The sum of these values equals 0.2 + 0.25 + 0.09 + 0.10 + 0.35 + 0.12 + 0.25 + 0.1 = 1.46 in. which is the static pressure against which the system must operate.

Fans and Control

The selection of fans may be based on data contained in Chapter 27 and for motors in Chapter 38. Because centrifugal fans reach their maximum efficiency when working against the resistance offered by the average central fan heating system, they are well adapted to such systems and are generally used. Information on temperature control for central fan systems is given in Chapter 37.

PROBLEMS IN PRACTICE

1 ● Consider a blast heating system handling 10,000 cfm. The resistance to air flow offered by one coil arrangement is 0.9 in. of water and by another coil arrangement is 0.2 in. of water. The fan operates 4000 hours per year and the combined efficiency of motor and fan is 60 per cent. Determine the annual energy saving if the second coil is used.

Difference in system resistance = 0.9 − 0.2 = 0.7 in. of water.

$$\text{Reduction in power input} = \frac{10{,}000 \times 0.7}{6356 \times 0.60} = 1.83 \text{ hp.}$$

Annual energy saving = 1.83 × 0.764 × 4000 = 5480 kwhr.

2 ● What saving results from recirculating some of the room air and reducing the amount of outside air?

Because outside air must be heated to room temperature, reducing the amount of outside air produces a proportionate saving in heat or fuel.

3 ● What items make up the total heating load in a central fan heating system?

1. The net heat loss from the conditioned space.
2. The heat required for evaporation of water for humidification.
3. The heat required to raise the temperature of outside air to room temperature.
4. Heat losses from pipes and ducts.

4 ● A group of three drafting rooms, having a total volume of 27,000 cu ft, a transmission loss of 110,100 Btu per hour, and an infiltration loss of 34,200 Btu per hour on the basis of 0 F outdoors and 70 F room temperature, is to be heated by a recirculating hot blast heating system with air entering the rooms at 116 F. How many cubic feet per minute, measured at 70 F, will be required?

Substitute in Equation 3. $H = 110{,}100 + 34{,}200 = 144{,}300$ Btu per hour; $t_y = 116$ F; $t = 70$ F; $Q = \dfrac{144{,}300}{60 \times 0.07492 \times 0.24\,(116 - 70)} = 2900$ cfm

5 ● In the preceding question, if the warm air loses 4 F between heater and rooms, how many pounds of steam per hour at 1-lb gage will the heating sections condense?

Substitute in Equation 12. $Q = 2900$ cfm, from solution of Question 4; $\Delta t = 116 + 4 - 70 = 50$ F; $h_{fg} = 968$ Btu, from steam table in Chapter 1.

$$W = \frac{60\,dQ \times 0.24 \times \Delta t}{h_{fg}} = \frac{60 \times 0.07492 \times 2900 \times 0.24 \times 50}{968} = 161.8 \text{ lb per hour.}$$

Chapter 22

CENTRAL SYSTEMS FOR COOLING AND DEHUMIDIFYING

Classification of Systems, Spray and Surface Type Dehumidifiers, Designing the System, Zoning, Location of Apparatus, Air Temperature Leaving Room Inlets, Calculations and Selection of Apparatus, Quantity and Temperature of Air Required, Heat Removed by Apparatus, Reheating Dehumidified Air, By-Pass System

CENTRAL systems, equipped for cooling and dehumidifying, are used principally in the air conditioning of theatres, restaurants, office buildings, or other places where people gather, and in manufacturing establishments where air conditions have an important influence on the quality of product or rate of production. A central cooling and dehumidifying plant is one in which the fans, dehumidifiers, and other related apparatus are assembled in suitable apparatus rooms from which supply and return ducts lead to the conditioned spaces. The design of such systems is considered in this chapter, while in Chapter 21 Central Systems for Heating and Humidifying are described. Air conditioning for industrial processes is considered in Chapter 33. A discussion of the dehumidifying equipment only, will be found in Chapters 24 and 25.

CLASSIFICATION OF SYSTEMS

Dehumidification or cooling of air may be accomplished by several methods, and by use of many heat transfer media. Most central station comfort air conditioning systems employ cold water or the direct expansion of a refrigerant in either spray type or surface type equipment to accomplish the required cooling and dehumidification. Hence this chapter will be concerned mainly with the design of such systems.

Two other methods of summer air conditioning are used to some extent. In regions where the summer wet-bulb temperature is low (see Chapter 8, Table 1), evaporative cooling can be used. A spray type unit is employed, with recirculation of the spray water and usually a supply of 100 per cent outside air. The dry-bulb temperature of the air is reduced but the relative humidity of the air is increased, as the air passes through the sprays and its sensible heat is converted into latent heat. The wet-bulb temperature remains constant, and for comfort conditioning it is advisable to have the final dry-bulb temperature a few degrees higher than the wet-bulb.