40 mm Diameter which is available in market.
Demand Calculation by Fixture Unit Method (Toilet):

SR. NO.	PARTICULATES	W.S.F.Us
1.	Health Faucet	0.75
2.	flush cock	6.00
3.	Shower	2.00
4.	Hot & cold water cock	2.00
5.	Pillar Cock	0.75
	TOTAL = 11.5 (For Toilet)	

Load Values in Water supply Fixture Units

Supply systems predominantly for flush tanks			Supply systems predominantly for flush valves		
Load	Demand		Load	Demand	
(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)	(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)
1	3.0	0.04104			
2	5.0	0.0684			
3	6.5	0.86892			
4	8.0	1.06944			
5	9.4	1.256592	5	15.0	2.0052
6	10.7	1.430376	6	17.4	2.326032
7	11.8	1.577424	7	19.8	2.646364
8	12.8	1.711104	8	22.2	2.967696
9	13.7	1.831416	9	24.6	3.288528
10	14.6	1.951728	10	27.0	3.60936
11	15.4	2.058672	11	27.8	3.716304
12	16.0	2.13888	12	28.6	3.823248
13	16.5	2.20572	13	29.4	3.930192
14	17.0	2.27256	14	30.2	4.037136
15	17.5	2.3394	15	31.0	4.14408
16	18.0	2.90624	16	31.8	4.241024
17	18.4	2.459712	17	32.6	4.357968
18	18.8	2.513184	18	33.4	4.464912
19	19.2	2.566656	19	34.2	4.571856
20	19.6	2.620128	20	35.0	4.6788
25	21.5	2.87412	25	38.0	5.07984
30	23.3	3.114744	30	42.0	5.61356
35	24.9	3.328632	35	44.0	5.88192
40	26.3	3.515784	40	46.0	6.14928
45	27.7	3.702936	45	48.0	6.41664

Water Demand as per Water supply Fixture Units[7]

Design Calculation for Tower A:

Design of Internal Diameter of Pipe (Toilet):

1) Health faucet:

WSFUs = 0.75

= 2.5 GPM (refer Table 5.6.2)

$Q = 0.157 \times 10^{-3}$ m³/sec.

Q = AV

Therefore, $d^2 = \frac{0.157 \times 10^{-3} \times 4}{3.14 \times 1.2}$

D=12 mm.

Provide 15 mm dia. Cpvc pipe which is available in market

2) Flush cock:

WSFUs = 6.00

= 10.7 GPM

$Q = 0.67 \times 10^{-3}$ m³/sec.

Q = AV

Therefore, $d^2 = \frac{0.67 \times 10^{-3} \times 4}{3.14 \times 1.2}$

D=25 mm.

Provide 25 mm dia. Cpvc pipe which is available in market

3) Shower:

WSFUs = 2.00

= 5.0 GPM

$Q = 0.315 \times 10^{-3}$ m³/sec.

Q = AV

Therefore, $d^2 = \frac{0.315\times 10^{-3}\times 4}{3.14 \times 1.2}$

D=18 mm.

Provide 20 mm dia. Cpvc pipe which is available in market

4) Hot and cold water cock:

WSFUs = 2.00

= 5.0 GPM

$Q = 0.315 \times 10^{-3}$ m³/sec.

Q = AV

Therefore, $d^2 = \frac{0.35\times 10^{-3}\times 4}{3.14 \times 1.2}$

D=18 mm.

Provide 20 mm dia. Cpvc pipe which is available in market

5) Pillar Cock (wash basin):

WSFUs = 0.75

= 2.5 GPM

$Q = 0.157 \times 10^{-3}$ m³/sec.

Q = AV

Therefore, $d^2 = \frac{0.157\times 10^{-3}\times 4}{3.14 \times 1.2}$

D=12 mm.

Provide 15 mm dia. Cpvc pipe which is available in market, but at site 20 mm dia. is provided so it can be revised.

Design of Toilet Down take Pipe:

1) 1st Floor (4-5):

WSFUs = 11.5

= 15.8 GPM (From Table: 6.7)

= 0.99 lit/sec.

