

PART VIII Appendix O

Sizing of Cold Water Supply and Distribution Piping

The water distribution within the building may be an upfeed or downfeed system. The design principles are the same for both the systems. The principal difference in the calculation procedure is that in the up feed system the difference in elevation between the fixtures and the water supply main exerts the pressure that supplies water into the fixtures, but in the down-feed system the difference in elevation between the fixtures and the roof storage tank provides the pressure to overcome the pipe friction. The following are the recommended pipe sizing procedures:

- O.1 The sketch of the main lines, risers and branches serving different fixtures will have to be drawn.
- O.2 Determine the number and types of fixture that will be required on the basis of the Table 8.6.1 in Chapter 6.
- O.3 The demand weight of different fixture units may be computed in terms of water supply fixture unit (wsfu) in accordance with Table 8.O.1.
- O.4 The peak demand load (or maximum probable flow) in liter per minute may be estimated with the data obtained in Sec O.3 using Figure 8.O.1 or on the basis of the number of occupants according to their occupancy classification specified in Table 8.5.1.
- O.5 The equivalent length of the main lines, risers and branches will be determined. The equivalent length of different fittings may be estimated on the basis of the data presented in the Tables 8.O.2(a), 8.O.2(b) and 8.O.2(c) or from manufacturer's specification. The total equivalent length is the sum of the equivalent lengths of all pipes and fittings.
- O.6 The pressure loss through water meter may be determined on the basis of their operating characteristics as shown in Figure 8.O.6 (Disk type water meter). The data for other types of water meter may be obtained from the manufacturer.
- O.7 The minimum pressure required at different fixtures to produce adequate flow may be estimated on the basis of the type of fixtures or minimum size of supply pipe in accordance with Table 8.5.6.
- O.8 The average pressure drop in kPa per meter of equivalent pipe length may be computed as follows:

$$F_p = (P \pm 9.807 H - f) / L \quad 8.O.1)$$

Where, F_p = Average available pressure loss (kPa) per meter of equivalent length of pipe

P = Pressure (kPa) in the water main or zero for overhead gravity storage tank.

H = Height (m) of the highest fixture above the water main or difference (m) in elevation between storage tank and the fixture under consideration.

f = Pressure loss (kPa) through water meter or such other fittings plus pressure (kPa) required to produce adequate flow through the most remote fixture in upfeed system or the fixture under consideration in down-feed system.

L = Equivalent pipe length (m)

* + sign is for down-feed system and - sign is for up-feed system

O.9 The pipe size may also be estimated from Figures 8.0.5 to 8.0.10 for different types of piping materials on the basis of the expected rate of flow determined in Sec 0.4 and the average pressure available for friction loss (F_p) in Sec O.8.

O.10 Alternative simple procedure of pipe size computation has also been explained in the Sec 5.10.3.

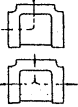
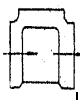
Table 8.O.1: Water Supply Fixture Unit (wsfu) Values for Various Plumbing Fixtures

Fixture or group	Supply Control	wsfu		
		Cold	Hot	Total
Bath group	Flush tank	4.5	3	6
Bath group	Flush valve	6	3	8
Bathtub	Faucet	1.5	1.5	2
Bidet	Faucet	1.5	1.5	2
Combination	Faucet	2	2	3
Kitchen sink	Faucet	1.5	1.5	2
Laundry tray	Faucet	2	2	3
Laundry	Faucet	1.5	1.5	2
Pedestal urinal	Flush valve	10	-	10
Restaurant sink	Faucet	3	3	4
Service sink	Faucet	1.5	1.5	2
Shower head	Mixing Valve	3	3	4
Stall or wall urinal	Flush tank	3	-	3
Stall or wall urinal	Flush valve	5	-	5
Water closet	Flush tank	5	-	5
Water closet	Flush valve	10	-	10

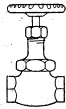
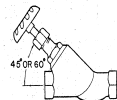
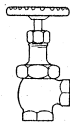
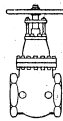
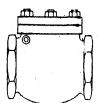
* Fixture with both cold and hot water supplies, the weight for maximum separate demands may be considered 75% of total wsfu.

Nominal Pipe or Tube Size (mm)	Smooth Bend Elbows					
	90°	90° Long	90°	45°	45°	180°
	Std*	Rad.**	Street*	Std*	Street*	Std*
						
10	0.43	0.27	0.70	0.21	0.34	0.70
13	0.49	0.31	0.76	0.24	0.40	0.76
19	0.61	0.43	0.98	0.27	0.49	0.98
25	0.79	0.52	1.25	0.40	0.64	1.25
32	1.01	0.70	1.71	0.52	0.92	1.71
38	1.22	0.79	1.92	0.64	1.04	1.92
50	1.53	1.01	2.50	0.79	1.37	2.50
63	1.83	1.25	3.05	0.98	1.59	3.05
75	2.29	1.53	3.66	1.22	1.95	3.66
88	2.75	1.80	4.58	1.43	2.23	4.58
100	3.05	2.04	5.19	1.59	2.59	5.19
125	3.97	2.50	6.41	1.98	3.36	6.41
150	4.88	3.05	7.63	2.41	3.97	7.63
200	6.10	3.97	-	3.05	-	10.07
250	7.63	4.88	-	3.97	-	12.81
300	9.15	5.80	-	4.88	-	15.25
350	10.37	7.02	-	5.49	-	16.78
400	11.59	7.93	-	6.10	-	18.91
450	12.81	8.85	-	7.02	-	21.35
500	15.25	10.07	-	7.93	-	24.71
600	18.30	12.20	-	9.15	-	28.67

* = R/D approximately equal to 1, ** = R/D approximately equal to 1.5

Nominal Pipe or Tube Size (mm)	Smooth Bend Tees				Metre Elbows			
	Flow Thru Branch	Straight-Thru Flow			90° Ell	60° Ell	45° Ell	30° Ell
		No Reduction	Reduced ¼	Reduced ½				
								
