

TABLE 8. STEAM CONSUMPTION FOR VARIOUS CLASSES OF BUILDINGS^a
(Heating Season Only)

BUILDING CLASSIFICATION	No. OF BUILDINGS LISTED	STEAM CONSUMPTION POUNDS PER DEGREE-DAY—65 F BASIS ^b		
		Per M Cu Ft of Heated Space	Per M Sq Ft of Radiator Surface	Per M Btu per Hr of Heat Loss ^c
Apartments.....	16	1.78	97.5	0.359
Hotels.....	10	1.46	80.6	0.371
Residences.....	12	1.32	64.2	
Printing.....	7	1.25	105.5	
Clubs and Lodges.....	10	0.96	77.0	
Retail Stores.....	18	0.90	80.6	0.268
Theatres.....	6	0.90	75.0	0.498
Loft and Mfg.....	16	0.89	72.3	0.283
Banks.....	7	0.88	45.2	
Auto Sales and Service.....	8	0.83	62.2	
Churches.....	6	0.58	49.4	
Department Stores.....	14	0.57	60.7	0.238
Garages (Storage) ^e	6	0.42	72.3	
Offices (Total).....	35	1.09	70.0	0.283
Offices (Heating only).....	35	0.975	65.4	0.256

^aIncludes steam for heating domestic water for heating season only.^bHeat loss calculated for maximum design condition (in most cases 70 F inside, zero outside).^cEquivalent steam radiator surface.^dThe figures are a numerical—not a weighted—average for the several buildings in each class.^eBased on zero consumption at 55 F.

with a heating value of 1000 Btu per pound is used so that no correction is necessary for heating value in the usual case. In comparing values from different cities, correction should be made for design temperature (see Table 5) when the unit figures are in terms of square foot of radiator or 1000 Btu per hour calculated heat loss, but not when the values are in terms of building volume or floor space.

Consideration has been given to the difference in steam utilization of different types of buildings and Table 8^d shows actual average units for these various types. These figures are obtained from operating results in

TABLE 9. 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

^aReport of Commercial Relations Committee, *Proceedings, National District Heating Association*, 1932.^bThe Heat Requirements of Buildings, by J. H. Walker and G. H. Tuttle (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 171).

196 buildings located in 21 different cities in the United States. Being averages, and for small groups in each type, the figures may need considerable modification to allow for local variations. It should be especially noted that the steam used for heating hot water is included in the values given in Table 8, but in the case of office buildings, the steam for heating only is also shown. Presentation of the unit consumption in three ways permits making the estimate if either the calculated heat loss or the volume of net heated space in the building is known.

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 9.

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.

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 9, 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 • What will be the estimated fuel 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 seasonal 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:

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

The maximum hourly heat loss will be:

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

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

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