$Q = 0.99\times 10^{-3}$ m³/sec.

Q = AV

Therefore, $d^2 = \frac{0.99 \times 10^{-3} \times 4}{3.14 \times 1.8}$

d = 32 m

Provide 32 mm dia. Cpvc pipe which is available in market

2) 2nd Floor (3-4):

WSFUs = 23

= 20.74 GPM

= 1.30 lit/sec.

$Q = 1.30 \times 10^{-3}\ m^3/sec.$

Q = AV

Therefore, $d^2 = \frac{1.30 \times 10^{-3} \times 4}{3.14 \times 1.8}$

d = 37 mm

Provide 40mm dia. Cpvc pipe which is available in market

3) 3rd Floor (2-3):

WSFUs = 34.5

= 24.5 GPM

= 1.56 lit/sec.

$Q = 1.56 \times 10^{-3}\ m^3/sec.$

Q = AV

Therefore, $d^2 = \frac{1.56 \times 10^{-3} \times 4}{3.14 \times 1.8}$

d = 40 mm

Provide 40mm dia. Cpvc pipe which is available in market

4) 4th Floor (1-2):

WSFUs = 45

= 27.7 GPM

= 1.74 lit/sec.

$Q = 1.74 \times 10^{-3}\ m^3/sec.$

Q = AV

Therefore, $d^2 = \frac{1.74 \times 10^{-3} \times 4}{3.14 \times 1.8}$

d = 42 mm.

Provide 45mm dia. Cpvc pipe which is available in market

5) 5^{th}Floor (A-1):

WSFUs = 56.5

= 26.03 GPM

= 1.94 lit/sec.

$Q = 1.94 \times 10^{-3}$ m³/sec.

Q = AV

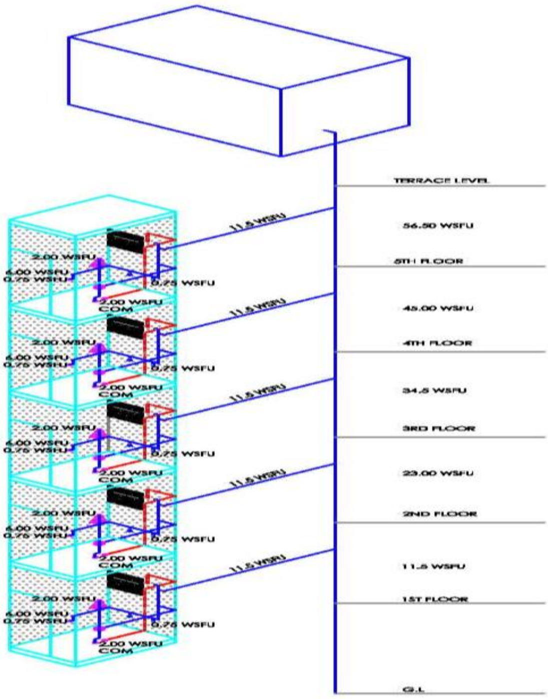
Therefore, $d^2 = \dfrac{1.94 \times 10^{-3} \times 4}{3.14 \times 1.8}$

d = 37 mm

Provide 40mm dia. Cpvc pipe which is available in market

Section	Design Diameter(mm)
Health faucet	D=15 mm.
Flush cock	D=25 mm.
Shower	D=20 mm
Hot and cold water cock	D=20 mm.
Pillar cock (wash basin)	D=15 mm.
(4-5)	d = 32 mm
(3-4)	d = 40 mm
(2-3)	d = 40 mm
(1-2)	d = 45 mm
(A-1)	d = 40 mm

Design of Toilet Down take Pipe.



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II. CONCLUSIONS

From the evaluation study of plumbing system in buildings (water supply, Drainage & Rain water systems) it is concluded that the plumbing drawings & design should be prepared first.

Drawing showings Internal water supply for toilet blocks , Kitchen & wash area should be prepared .

Schematic Diagrams for down take water supply pipes w.r.t. floors should be prepared.

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