10	0.82	0.27	0.37	0.43	0.82	0.34	0.18	0.09
13	0.92	0.31	0.43	0.49	0.92	0.40	0.21	0.12
19	1.22	0.43	0.58	0.61	1.22	0.49	0.27	0.15
25	1.53	0.52	0.70	0.79	1.53	0.64	0.31	0.21
32	2.14	0.70	0.95	1.01	2.14	0.92	0.46	0.27
38	2.44	0.79	1.13	1.22	2.44	1.04	0.55	0.34
50	3.05	1.01	1.43	1.53	3.05	1.37	0.70	0.40
63	3.66	1.25	1.71	1.83	3.66	1.59	0.85	0.52
75	4.58	1.53	2.14	2.29	4.58	1.95	0.98	0.61
88	5.49	1.80	2.44	2.75	5.49	2.23	1.22	0.73
100	6.41	2.04	2.75	3.05	6.41	2.59	1.37	0.82
125	7.63	2.50	3.66	3.97	7.63	3.36	1.83	0.98
150	9.15	3.05	4.27	4.88	9.15	3.97	2.14	1.22
200	12.20	3.97	5.49	6.10	12.20	5.19	2.75	1.56
250	15.25	4.88	7.02	7.63	15.25	6.41	3.66	2.20
300	18.30	5.80	7.93	9.15	18.30	7.63	3.97	2.44
350	20.74	7.02	9.15	10.37	20.74	8.85	4.58	2.75
400	23.79	7.93	10.68	11.59	23.79	9.46	5.19	3.05
450	25.93	8.85	12.20	12.81	25.93	11.29	5.80	3.36
500	30.50	10.07	13.42	15.25	30.50	12.51	6.71	3.97
600	35.08	12.20	15.25	18.30	35.08	14.95	7.63	4.88

* = R/D approximately equal to 1, ** = R/D approximately equal to 1.5

Nominal Pipe or Tube Size (mm)	Globe	60° – Y	45° – Y	Angle*	Gate	Swing Check**	Lift Check
							
10	5.19	2.44	1.83	1.83	0.18	1.53	Globe Lift and Vertical Lift: Same as Globe Valve**
13	5.49	2.75	2.14	2.14	0.21	1.83	
19	6.71	3.36	2.75	2.75	0.27	2.44	
25	8.85	4.58	3.66	3.66	0.31	3.05	
32	11.59	6.10	4.58	4.58	0.46	4.27	
38	13.12	7.32	5.49	5.49	0.55	4.88	
50	16.78	9.15	7.32	7.32	0.70	6.10	
63	21.05	10.68	8.85	8.85	0.85	7.63	
75	25.62	13.12	10.68	10.68	0.98	9.15	
88	30.50	15.25	12.51	12.51	1.22	10.68	
100	36.60	17.69	14.34	14.34	1.37	12.20	
125	42.70	21.66	17.69	17.69	1.83	15.25	
150	51.85	26.84	21.35	21.35	2.14	18.30	Angle Lift: Same as Angle Valve
200	67.10	35.08	25.93	25.93	2.75	24.40	
250	85.40	44.23	32.03	32.03	3.66	30.50	
300	97.60	50.33	39.65	39.65	3.97	36.60	
350	109.8	56.43	41.18	41.18	4.58	41.18	
400	125.05	64.05	54.90	54.90	5.19	45.75	
450	140.3	73.20	61.00	61.00	5.80	50.33	
500	158.6	83.88	71.68	71.68	6.71	61/00	
600	186.05	97.60	80.83	80.83	7.63	73.20	

* These losses do not apply to valves with needle point type seat, ** Losses also apply to the in-line, ball type check valve.

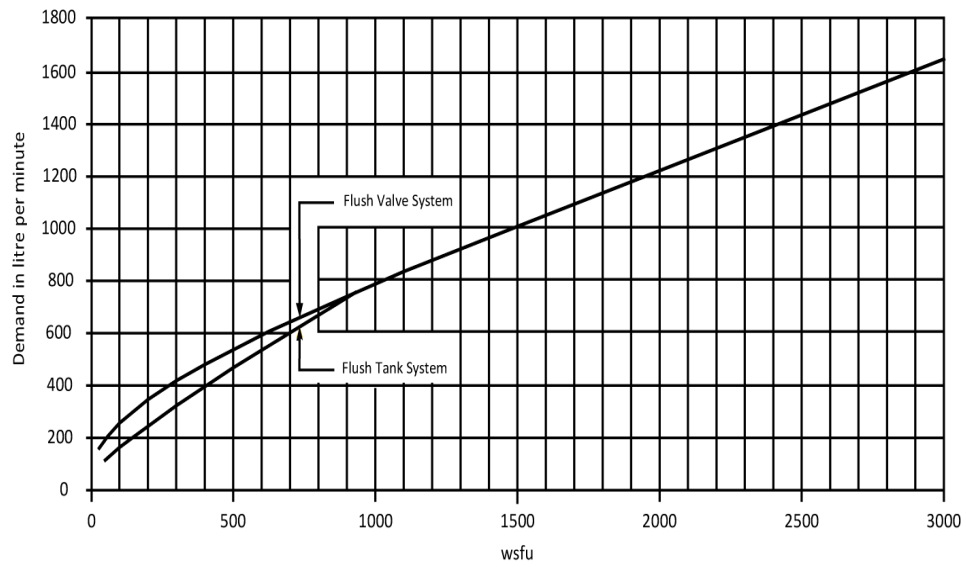


Figure 8.O.1 Water supply demand for various load in water supply fixture units (Wsfu)

