11 ● From the results of Questions 7 and 9, calculate the heat loads per heating season in Btu and note the savings by better construction.

The 7851 degree days for the heating season multiplied by 24 hours, times the Btu loss per hour for 1 F drop in temperature gives the Btu load per heating season.

Saving = 250,800,000 − 148,000,000 = 102,800,000 Btu.

12 ● The dry-bulb temperature and the relative humidity at the ceiling of a mixing room in a bakery are 80 F and 60 per cent, respectively. The roof is a 4-in. concrete deck covered with built-up roofing. If the lowest outside temperature to be expected is −10 F, what thickness of rigid fiber insulation will be required to prevent condensation?

From Table 11, Chapter 5, U for the uninsulated roof = 0.72. From Table 2, Chapter 5, k for rigid fiber insulation = 0.33. From the psychrometric chart the dew point of air at 80 F and 60 per cent relative humidity is 65 F. The ceiling temperature, therefore, must not drop below 65 F if condensation is to be prevented.

When equilibrium is established, the amount of heat flowing through any component part of a construction is the same for each square foot of area.

Therefore,

$$U[80 - (-10)] = 1.65\,(80 - 65)$$

where

U is the transmittance of the insulated roof.

Solving the equation, $U = 0.275$.

The resistance of the insulated roof $= \dfrac{1}{0.275} = 3.64.$

The resistance of the uninsulated roof $= \dfrac{1}{0.72} = 1.39.$

The resistance of the insulation = 3.64 − 1.39 = 2.25.

Resistance per inch of insulation $= \dfrac{1}{0.33} = 3.0.$

Since a resistance of 2.25 is required, and 1 in. of insulation has a resistance of 3, one inch will be sufficient to prevent condensation.

The same result might have been obtained by selecting an insulated 4-in. concrete slab having a U of less than 0.275 from Table 11, Chapter 5. This 4-in. concrete slab with 1-in. rigid insulation has a U of 0.23 which is safe.

Chapter 8

COOLING LOAD

Conditions of Comfort, Cooling Load, Sensible Heat Conducted, Design Outside Temperatures, Solar Radiation Through Walls and Roofs, Time Lag, Solar Radiation Transmitted Through Glass, Outside Air Heat and Moisture Leakage, Heat and Moisture Sources

THE method of calculating the cooling load is similar to that used in calculating the heating load. The direction of the flow of heat is reversed, however, and in most cases additional factors must be considered, such as solar radiation and the heat from occupants, lights, motors, and other sources. The character of the load depends on the type of building to be cooled as, for example, in auditoriums and other places of assemblage where the maximum load usually is that due to the heat and moisture given off by the occupants, or in office buildings and residences where solar radiation and the transmission and infiltration of heat through the building shell are most important.

While cooling is generally identified with the summer season, it is often necessary to cool in winter as well as in summer. In a crowded place of assemblage the heat given off by the occupants, together with that given off by the lighting and power equipment, may be more than the normal heat loss through the structure even in winter under cold climatic conditions.

Much of the basic information for the design of comfort conditioning installations has resulted from research conducted at the A.S.H.V.E. Research Laboratory and at institutions with which cooperative research investigations have been carried on. These data include the effective temperature index, and heat and moisture loss data given in Chapter 3.

CONDITIONS OF COMFORT

The conditions to be maintained in an enclosure are variable and depend on many factors, especially the season of the year and (during the summer) the outside dry-bulb temperature and the duration of the period of occupancy. Information concerning the proper effective temperatures to be maintained for various seasons is given in Chapter 3, where are also tabulated the most desirable indoor air conditions to be maintained in summer for exposures less than three hours. (See Table 2, Chapter 3.)

In installations for restaurants and theaters the requirements are different from those in offices, since there must be a considerable volume of air circulated in order to provide ventilation and cooling.