quantity of water is the pressure necessary to overcome friction in the pipes (when horizontal) plus the static pressure when the discharge is higher than the supply.

Table 56, column 1, gives the vertical rise in feet to any fixture up to 150 ft. in height; column 2, gives the static head in lb. per sq. in. corresponding with the vertical rise.

The underlying principle involved in determining the proper pipe sizes for mains, risers and branches is to so regulate the size of these pipes that they will carry the maximum amount of water required of them and absorb by friction and static head, all the pressure at the source and still deliver water at the fixture in sufficient quantity but at a pressure practically equalling zero or slightly above except that due to velocity of flow through the fixture.

Table 53 gives the amount of water in gallons which should flow per minute for the number of fixtures indicated of each different type, together with the branch pipe size necessary to carry this amount of water with a pressure drop of 30 lb. per 100 ft. of run.

The volume of water required per fixture is reduced as the number of fixtures in each group is increased, to take care of the factor of probable use.

In estimating the pipe size for any part of a riser in a building of several stories, take 60 per cent of the water to be used on any floor and all floors above as determined from Table 53 and deduct 10 per cent for each floor above. This reduction in estimated amount is to take care of probable use. Thus, if 100 gallons are used on each floor of a 10-story building the size or pipe will be determined as follows:

TABLE 54. WATER RISERS FOR MANUFACTURING BUILDINGS, LOFT BUILDINGS, APARTMENT HOUSES, HOTELS

	G. P. M.	G. P. M.	PIPE SIZE WITH 10 LB. DROP
10th Floor	100 x 0.60	60% = 60	2″
10 and 9	200 x 0.60	90% = 108	2½″
10 and 9 and 8	300 x 0.60	80% = 144	2½″
10 to 7 incl.	400 x 0.60	70% = 168	3″
10 " 6 "	500 x 0.60	60% = 180	3″
10 " 5 "	600 x 0.60	50% = 180	3″
10 " 4 "	700 x 0.60	40% = 184	3″
10 " 3 "	800 x 0.60	40% = 192	3″
10 " 2 "	900 x 0.60	40% = 216	3″
10 " 1 "	1000 x 0.60	40% = 240	3″

Note.—For residences, use Table 53, and for the main supply use 25 per cent of total of gallons used by fixtures and then take pipe size from Table 55 on a basis of 10 lb. pressure drop per 100 ft. or less if water supply pressure is less than 50 lb.

The pressure drop of 30 lb. per 100 ft. of run will give satisfactory results for branches on the top floor but a higher pressure drop can be used on floors below corresponding with the pressures as given in Table 55 which show that for a building 100 ft. in height, a pressure drop of 100 lb. can be used on the fixture lowest branches and that for a building 50 ft. in height, a pressure drop of 52 lb. can be used on the lowest fixture branches; Table 53, however, can be used with safety on any of the floors but will give pipe sizes larger than necessary for the lower floors in a very tall building.

TABLE 55. PIPES MAY BE SIZED FOR GIVING ANY DESIRED PRESSURE DROP PER 100 FT. OF RUN

FRICTION PRESSURE DROP LB. PER SQ. IN. PER 100 FT. RUN	PIPE SIZES IN INCHES								
	¾	1	1¼	1½	2	2½	3	3½	4
	Gallons per Minute								
5	5.4	11	19	30	62	109	171	252	353
7	6.4	13	23	36	74	129	203	298	418
10	7.6	15	27	43	88	154	242	357	499
20	10.8	22	38	61	125	218	343	504	706
30	13.2	27	47	76	153	267	420	618	864
40	15.0	31	54	86	176	308	485	714	998
50	17.0	35	60	96	197	345	542	800	1115
75	21.0	43	74	117	242	423	665	978	1365
100	24.0	49	85	136	278	485	769	1130	1578
125	27.0	55	96	152	311	544	858	1260	1765
150	30.0	60	105	166	341	598	939	1380	1930

TABLE 56. SHOWING WATER PRESSURE REQUIRED TO DELIVER WATER TO TOP OF VERTICAL RISER WITH 15 LB. PRESSURE AT THE TOP BRANCH

VERTICAL RISE OF WATER FROM MAIN TO HIGHEST FIXTURE BRANCH	STATIC HEAD IN LB. PER SQ. IN.	WATER PRESSURE IN LBS. REQUIRED TO DELIVER WATER TO TOP OF RISER WITH 15 LB. TERMINAL PRESSURE				
		Pressure Drop per 100 Ft.				
		5 LB.	7 LB.	10 LB.	20 LB.	30 LB.
0	0	15	15	15	15	—
10	4.33	20.5	20.7	21	22	—
20	8.66	25	25.4	26	28	—
30	12.99	29.5	30.1	31	34	—
40	17.32	35	35.8	37	41	—
50	21.65	39.5	40.5	42	47	52
60	25.99	44	45.2	47	53	—
70	30.32	49.5	50.9	53	60	—
80	34.65	54	55.6	58	64	—
90	38.98	58.5	60.3	63	72	—
100	43.31	64	66	69	79	89
110	47.64	68.5	70.7	74	85	—
120	51.97	73	75.4	79	91	—
130	56.30	77.5	80.1	84	97	—
140	60.63	83	85.9	90	104	—
150	64.96	87.5	90.5	95	110	—

Note.—The water pressures given in above table are the pressures at the base of the riser, necessary to deliver water to top of riser with a terminal pressure of 15 lb., when discharging the number of gallons per minute called for in Table 55, at the pressure drop indicated.

The following examples show how to use Table 55:

Example.—What are the sizes required for mains and branches in a building 100 ft. high, supplied with a water pressure of 75 lb. per sq. in. with 100 gal. of water per minute required on each floor?

This is worked out in Table 54 and gives the pipe sizes for the main riser with a 10 lb. drop for 100 ft. of run and shows that a 3 in. main, reduced to 2 in., would be required: branches to the various groups of fixtures can be taken from Tables 55 and 56. On the top floor it will be necessary to use a 1½ in. branch to carry 60 gal. per min. with a pressure drop of 30 lb. but that at 30 ft. vertically from the supply, a 1¼ in. branch pipe will carry 60 gal. per minute, therefore 1¼ in. pipe could be selected for this branch. Assuming that the pressure drop in the main riser is 10 lb. per 100 ft. run and the pressure drop on the top floor in the branch does not exceed 15 lb. in all and the static head for building 100 ft. as given in column 2 of Table 56 is 43.31 lb. making a total of 58.31 lb.; it will be seen that 75 lb.—58.31 lb., which equals 16.59 lb., is the amount of pressure over and above that required, and that this pressure can be utilized to overcome the friction drop in the main feed line running from the source of supply to the base of the riser.

From Table 54 it is found that 240 gal. per min. will flow at the first floor, and assuming that this water supply is to be brought in a main 300 ft. long; Table 55 will show that a 3½ in. supply would be necessary.