TABLE 6. COMPUTATION OF BRANCH SIZE IN EXAMPLE 2

FIXTURES NO. AND KIND	FIXTURE UNITS (FROM TABLE 2 AND NOTE c)	DEMAND (FROM FIG. 2) GPM	PIPE SIZE (FROM FIG. 4) IN.
3 flush valves	3 x 6 = 18		
2 bath tubs	¾ (2 x 2) = 3		
3 lavatories	¾ (3 x 1) = 2.25		
Total	23.25	38	1½

the computed pipe sizes for the fittings. For the purposes of this example assume that the total equivalent length of the pipe fittings is 50 ft.

Then the permissible pressure loss per 100 ft of equivalent pipe is $12 \times 100/(100 + 50) = 8$ psi.

Assuming that the corrosive and caking properties of the water are such that Fig. 4 for fairly rough pipe is applicable, a 2 in. building main will be adequate.

The sizing of the *branches* of the building main, the *risers*, and *fixture branches* follow the principles outlined. For example, assume that one of the branches of the building main carries the cold water supply for 3 water closets, 2 bath tubs, and 3 lavatories. Using the permissible pressure loss of 8 psi per 100 ft, the size of branch determined from Table 2 and Figs. 1 and 4 is found to be 1½ in. Items entering the computation of pipe size are given in Table 6.

COOLING WATER PIPING

Water is very frequently used in refrigeration systems, cooling towers and other similar installations. In designing the piping system of such installations, the principles of hydraulics, as already outlined, are employed. Nevertheless, there are several practical items having particular application to cooling installations. They are outlined in the following paragraphs, and it is important that the designer be familiar with them.

In choosing pipe material, the problem of corrosion should be kept in mind to prevent defects in the system. If the water does not have drastic corrosion characteristics, wrought iron or steel piping may be used; otherwise, galvanized steel piping may be preferred. If sea water is used as the circulating medium, it is advisable to use alloys such as admiralty metal in pipe and tubing. In refrigeration condensers where water is the cooling medium, iron pipe is commonly employed.

In regard to assembly, cast-iron flanges or welded joints are to be preferred to screwed joints wherever possible.

Valves used in circulating systems may be of the globe, gate, or angle

TABLE 7. PIPE SIZES FOR COOLING TOWERS[2]

RATED TONS OF REFRIG.	COOLING WATER GPM	PIPE SIZES (NOMINAL INCHES)	
		Inlet to Tower	Outlet from Tower
3 to 5	10 to 18	1½	1½
7 to 15	20 to 45	2	2
20	65	2½	3
25	86	2½	4
35	115	3	4
50	170	3	4
75	225	5	6
100	300	5	6
150	450	5	8
200	600	6	8
250	750	8	8

types. If water is the circulating medium, brass valves are usually used. However, if the circulating medium is an electrolyte, such as brine, then it is preferable to use valves made of the same material as the piping itself.

The friction loss in the piping may be determined from Fig. 4 for fairly rough pipe. If the coolant is brine, a correction for the proper density must be made. Experience indicates that in sizing piping for cooling systems, a pressure drop of the order of 2 to 3 psi per 100 ft of pipe length, and a fluid velocity of 3 to 8 fps, yield most economical results.

In the case of cooling towers, the amount of circulating water is about 3 gpm per ton of refrigeration, when based on a design wet-bulb tempera-

TABLE 8. MAXIMUM DAILY (24-HR) REQUIREMENTS FOR HOT WATER IN GALLONS

	NO. OF ROOMS	NUMBER OF BATHROOMS				
		1	2	3	4	5
Apartments and Private Homes	1	60	—	—	—	—
	2	70	—	—	—	—
	3	80	—	—	—	—
	4	90	120	—	—	—
	5	100	140	—	—	—
	6	120	160	200	—	—
	7	140	180	220	—	—
	8	160	200	240	250	—
	9	180	220	260	275	—
	10	200	240	280	300	—
	11	—	260	300	340	—
	12	—	280	325	380	450
	13	—	300	350	420	500
	14	—	—	375	460	550
	15	—	—	400	500	600
	16	—	—	—	540	650
	17	—	—	—	580	700
	18	—	—	—	620	750
	19	—	—	—	—	800
	20	—	—	—	—	850

Hotels	Room with basin	10
	Room with bath—transient	50
	Room with bath—resident	60
	2 Rooms with bath	80
	3 Rooms with bath	100
	Public shower	200
	Public basins	150
	Slop sink	30
Office Buildings	White color worker (per person)	2.0
	Other workers (per person)	4.0
	Cleaning per 10,000 sq ft	30.0
Hospitals	Per bed	80–100

ture of about 76 F. Table 7 gives pipe sizes frequently used for various sizes of cooling towers, assuming a hot-water temperature of 95 F and a cold-water temperature of 85 F.[2]

ESTIMATING HEATING LOAD AND STORAGE CAPACITY

The maximum daily and the maximum hourly hot water demand form the basis for the selection of the heater and the storage tank.

In general, two thirds of the total daily water consumption is hot water. For residential dwellings, a design value of about 20 to 30 gal per capita per day may be assumed, but it should be remembered that the hot water used will depend on the number of rooms and the number of bathrooms in