

about 400 Btu per hour. Part of this is latent heat due to the evaporation of 700 to 1200 grains of moisture per hour. Examples illustrating heat and moisture loss calculations for human beings are given in Chapter 3.

All sources of heat must of course be considered in designing the conditioning system. The heat gain due to various devices is given in Table 5.

Moisture evaporated by appliances must be included in the total latent heat load. In some cases only a small part of the heat from lights immediately affects the cooling load. Tests⁷ show that with lights placed near the ceiling under some conditions the electricity used for illumination has little effect on the cooling load in an office cooled during the usual short period. The air heated by the lights stratifies closely to the ceiling and the temperature of the lower layers of air is raised only a small amount after a considerable lapse of time. An example of cooling load calculation is given in Chapter 9.

PROBLEMS IN PRACTICE

1 ● In buildings such as an office building which is cooled intermittently, will the maximum cooling load occur coincidently with the maximum dry-bulb temperature?

Not necessarily. Tests indicate that particularly for east and south exposures the maximum rate of cooling occurs shortly after the equipment is started in the morning. This extra heat is that which was absorbed by the building during the preceding day and also during the off period. The rapid lowering of the room temperature after the cooling equipment is started causes this stored up heat to flow quickly from wall and floor surfaces to the room air.

2 ● The outdoor and indoor temperatures are 90 F and 78 F, respectively. What is the amount of heat transmitted per hour through a 7 ft by 4 ft north window?

$$H_t = 28 \times 1.13 (90 - 78) = 380 \text{ Btu per hour.}$$

(Equation 1, Chapter 8 and Table 13, Chapter 5.)

3 ● What are the proper design temperatures for a Detroit store?

Outdoor dry-bulb, 93 F; wet-bulb, 73 F. (Table 1, Chapter 8.)

Indoor dry-bulb, 79.2 F; wet-bulb, 64.8 F. (Table 2, Chapter 3.)

4 ● a. What is the maximum heat transmission for a flat roof exposed to the sun with the outdoor and indoor temperature 95 F and 80 F, respectively? The roof is of uninsulated 6-in. concrete, with its underside exposed, and with a black upper surface.

b. If the temperatures specified were the maximum for the day and occurred at 12 o'clock, at what time would the maximum cooling load due to the roof exist?

$$a. H_t = 1 \times 0.64 (95 + 45 - 80) = 38.4 \text{ Btu per hour per square foot.}$$

(Equation 1 and Table 2, Chapter 8, and Table 11, Chapter 5.)

b. At 3 p.m. (Table 3.)

5 ● For south windows equipped with canvas awnings, what is the maximum amount of heat delivered to a room when the outdoor temperature is 90 F and the indoor temperature is 78 F?

$115 \times 0.28 = 32.2$ Btu per square foot of glass (Fig. 1 and Table 4; note that glass transmission can be neglected).

6 ● What is the heat gain per cubic foot of outside air introduced, under the following conditions:

Outdoor temperatures, 90 F dry-bulb and 75 F wet-bulb.

Inside temperatures, 78 F dry-bulb and 65 F wet-bulb.

$H_i = 60 Q d_o (\Theta_o - \Theta_i)$. (From Equation 2.)

The relative humidity of the outdoor air is 50 per cent (Psychrometric Chart), and the volume of 1 lb of air is $\frac{13.84 + 14.53}{2} = 14.19$ cu ft (Table 5, Chapter 1).

$$d_o = \frac{1}{14.21} = 0.0704.$$

$\Theta_o = 38.46$ and $\Theta_i = 29.96$ (Table 5, Chapter 1). The total heat of any air-vapor mixture may be obtained from the last column in Table 5, Chapter 1, by considering the temperatures to be wet-bulb readings, since the total heat of a mixture is constant for a given wet-bulb temperature.

$$H_i = 0.0704 (38.46 - 29.96) = 0.598 \text{ Btu per cu ft.}$$

7 ● If there are twenty 200-watt lights in use in a room, what is the cooling load due to lights?

$$200 \times 20 = 4000 \text{ watts} = 4 \text{ kw.}$$

$$3413 \times 4 = 13,652 \text{ Btu per hour (Table 5, Chapter 8).}$$

8 ● a. If a restaurant has two 10-gal coffee urns, what is the cooling load due to them?

b. What is the cooling load due to four 1350-watt burners on an electric range?

$$a. 16,000 \times 2 = 32,000 \text{ Btu per hour (Table 5, Chapter 8).}$$

$$b. 1.35 \times 4 \times 3413 = 18,430 \text{ Btu per hour (Table 5, Chapter 8).}$$

9 ● Why may the heat gain by transmission through glass on the sunny exposures be neglected?

Solar radiation on a glass surface during peak hours will cause the outer surface of the glass to rise up to or slightly above the simultaneous air temperature, hence no heat can flow from outside air to the glass at this time.

10 ● What should be the dry- and wet-bulb temperatures in a restaurant when the outdoor dry-bulb temperature is 95 F?

Dry-bulb, 80 F; wet-bulb, 65 F (Table 2, Chapter 3).

11 ● In an office building in which the occupants remain indoors most of the day, what is the most desirable indoor dry-bulb temperature and relative humidity in summer?

76.5 F and 50 per cent relative humidity (Fig. 5, Chapter 3).

12 ● An office with western exposure in a building having concrete floors is cooled only during office hours. If the windows are bare and unshaded, what is the maximum cooling load in the office due to solar radiation through the windows?

$215 \times 0.97 \times \frac{1}{2} = 104$ Btu per square foot of glass per hour (Fig. 1 and Table 4; note that only one-half of the heat need be considered because of absorption by the floor).

13 ● A 7 × 4 ft west window is equipped with an inside Venetian blind which is adjusted to fully cover the window when the sun shines. The net glass area is 75 per cent of the total area of the window. What is the cooling load due to the window at 10 a.m. and 4 p.m. assuming solar radiation as shown in Fig. 1 and