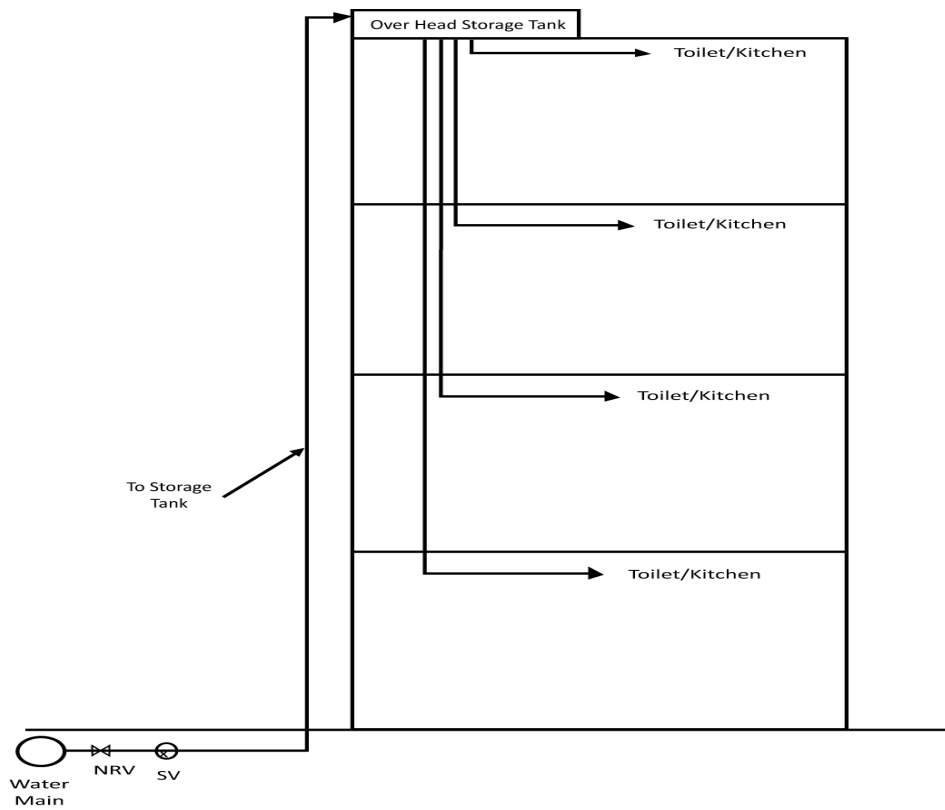


Figure 8.O.2(a) Direct connection of roof storage tank with public water main

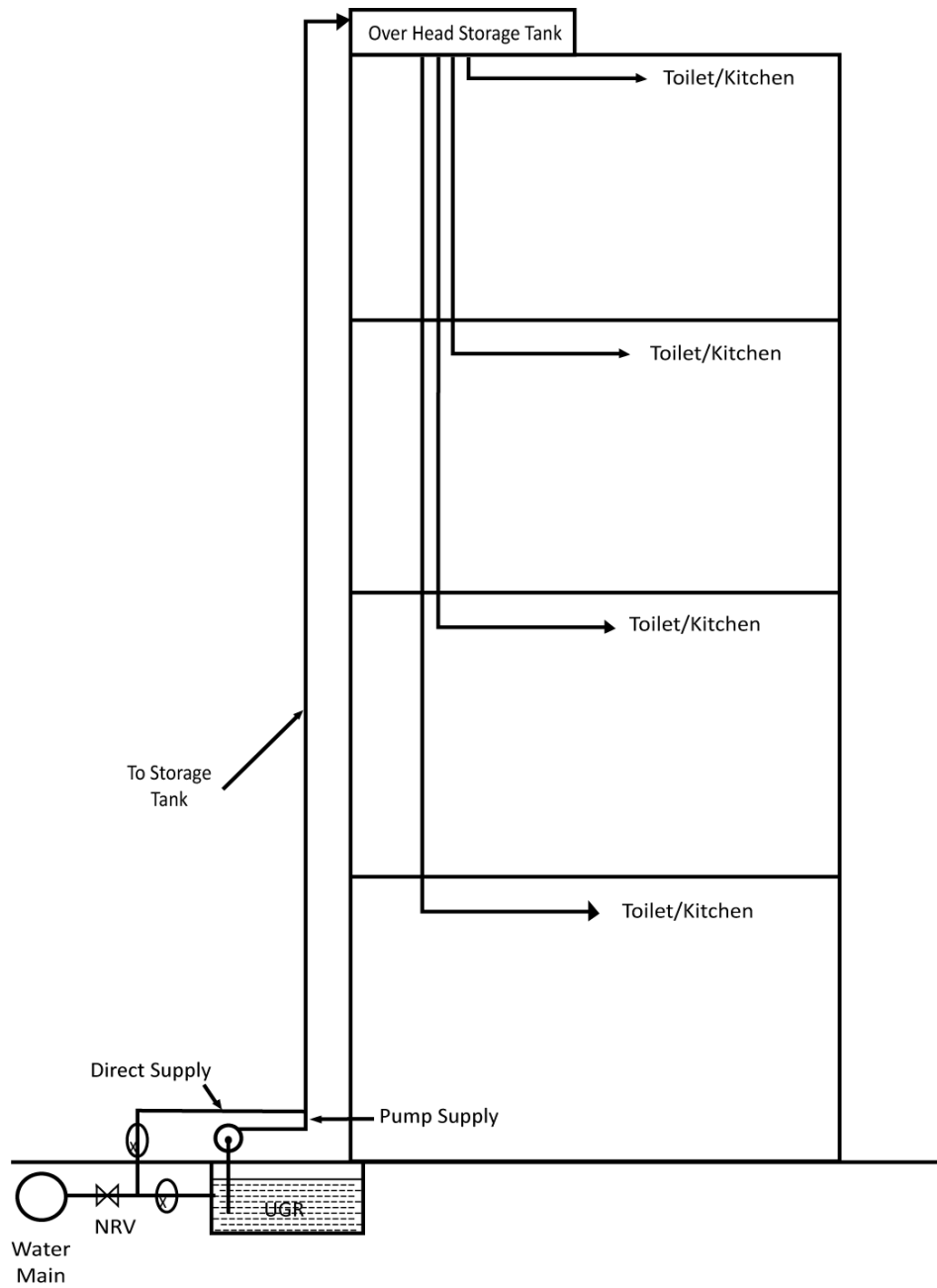


Figure 8.O.2(b) System incorporating balancing roof tank and direct water main connection

