For hot water or warm air heat the fuel consumption is about 0.19 cu ft per degree-day per square foot of equivalent steam *radiation*, that is, per 240 Btu per hour. The actual requirements likewise relatively increase with hot water or warm air systems as the number of degree-days decreases below 3000. For larger installations, that is 1000 sq ft of theoretical *radiation* and above, there is an increase in efficiency, and a consequent decrease in the fuel consumption per degree-day per square foot of heating surface.

The approximate quantities of steam required in New York City per square foot of heating surface for various classes of buildings are given in Chapter 37.

The preceding discussion on fuel consumption has dealt with the heating requirements of the building irrespective of any air that may be introduced for ventilation purposes other than the normal infiltration of outside air. The heat required for warming air brought into the building for ventilation may be estimated from data given in Chapters 3 and 9.

MAXIMUM DEMANDS AND LOAD FACTORS

In one form of district heating rates, a portion of the charge is based upon the maximum demand of the building. The maximum demand may be measured in several different ways. It may be taken as the instantaneous peak or as the rate of use during any specified interval. One method is to take the average of the three highest hours during the winter. These figures are available for a number of buildings in Detroit, as shown in Table 4.

These maximum demands were measured by an attachment on the condensation meter and therefore represent the amounts of condensation passed through the meter in the highest hours, rather than the true rate at which steam is supplied. There might be slight differences in these two quantities due to time lag and to storage of condensate in the system, but wherever this has been investigated it has been found to be negligible.

Table 4. Building Load Factors and Demands of Some Detroit Buildings[a]

Building Classification	Load Factor	Lb of Demand per Hr per Sq Ft of Equivalent Installed Radiator Surface
Clubs and Lodges	0.318	0.184
Hotels	0.316	0.207
Printing	0.287	0.217
Offices	0.263	0.209
Apartments	0.255	0.225
Retail Stores	0.238	0.182
Auto Sales and Service	0.223	0.248
Banks	0.203	0.158
Churches	0.158	0.152
Department Stores	0.138	0.145
Theatres	0.126	0.151

[a]Loc. Cit. Note 5.

The load factor of a building is the ratio of the average load to the maximum load and is an index of the utilization habits. Thus, in Table 4, the theatres, operating for short hours, have a load factor of 0.126 as compared with the figure of 0.318 for clubs and lodges.

PROBLEMS IN PRACTICE

1 ● Is it correct to use the total calculated heat loss of a building for estimating fuel consumption?

No. The heating load does not generally involve the sum of the separate infiltration losses of the several heated spaces. When a building has interior walls and partitions it is sufficiently accurate to consider only half of the total calculated infiltration losses.

2 ● What will be the cost per year of heating a building with gas, assuming that the calculated hourly heat loss is 92,000 Btu based on 0 F, which includes 26,000 Btu for infiltration? The design temperatures are 0 F and 72 F. The normal heating season is 210 days, and the average outside temperature during the heating season is 36.4 F. The heating efficiency will be 75 per cent. The heating plant will be thermostatically controlled, and a temperature of 55 F will be maintained from 11 p.m. to 7 a.m. Assume that the price of gas is 7 cents per 100,000 Btu of fuel consumption, and disregard the loss of heat through open windows and doors.

The average hourly temperature is

$$\frac{(72 \times 16) + (55 \times 8)}{24} = 66.3 \text{ F}.$$

The maximum hourly heat loss will be

$$92{,}000 - \frac{26{,}000}{2} = 79{,}000 \text{ Btu} = H.$$

$$M = \frac{79{,}000\ (66.3 - 36.4) \times 24 \times 210}{100{,}000 \times 0.75 \times (72 - 0)} = 2204.6 \text{ hundred thousand Btu.}$$

$$2204.6 \times 0.07 = \$154.34 = \text{cost per year of heating the building.}$$

3 ● What factors should be taken into consideration when determining the efficiency at which a fuel will be burned?

Manufacturers' catalogs usually give equipment efficiencies obtained under test conditions. These values do not allow for poor attendance, defects in installation, or poor draft. Such efficiencies do not consider heat radiated from the outside of the equipment, but in many cases this heat is utilized.

4 ● If 20 tons of coal having a calorific value of 13,000 Btu per pound are burned in a warm air furnace and produce 286,000,000 Btu at the bonnet, what is the efficiency of the furnace?

$$\frac{\text{Number of Btu at bonnet}}{\text{Number of tons} \times \text{calorific value} \times \text{number of pounds in one ton}} = \text{efficiency.}$$

$$\frac{286{,}000{,}000 \times 100}{20 \times 13{,}000 \times 2000} = 55 \text{ per cent.}$$

5 ● In making degree-day calculations, why is the base of 65 F used for an inside temperature of 70 F?

This base was chosen because data collected from numerous installations show that heat is seldom supplied to a residence when the outdoor temperature is greater than 65 F. It was also found that the amount of fuel consumed varied in almost direct proportion with the difference between 65 F and the outside temperature.