5 ● Is the steam consumption less in a building that shuts off its steam at night than in one that does not? Why?

It has been thoroughly demonstrated that the steam consumption is less in a building where the steam is shut off at night. Although there is, in some cases, an increased consumption of heat when steam is again turned on in the morning, there is a large net saving which may be explained by the fact that the lower inside temperature maintained during the night obviously results in lower heat loss from the building, and less heat need therefore be supplied.

6 ● What are the common methods used to graduate the heat supply according to variations in outside temperature?

a. Thermostats controlled by building temperatures and operating a motor valve.
b. A weather compensating thermostat will regulate the steam supply according to outside temperatures. These controls can be arranged to give short intervals of intermittent steam supply. Those without time clocks can be equipped with suitable timing arrangements.
c. Another method which is very simple is the use of an ordinary vacuum return line system in which the pressure in the radiators is varied between a high vacuum and a few pounds to produce some control over the heat output. There are systems on the market which will do this automatically.
d. The use of orifice systems insures proper distribution and graduation of heat supply.
e. The time-limit control which may be set to provide no service, continuous service, or periodic service, is also used. For periodic service, steam may be supplied during each period in increments of a certain number of minutes for each successive setting of the switch, steam being shut off during the balance of the period. This type of service is provided by several intermittent settings. A night switch will maintain the intermittent day setting, or interrupt the day operation and cut off the supply of steam at night during any desired hours.

7 ● What is the common method of determining the size of mains in a distribution system?

On the basis of pressure drop: The initial pressure and the minimum permissible terminal pressure are specified, and the pipe sizes are so chosen that the maximum estimated amount of steam may be transmitted without exceeding this pressure difference. The steam's velocity is disregarded and it may reach a magnitude in excess of 35,000 fpm which is not considered high.

8 ● Determine the size of pipe from the following data using Unwin's formula: length of pipe, 600 ft; steam to be carried, 90,000 lb per hour, dry saturated; initial pressure, 100 lb per square inch, gage; and final pressure, 40 lb per square inch, gage.

The pressure drop, $P = 100 - 40 = 60$ lb per square inch.

The weight of steam per minute, $W = \dfrac{90{,}000}{60} = 1500.$

The length of pipe in feet, $L = 600.$

The average density of steam d in pounds per cubic foot, taken from Keenan's Tables:

At 100-lb gage, $d = 0.2578$
At 40-lb gage, $d = 0.1285$
Average, $d = 0.1932$

The diameter of the pipe in inches $= D.$

Substituting the values in the Formula (1):

$$60 = \frac{0.0001306 \times 1500^2 \times 600\left(1 + \dfrac{3.6}{D}\right)}{0.1932 \times D^5}$$

$$D = 7.35 \text{ in.}$$

Therefore, an 8-in. pipe should be used.

Chapter 43

WATER SUPPLY PIPING AND WATER HEATING

Maximum Possible Flow, Maximum Probable Flow, Average Probable Flow, Factor of Usage, Kind of Pipe Used, Sizing of Risers, Sizing of Mains, Sizing of Systems, Hot Water Supply, Hot Water Heating, Hot Water Storage, Swimming Pool Heating Requirements

DOMESTIC water supply systems present the engineer with a design problem that requires combining the somewhat empirical rules and formulæ in use with the more or less exact hydraulic principles involved. Unlike heating and ventilating layouts, there are practically no definite data for estimating the quantity of water likely to be consumed or the probable rate of water flow at any particular moment.

Metered results in one building often show two or three times the metered amount in another building of the same size and with the same type of tenants. In hotels, one riser will often have an almost constant flow that may never be reached by another at peak load. In office buildings, the women's toilets show a far greater daily consumption than those of the men, yet at no time will they approach the hourly consumption of the men's toilet during the first hour of the day. This condition has led to a multiplicity of rules of practice which vary as much as the data used. All must of necessity be based on an assumed rate of consumption and on an assumed probability of simultaneous use, and while the formulæ employed may have been derived on sound technical basis the assumptions are often in error.

To arrive at a safe standard, the approximate rate of flow of each fixture to be supplied must be known and the probable number of fixtures in use at any one time must be assumed. Obviously, the maximum number of fixtures assumed to be in use must be taken at the peak of demand and the lines must be made adequate to supply such a peak regardless of the riser or branch on which the demand may occur. This means that all water piping under the usual conditions will be over-sized.

In tall buildings it is customary to divide the water supply systems, both hot and cold, into sections of 10 to 20 stories. Such *zoning*[1] or

[1]It is impractical to attempt to size piping so as to produce the proper pressure on fixtures at different levels by employing friction, owing to the fact that this friction will be built up to the amount desired only in times of maximum demand and at all other times the friction will be only a fraction of the maximum friction so that the fixtures by this method are subjected to a varying pressure on the water supply line. A much more practical method is to throttle the flow at the fixture, or to use flow regulators, so that the quantity of water delivered will approximate the fixture demands and so that this is accomplished without splashing or noise.