DESIGN OF A TYPICAL PLUMBING SYSTEM

Given Data

1. **25 storied Building – Per floor 10ft**
2. **Water Pressure = 50 Psi at Public main**
3. **Men's & Women's Toilets on alternate floors.**
4. **3 Water Closets and 2 Pedestrial Urinals and 2 Lavatories on each floor.**
5. **Flush valve fixtures except on the 24^{th} & 25^{th} floors where flush tank fixures are used.**
6. **Maximum Pressure at any fixture is not to exceed 50 psi.**
7. **Service Pipe (Main to the floor of the riser) Length = 70 ft**
8. **Minimum fixture Pressure :**
   Lavatory = 8 psi
   Water closet = 8psi (Flush tank)
   = 15 psi (Flush valve)
9. **Fixture Unit (FU) :**
   Lavatory = 2FU
   Water Closet = 5 FU (Flush tank)
   = 10 FU (Flush valve)
10. **Assume, Pressure drop for branch = 1psi**
11. **Water tank distance above roof = 24ft**

Assume any reasonable values for missing data if required.

Determine the zoning of the building and the sizes of riser pipe.

Solution:

Load of service pipe:

For Flush Valve:

3 water closet = 3*10= 30 FU

2 lavatories = 2*2 = 4 FU

Total = 34 FU/floor

For Flush Tank:

3 water closet = 3*5= 15 FU

2 lavatories = 2*2 = 4 FU

Total = 19 FU/floor

Total service pipe load = (34 FU* 23 Floors + 19 FU* 2 Floors)

= 820 FU

Determine the Zoning Of the Building:

From the "Demand vs Fixture unit " graph

Using 820 FU, Max Demand = 184 gpm

From the " Flow vs Friction loss/100 ft " graph (Using 184 gpm)

If we use, 3 in pipe = 6 psi pressure drop/ 100 ft

4 in pipe = 1.4 psi pressure drop/100 ft

We select 4 in pipe = 1.4 psi pressure drop /100 ft for friction

From " Pressure loss vs Flow graph using 184 gpm, Drop in water meter

p = 3.5 psi " and 50 % extra length is considered for fitting friction

For Upfeed zone,

- P= p + 0.434h + f
- 50 = 3.5 + 1.5(70+ h)* 1.4/100 + 0.434h +15 +1
- h = 64 ft [Min fixture pressure =15 psi
  Drop for branch = 1 psi]

No of floors = 64/10 = 6.4 ~ 6 floors

But the water main remains below ground level.

Hence, considering 1 floor below the GL.

So Up feed zone = 5 floors

Now, Max height for downfeed = 50/0.434 = 115 ft

Given, Water tank 24 ft above roof [Max Fixture pressure = 50 psi]

Available height = 115-24 = 91 ft

So, 91/10 =9.1 ~9 floors

Therefore, we consider 2 down feed zone = 2*9 = 18 floors

Total served = 18+ 5 = 23 floors

Hence 2 floors left

Now we have 2 choices :

1. Increase the number of Down feed zone to 3
2. Rise max fixture pressure slightly

As increasing the Down feed zone is more expensive, we increase the max fixture pressure.

Pressure grain = 0.434 psi per ft

For 10 ft = 4.34 psi

So, (50+4.34)~ 55 psi is assumed to be the max fixture pressure.

Now,

I. **Zone #1 – 5 floors – 1st to 5th - Up feed zone**
II. **Zone #2 – 10 floors – 15th to 6th - Down feed zone**
III. **Zone #3 – 10 floors – 25 th to 16th - Down feed zone**

Design of Up feed zone:

Pressure remaining for piping and fitting friction

= 50 – (3.5+ 60 *0.434+15+1)

= 4.46 psi

Main to Riser Length = 70 ft

Riser Length = 60 ft

Total =130 ft

Now, considering 50% extra length for fitting friction

Total length = 1.5* 130 = 195 ft

∴ Pressure loss for friction / 100 ft = (4.46*100)/ 195

= 2.3 psi / 100 ft

Floor	FU	Accumulated FU	Demand Flow (gpm)	Pressure loss / 100 ft (psi)	Pipe Size (in)
Service Pipe	**-**	**820**	**184**	**2.3**	**3.5**
1st	**34**	**170**	**85**	**2.3**	**3**
2nd	**34**	**136**	**77**	**2.3**	**2.5**
3rd	**34**	**102**	**68**	**2.3**	**2.5**
4th	**34**	**68**	**58**	**2.3**	**2.5**
5th	**34**	**34**	**43**	**2.3**	**2**