

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.

$$\text{Saving} = 262,000,000 - 152,500,000 = 109,500,000 \text{ Btu.}$$

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, $U = 0.275$.

$$\text{The resistance of the insulated roof} = \frac{1}{0.275} = 3.64$$

$$\text{The resistance of the uninsulated roof} = \frac{1}{0.72} = 1.39$$

$$\text{The resistance of the insulation} = 3.64 - 1.39 = 2.25$$

$$\text{Resistance per inch of insulation} = \frac{1}{0.33} = 3.0$$

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, Design Outside Temperatures, Components of Heat Gain, Normal Heat Transmission, Solar Heat Transmission, Sun Effect Through Windows, Heat Emission of Occupants, Heat Introduced by Outside Air, Heat Emission of Appliances

LOAD calculations for summer air conditioning are more complicated than heating load calculations for the reason that there are several more factors to be considered. Because of the variable nature of some of the contributing load components and the fact that they do not necessarily impose their maximum effect simultaneously, considerable care must be exercised in determining their phase relationship in order that equipment of proper capacity may be selected to maintain specified indoor conditions.

CONDITIONS OF COMFORT

The conditions to be maintained in an enclosure are variable and depend upon several factors, especially the outside design conditions, duration of occupancy and relationship between air motion, dry-bulb and wet-bulb temperatures. Information concerning the proper effective temperature to be maintained is given in Chapter 3, where are also tabulated the most desirable indoor conditions to be maintained in summer for exposures over 40 min (see Table 2, Chapter 3).

DESIGN OUTSIDE TEMPERATURES

Summer dry-bulb and wet-bulb temperatures of various cities are given in Table 1. It will be noted that the temperatures are not the maximums but the design temperatures which should be used in air conditioning calculations. The maximum outside wet-bulb temperatures as given in Weather Bureau reports usually occur only from 1 to 4 per cent of the time, and they are therefore of such short duration that it is not practical to design a cooling system covering this range. The temperatures shown in Table 1 are in part based on available design conditions known to be successfully applied and for those localities where this information is lacking they are based on a study of the hourly temperatures in New York City from which factors were derived and applied to the average maximum dry- and wet-bulb temperatures for other cities. This study covered a twenty-year record of Weather Bureau temperatures. The design