ZONING THE SYSTEM

The foregoing general outline of procedure will prove satisfactory for the smaller and less complex installations. However, when dealing with air conditioning systems for large buildings, after a proper analysis has been made of the conditions to be maintained and the heat loads encountered, it is generally considered good practice to divide the complete job into a number of suitably sized units. In some cases a unit per floor or group of floors may complete the design satisfactorily, whereas in others it may be advantageous to have separate units for each of the various outside exposures of the building. The heat loads on inside rooms are apt to be less variable since the fluctuations of the outside weather conditions are not directly involved. Where the floor area is large in relation to the outside wall exposure, it is obvious that special provision must be made for the variable load to which the outside exposures are subjected. Such conditions often result in the natural zoning or segregation of rooms having similar exposures and internal heat loads. Variations in the hours of occupancy in different portions of a building also frequently require careful zoning for successful operation.

LOCATION OF APPARATUS

Availability of space for apparatus and duct work is of primary importance when selecting the type of system for a given design. In general, for large installations, the refrigeration equipment, because of its size, weight, and operating characteristics, is located in the basement along with the boilers, fire pumps, and other equipment. The air conditioning apparatus is generally located where clean outdoor air is readily available, the designer bearing in mind that supply and return air ducts, steam connections, water and drain connections, and electrical connections must be made to the equipment proper.

AIR TEMPERATURE LEAVING ROOM INLETS

In comfort conditioning applications, air has been distributed from properly designed inlets without producing drafts at temperatures varying from approximately 5 to 30 F below the required room temperature. Factors influencing the design and selection of air inlets are: ceiling height, contour of ceiling, length of blow, and temperature and quantity of air to be distributed. Most summer conditioning installations are designed to supply the air to the conditioned space at from 8 to 18 F below room temperature. Recently the use of specially designed nozzles has indicated the possibility of reducing the air quantity necessary to dissipate a given heat load by introducing the air into the room as much as 30 F below room temperature. Directional flow inlets which spread the air fanwise permit lower inlet temperatures than single direction inlets. Comfort conditioning systems employing differentials greater than 18 F require special consideration and design experience because high pressure inlets or nozzles are usually used. Further, care must be taken to allow a sufficient air quantity under all load conditions to insure good distribution. If winter heating, as well as summer conditioning, is to be accomplished by the same distributing system, the design of the

inlets will be influenced as discussed in Chapter 21. Industrial systems in which drafts are not objectionable usually employ a temperature differential equal to the dew-point depression.

CALCULATIONS AND SELECTION OF APPARATUS

When the cooling loads in the rooms to be served have been calculated as outlined in Chapter 8, they are combined to obtain the total room load. However, all loads must be calculated in two parts: (1) the sensible heat or dry load, and (2) the latent heat or moisture load. For convenience it is customary to state this division of loads by a ratio, as for instance the ratio of sensible heat load to total load. Unfortunately there is as yet no uniform practice in the statement of this ratio, and hence in Table 1 all the common ways of stating the load ratio are given. It should be noted *that the heat load ratio for the dehumidifier is not exactly the same as the* heat load ratio of the room except in the case of 100 per cent recirculation and zero reheat.

The heat load ratio of a room depends upon its occupancy as well as upon the heat transmitted through its walls and windows. This is approximately indicated in Table 1. Since human occupants are one of the greatest sources of latent heat or moisture load, this load is frequently a minimum when there is a large room space per occupant and the occupants are not doing physical work.

Examples of the solution of a typical problem of treating air to produce room conditions of 80 F dry-bulb and 50 per cent relative humidity are also given in Table 1. In these examples it is assumed that as the air is discharged into the room and diffuses with the room air, it is required to absorb sensible and latent heat in the ratio indicated, and that its final condition after absorbing this heat is the ***room condition*** of 80 F dry-bulb and 50 per cent relative humidity. Table 1 deals with the room only, and the heat load ratios for the dehumidifier and the temperatures leaving the same will not be identical with those given for the room. However, if the heat gains in the duct work have been included as part of the room load, the dry-bulb temperatures in Table 1 will be those at the discharge of the central conditioning apparatus. To obtain the total heat load on the dehumidifier, and its corresponding heat load ratio, the load due to outside or ventilating air must of course be added. The significance of these statements is illustrated in the examples following.

Quantity and Temperature of Air Required

The quantity of air to be circulated is usually determined on the basis of the sensible heat load, although in some cases the air quantity will be determined by the latent heat load, or by the air distribution or ventilation requirements.

Example 1. A room is to be maintained at a dry-bulb temperature of 80 F and a relative humidity of 55 per cent, (68.5 F wet-bulb, 62.5 F dew-point, 85.5 grains of moisture per pound). The sensible heat gain in this room is 100,000 Btu per hour, and the latent heat gain is 33,000 Btu per hour, or a heat load ratio, sensible to total, of 75 per cent. A temperature differential of 12 F between the room air and the conditioned supply has been selected, i.e., the air is to be supplied at 68 F dry-bulb. Find the quantity and condition of the air supply required.