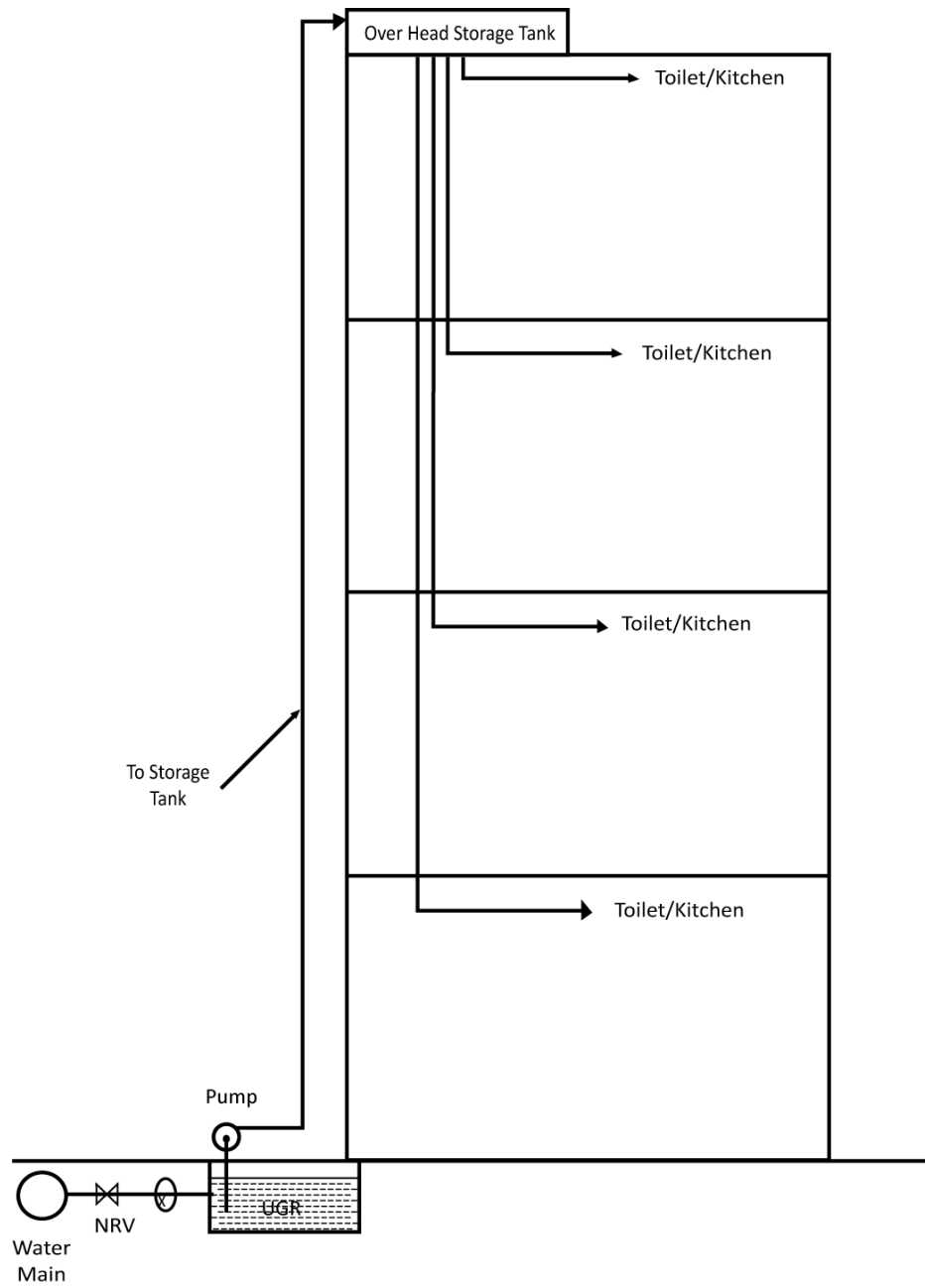


Figure 8.O.2(c) System incorporating underground tank

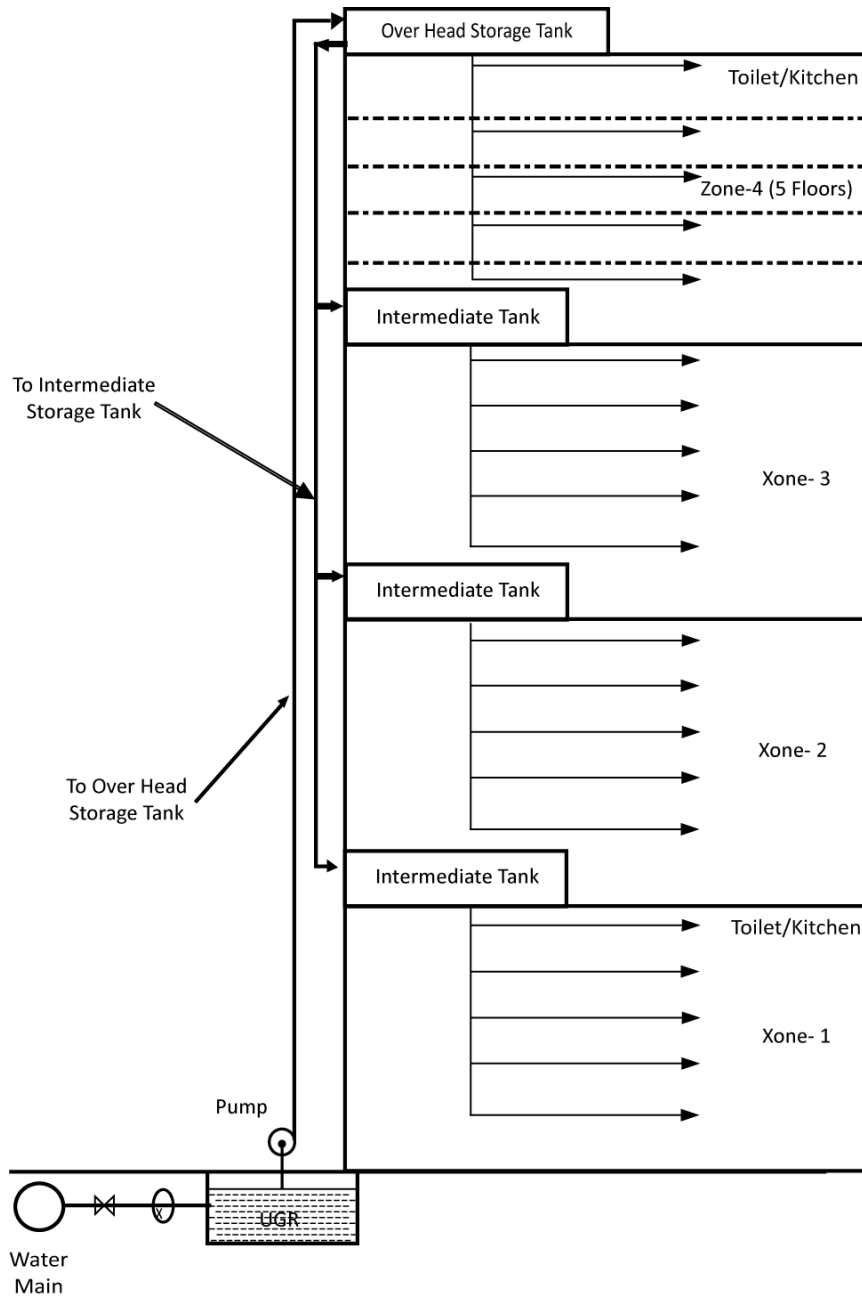


Figure 8.O.3(a) Zoning floors (5) by intermediate tanks supplied by OH storage tank

