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High Rise Drainage Design By Fixture UnitMethod: A Case study

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Abstract: A building is an enclosed structure that has walls, floors, a roof, and usuallywindows.
A 'tallbuilding' isamulti story structure in which mostoccupants depend on elevators [lifts]to reach their destinations. Themostprominent tallbuildingsarecalled'high-rise buildings'. Any structure where the height can have a serious impact on evacuation" (The International Conference on Fire Safety in High-Rise Buildings."For most purposes, the cut-off point for high-rise buildings is around seven stories. Sometimes, seven stories or higher define a high-rise, and sometimes the definition is more than seven stories. Sometimes, the definition is stated in terms of linear height (feet or meters) rather than stories.Generally, a high-rise structure is considered to be one that extends higher than the maximum reach of available fire-fighting equipment. In absolute numbers, this has been set variously between 75 feet (23 meters) and 100 feet (30 meters),"5 or about seven to ten stories (depending on the slab-to-slab distance between floors).The exact height above which a particular building is deemed a high-rise is specified by fire and building codes for the country, region, state, or city where the building is located. When the building exceeds the specified height, then fire, an ever-present danger in such facilities, must be fought by fire personnel from inside the building rather than from outside using fire hoses and ladders.For practicality and convenience such a multi-level or multi-story structure uses elevators as a vertical transportation system and, in addition, some utilize escalators to move people between lower floors.

1.Case study problem:

The case study problem is provided with 9th floor building problem with a solution viza viz.Pipe diameter &fixture units available in totality with horizontal branches & ceiling network at every floor.

Table No 1.:FU utilized at each floor

Floor	**Fixtureunit provided**	**Diameter of pipe in (mm**
ROOF	--	---
9th floor	70FU	100
8th floor	90FU	100
7th floor	120FU	100
6th floor	90FU	100
5th floor	150FU	100
4th floor	180FU	125
3rd floor	190FU	125
2nd floor	160FU	100
1st floor	200FU	125

2 :Step by step procedure for plumbing system design for high rise building

2.1:Determination of plumbing system pipe sizes
2,2:Calculation procedure
2.3:Select the upper floor branch layout
2.4:Compute the upper floor branch fixture units
2.5:Size the upper floor branch pipes
2.6:Size the upper floor branch pipes
2.7:Size the upper floor stack
2.8:Size the upper floor vent pipe

2.9:Size the upper floor stack
2.10:Size the lower floor branch layout
2.11:Compute the lower floor branch fixture units
2.12:Size the lower floor stack
2.13:Size the lower floor vent pipe

3.1 Maximum Permissible F.U Loads For Sanitary Stacks:
The maximum permissible fixture load for high rise buildings can be decided as per following

Table no.2: Maximumpermissible F.U loads for sanitary stack

Stack diameter inches	**Stack three stories or less in heightt**	**Stacks more than three stories in height**	**Total discharge into one branch interval F.U**
2	10	24	6
2.5	20	42	9
3	30	60	16
4	240	500	90
5	540	1100	200
6	960	1900	350
8	2200	3600	600
10	3800	5600	1000
12	6000	8400	1500

The theoretical analysis of the problem is too involved and lengthy for coverage in this book, but the interested reader is referred to the original paper for study in depth.

3.2Slope:-
3.2.1 House drain are designed to flow at half full capacity to a maximum of three quarter full under uniform flow conditions so as to prevent violent pneumatic fluctuations and the development of hydraulic pressure. A minimum slop of ¼ in/ft should be provided for 3 in. Through 6 in.pipe and 1/16 in/ft for 8in and larger .these minimum slopes are required to maintain a velocity of flow greater than 2fps for scouring action.

Table No.3: Maximum permissible slope for sanitary buildings drains and runouts from stacks

Pipe diameter in inches	**Building drain slopes**		
	1/8	1/4	1/2
2	.....	21	26
$2^{1/2}$	.....	24	31
3	20	27	36
4	180	216	250
5	390	480	575
6	700	840	1000
8	1600	1920	2300
10	2900	3500	4200
12	4600	5600	6700
15	8300	10000	12000

Table no 4.2 gives the approximate velocities or slopes for given slopes and diameters of horizontal drains. A value of 2FU can be assigned for each gallon per minute(3.8L) of flow for continuous or semivontinuous flow into the drainage system such as from sump pumps.

3.2.2: Slope to drainage line with corresponding discharge -

Table No4:Gradient of drainage line with discharge

Diameter (mm)	**Gradient**	**Discharge (m3/min)**
100	1 in 5-6	0-59
150	1 in 9-7	1-32
200	1 in 14	2-4

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230	1 in 17	2-98
250	1 in 19	3-60
300	1 in 24-5	5-30

Table no4. gives the approximate gradient or slopes for given of horizontal drains..

Table No.5:Gradient to drainage line

Diameter of Pipe (mm)	**Gradient**			
	1/200	**1/100**	**1/50**	**1/25**
100	-	180	216	250
150	-	700	840	1 000
200	1 400	1 600	1 920	2 300
250	2 500	2 900	3 500	4 200
300	3 900	4 600	5 600	6 700
375	7 000	8 300	10 000	12 000

Table No.6:Gradient

Diameter (mm)	**Gradient**	**Discharge (m3/min)**
100	1 in 57	0-18
150	1 in 100	0-42
200	1 in 145	0-73
230	1 in 175	0-93
250	1 in 195	1-10
300	1 in 250	1-70

TableNo.7:Fixture units

Type of Fixtures	**Fixture Unit Value as Load Factor**
One bath room group consisting of water closet, wash basin and bath tub or shower stall :	---
a) Tank water closet	6
b) Flush-valve water closet	8
Bath tub	3
Bidet	3
Combination sink-and-tray (drain board)	3
Drinking Fountain	1
Floor trapst	1
Kitchen sink, domestic	2
Wash basin, ordinary	1
Wash basin surgeon's	2
Shower stall, domestic	2
Showers (group) per head	3
Urinal wall lip	4
Urinal stall	4
Water closet, tank-operated	4
Water closet, valve-operated	8

Table No.7 gives the exact F.U should be given to different fixtures

Table No.8:Maximum fixture unit can be connected any line

Diameter of Pipe (mm)	**Maximum Number or Fixture Unit that may be connected to**			
	Any horizontal fixture branch	**One stack of 3 Storeys in Height or 3 Intervals**	**More than 3 Storeys in Height**	
			Total for stack	**Total at one storey on branch interval**
(1)	**(2)**	**(3)**	**(4)**	**(5)**

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30	1	2	2	1
40	3	4	8	2
50	6	10	24	6
65	12	20	42	9
75	20	30	60	16
100	160	240	500	90
125	360	540	1 100	200
150	620	960	1 900	350
200	1 400	2 200	3 600	600
250	2 500	3 800	5 600	1 000
300	3 900	6 000	8 400	1 500
375	7 000	-	-	-

3.3Case study solution with Indian standards –

The case study problem is provided with 9th floor building problem with a solution viz a viz. Pipe diameter &fixture units available in totality with horizontal branches & ceiling network at every floor.

Table No.9 :FU utilized at each floor &corresponding diameters by Indian standards

Floor	Fixtureunit provided	Diameter	Dia. Asper Indian standards &codes	Remarks
ROOF	--	---	---	---
9th floor	70FU	100mm	100mm	Shows 500FU can beconnected OK
8th floor	90FU	100mm	100mm	Shows 500FU can be connected OK
7th floor	120FU	100mm	100mm	Shows 500FU can be connected OK
6th floor	90FU	100mm	100mm	Shows 500FU can be connected OK
5th floor	150FU	100mm	100mm	Shows 500FU can be connected OK
4th floor	180FU	125mm	125mm	Shows 1100FU can be connected OK
3rd floor	190FU	125mm	125mm	Shows 1100FU can be connected OK
2nd floor	160FU	100mm	100mm	Shows 500FU can be connected OK
1st floor	200FU	125mm	125mm	Shows 1100FU can be connected OK
G.L	200FU	125mm	125mm	Shows 1100FU can be connected OK

Table 9 shows Fixture Units utilized at each floor &corresponding diameters by Indian standards&Codes as SP7National building code of India &SP35.Dont shows much more difference.

CONCLUSIONS

1. Each and every stack should be provided with sufficient ventilating Pipe.
2. The ultra-Low flow units is the most useful unit saves water during Stage and post usage need for waste water treatment.
3. Relief vent should be provided for each 8th floor interval.
4. The branch piping and house drain will be pitched 6.4 mm per meter length of pipewhile designing any high rise select the upper floor branch &stack first.
5. The ultra-Low flow units is likely to cause accumulation of solids is horizontal drain pipes.

6. To remove solids in horizontal drain piping must be snaked out at regular interval, depending on the system usage bidet can be provided with hot and cold water supply connect to the soil pipe in two pipe system.
7. Water closet as far as possible should be of Indian style squatting typesoil pipe shall be preferably be of caste iron asbestoses cement type building pipe may also be used as soil pipe only above ground floor.
8. Every pipe in a building carrying of the waste or overflow water.
9. Water from everybath ,wash basin or sink to a drain shall be of 32mm to 50mm.

REFERENCES

[1]. National building code of India 2005,Bureau of Indian standards, Manakbhavan 9 bhadur shah - Zafarmarg ,New Delhi section 1.,7-80.
[2]. Engineered plumbing design II,Alfredsteele,American society of plumbing Engineers,6400 - Shafer court ,USA.,50-61.
[3]. Hand book of mechanical Engineering calculations,secondaddition,Tyler G Hicks ,McGrawHills,New Delhi.,15.1-16.1
[4]. Hand book on water supply and drainage SP35:1987,drainage.Bureau of Indian standards, Bureau of Indian standards, Manakbhavan 9 bhadur shah Zafarmarg ,New Delhi:99-150
[5]. American society of plumbing Engineers,Plimbing Engineer’s Design handbook volumeII,37-47