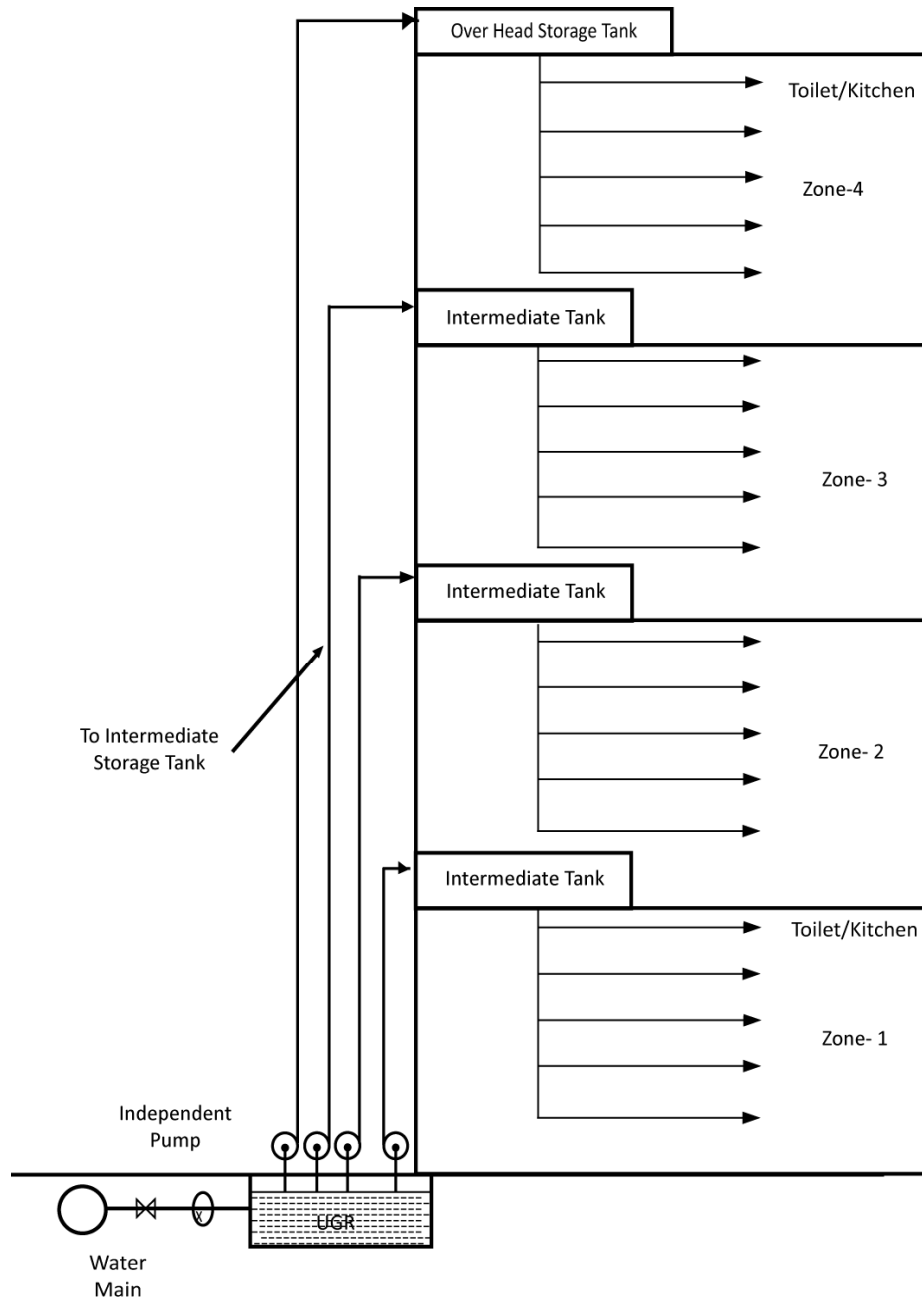


Figure 8.O.3(b) Zoning floors (5) by intermediate tanks supplied by independent pumps

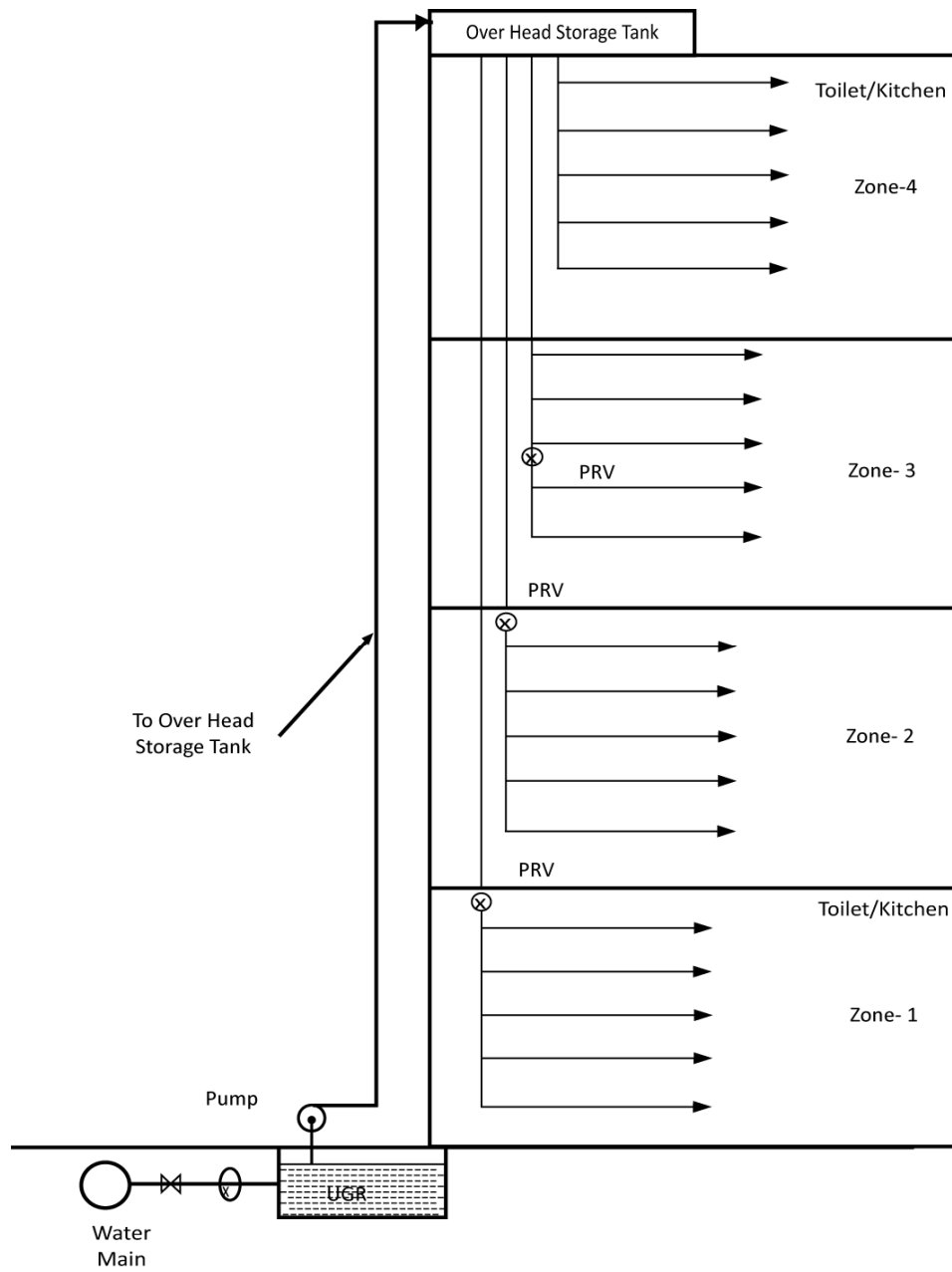


Figure 8.O.3(c) Gravity water supply system with pressure-reducing valves

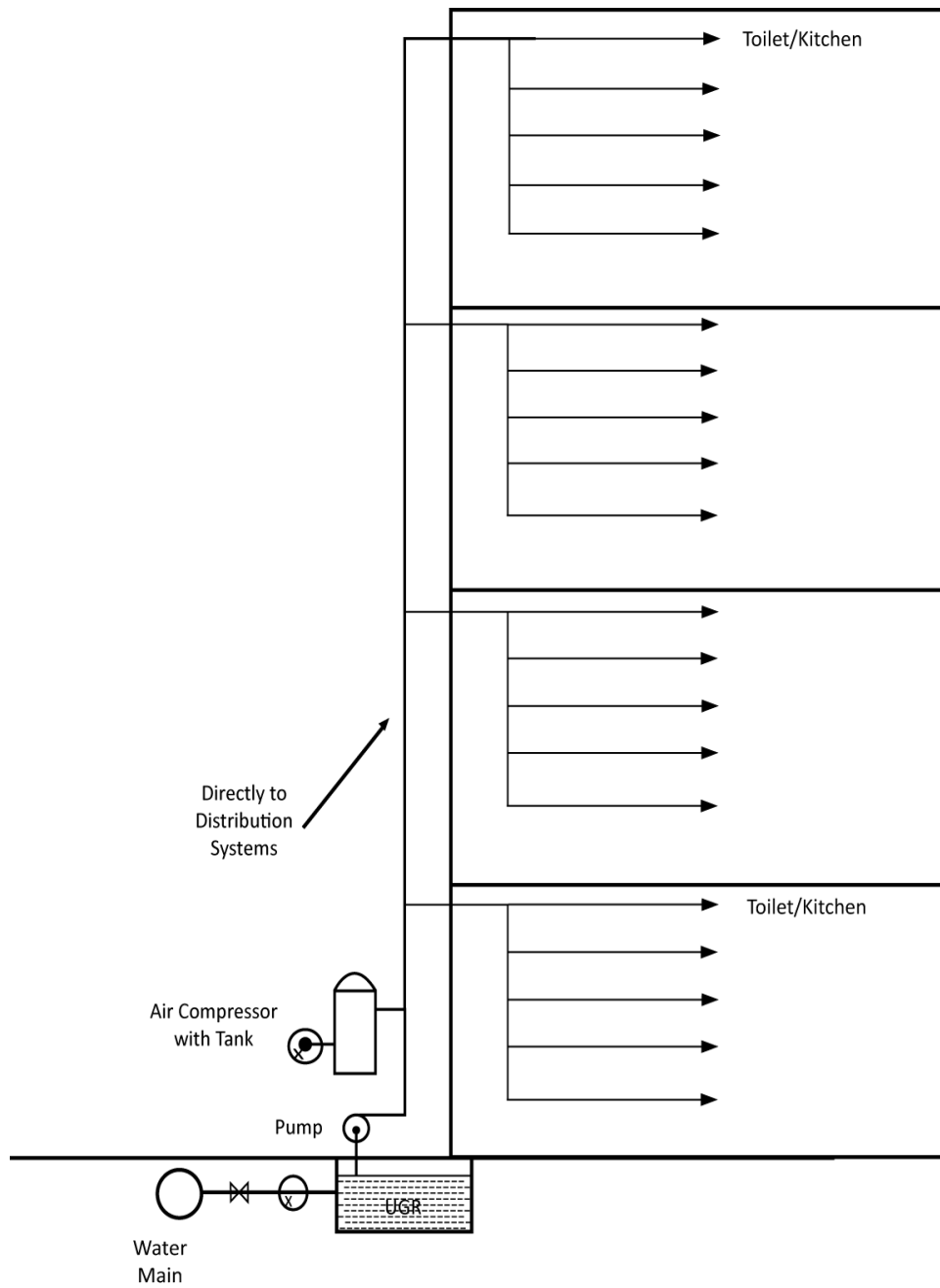
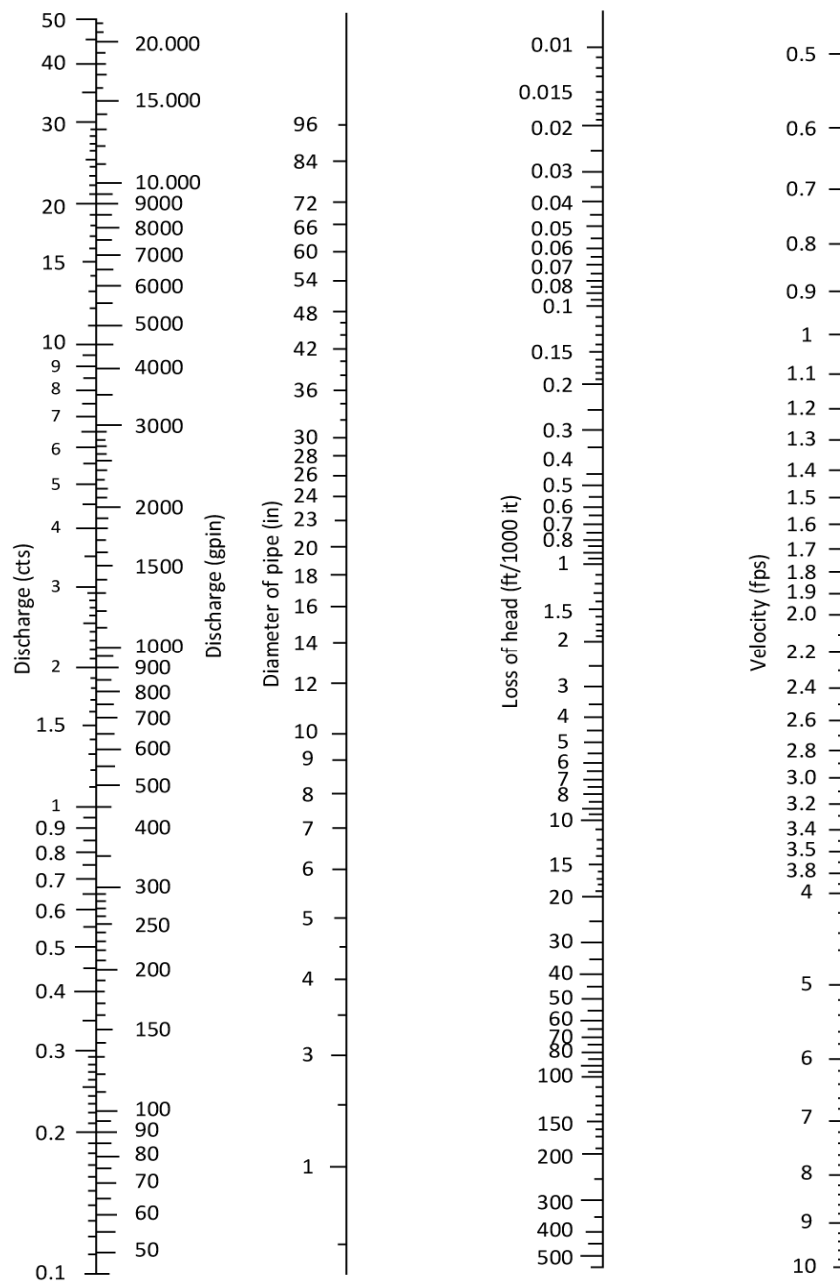


Figure 8.O.3(d) Hydro-pneumatic system of water supply in a building

Figure 8.O.4 Hazen-Williams nomograph with roughness coefficient, $C = 100$

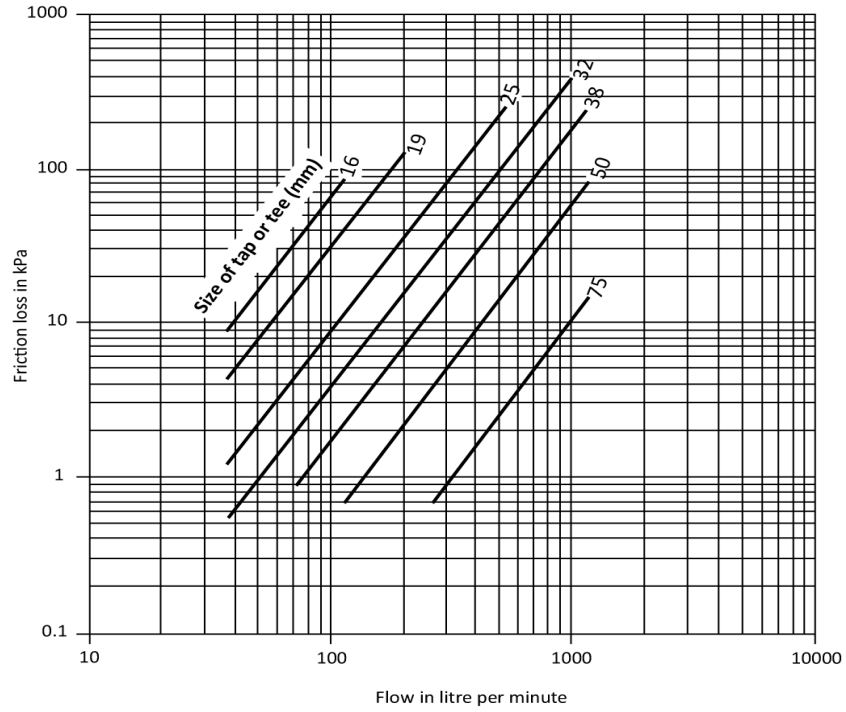


Figure 8.O.5 Friction loss through taps and tees

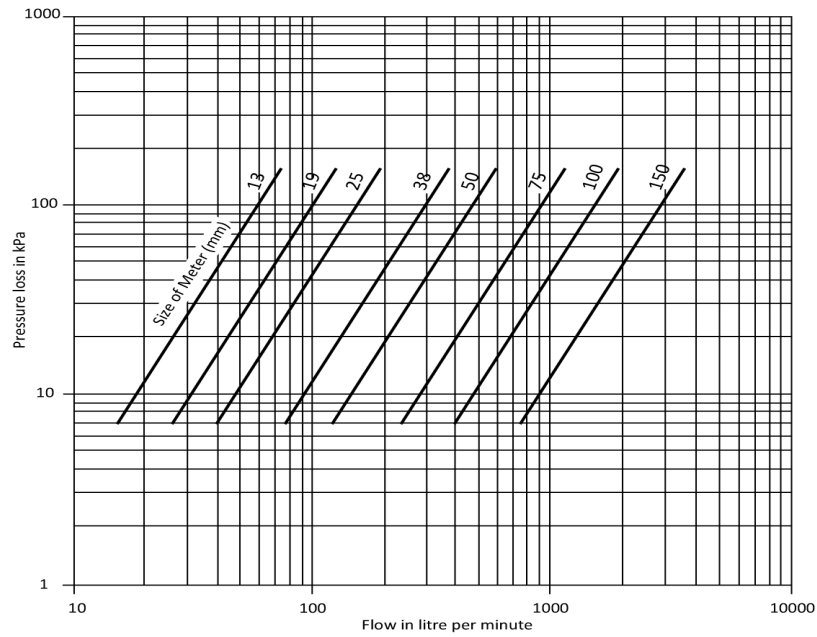


Figure 8.O.6 Loss of pressure through disc - type meter in kPa

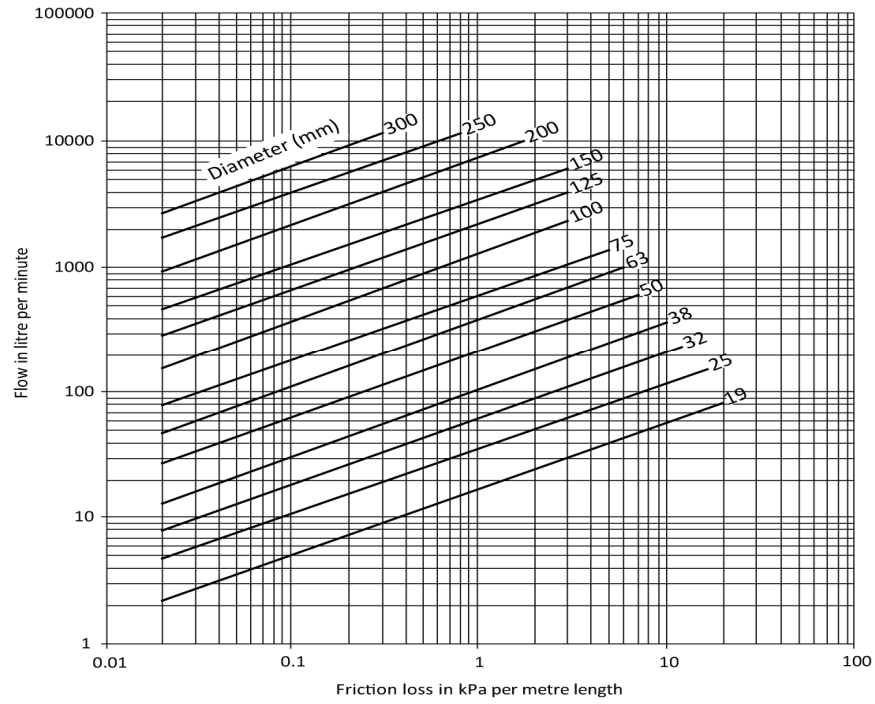


Figure 8.O.7 Friction loss in fairly rough pipe

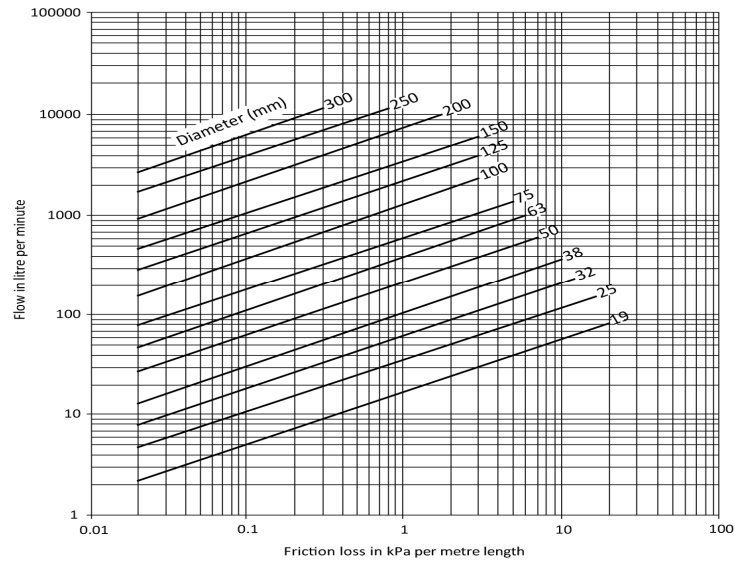


Figure 8.O.8 Friction loss in rough pipe

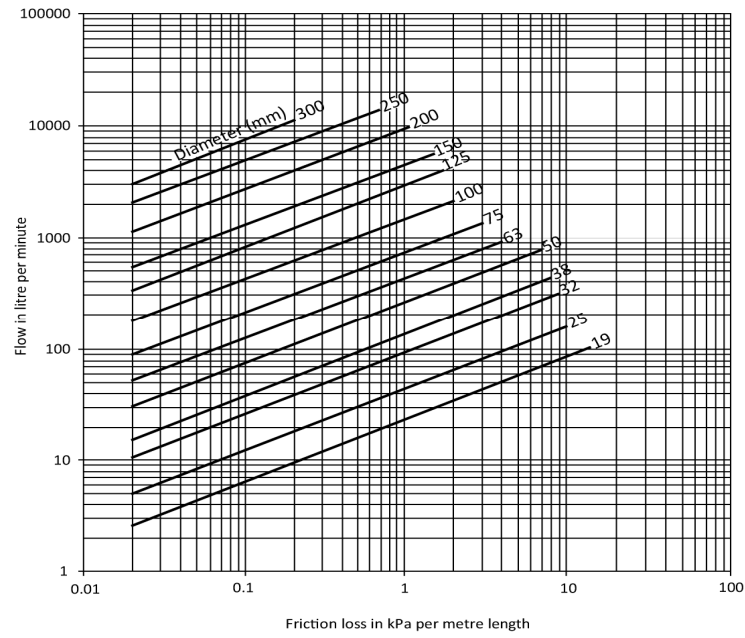


Figure 8.O.9 Friction loss in fairly smooth pipe

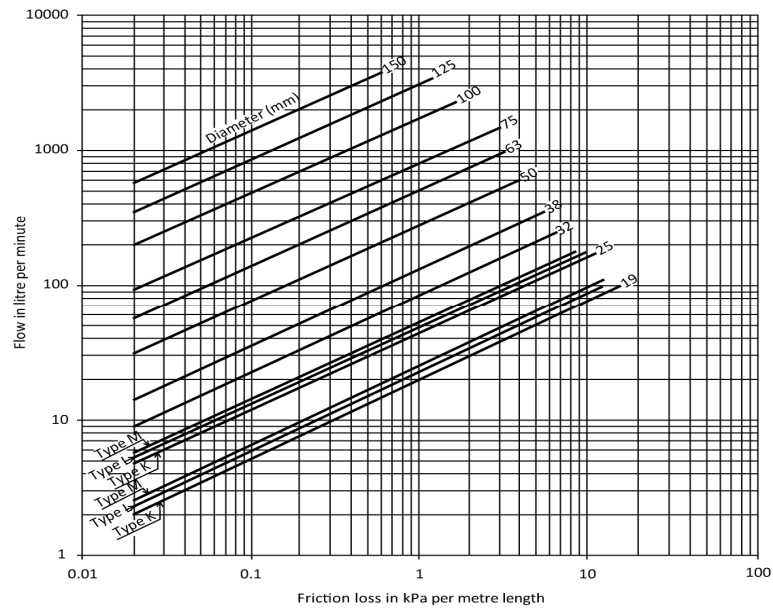


Figure 8.O.10 Friction loss in copper pipe

PART VIII
Appendix P

Recommended Water Quality for Domestic Purposes

Table 8.P.1: Water Quality Standards

Water Quality Parameters	Unit	WHO Guideline Values (2004)	Environmental Conservation Rules (ECR, 1997)
1. pH	Value	6.5 - 8.5	6.5 - 8.5
2. Turbidity	NTU	5	10
3. Color	TCU	15	15
4. Odor	TON	--	Odorless
5. Hardness (as CaCO ₃)	mg/l	500	200-500
6. Iron (Fe)	mg/l	0.3	0.3-1.0
7. Manganese, Mn	mg/l	0.4*	0.1
8. Sodium, Na	mg/l	200	200
9. Calcium, Ca	mg/l	--	75
10. Magnesium, Mg	mg/l	--	30-35
11. Potassium, K	mg/l	--	12
12. Chloride, Cl	mg/l	250	150-600
13. Nitrate, NO ₃	mg/l	50	10
14. Ammonia-Nitrogen, NH ₃ -N	mg/l	1.5	0.5
15. Sulfate, SO ₄	mg/l	250	400
16. Phosphate, PO ₄	mg/l	--	6
17. Fluoride, F	mg/l	0.6 -1.5	1
18. Mercury, Hg	mg/l	0.001	0.001
19. Arsenic, As	mg/l	0.01	0.05
20. Lead, Pb	mg/l	0.01	0.05
21. Chromium, Cr	mg/l	0.05	0.05
22. Cadmium, Cd	mg/l	0.003	0.005
23. Boron, B	mg/l	0.5	1.0
24. Aluminum, Al	mg/l	0.2	0.2
25. Nickel, Ni	mg/l	0.02	0.1
26. Copper, Cu	mg/l	2.0	1.0
27. Total Dissolved Solids, TDS	mg/l	1000	1000
28. Total Suspended Solids, SS	mg/l	--	10
29. Total Coliform, TC	CFU	0	0
30. Faecal Coliform, FC	CFU	0	0

* Health Risk Guideline Value