which is indicated as being the maximum number of people within the enclosure when the sum of the remaining loads is a maximum. The Code further states that the assumed ventilation rates shall not be less than 15 cfm per stated number of occupants in enclosures where smoking is customarily permitted, and that provision shall be made for air removal from the enclosure either by natural or mechanical means at not less than the assumed ventilation rate. For the purpose of the Code, air quality or purity are assumed to be met if means are provided for the positive introduction of outside air in the amounts previously mentioned and for removal of 95 per cent by count of all dust particles over 10 microns in diameter from all air delivered to the enclosure.

The heat required to warm ventilation air is determined in the same manner as for infiltration air. It should be kept in mind, however, that infiltration increases the amount of heat required to warm the conditioned space, while ventilation air adds to the load on the heating coil.

The heat required to evaporate the necessary water required for winter humidification and superheat the resulting vapor in order to raise the moisture content of the outside air, assumed to enter the enclosure by infiltration or positively introduced for ventilation, should be calculated according to the information included in Chapter 1.

Information is given in Chapter 42 for calculating heat transfer through ducts and housings.

The heat emission of occupants, lights, and other sources is treated later in this chapter. This heat gain may be used as a credit against the heat loss calculations. In general, however, the design for heating disregards these gains as in most cases these values are not a continuous or uniform source of heat and the heating system must be adequate to maintain the required temperature at all times including nights, Sundays and holidays, when the space is not in normal use.

The sum of the several losses (*Items 2a* and *2b*) will give the amount of heat to be supplied to the conditioned space. The above quantity plus ventilation and humidification load and heat loss in ducts represents load on conditioner.

Load Calculations for Cooling

The heat gain through the windows, partitions, doors, floors, skylights, ceilings or roofs of the enclosure due to the air dry-bulb temperature difference assumed to exist between the air on the opposite sides of the construction may be determined from data given in Chapter 3. Charts and tables are given in Chapter 6 for the determination of sun effect on walls, roofs, and windows.

The heat gain from occupants may be calculated from data in Chapter 2, which give the metabolic rate for people engaged in various activities. In addition charts are included which give a separation of the sensible and latent heat losses from the body which should be itemized separately in all calculations.

The heat emission from various appliances should be calculated according to the information and data given in Chapter 6, with special consideration being given to the division of latent and sensible heat requirements of the apparatus. Complete details may also be found in

Chapter 6 for determining the heat gain resulting from electric lights and motors within the enclosure.

The heat gain from infiltration air and ventilation air is determined by the method shown in Chapter 4. Separate sensible and latent heat. (See Chapter 42 for heat gain in ducts.)

Air Distribution System for Heating

The total heating load to be supplied by the central system is determined from the several components of the load listed under *Item 2*. The quantity, air motion, and temperature of the treated air and the method of introducing it to the conditioned space should be designed so as to limit the variation in dry-bulb temperature to 3 F or less at a 5 ft level throughout that portion of the enclosure which is normally frequented by persons. It is desirable to avoid air velocities exceeding 50 linear feet per minute in the occupied zone between the floor and the 5 ft level. When architectural or other construction requirements necessitate the location of a supply or return grille below the 5 ft level in an occupied space, special consideration should be given to the air velocities in that region to avoid uncomfortable drafts.

It is desirable to use reasonably low temperature differences between the entering air and room conditions where possible. Air temperatures from 80 to 90 F will generally be satisfactory, although where the quantity of air to be circulated is kept at a minimum and where the arrangement of air inlets permits adequate mixing with the room air before reaching the breathing zone, higher temperatures from 100 to 120 F can be used. Having selected the desired temperature of the entering air, the quantity of air is determined as follows:

$$Q = \frac{H}{60d \times 0.24\,(t_2 - t_1)} \tag{1}$$

where

Q = volume of air to be introduced, cubic feet per minute.
H = sensible heat loss of space to be conditioned, Btu per hour.
d = density of air, pounds per cubic foot.
t_2 = outlet temperature at the grille, degrees Fahrenheit.
t_1 = design room temperature, degrees Fahrenheit.

If the air quantity calculated is excessive, it may be decreased by using a higher entering temperature. If the quantity is too small to provide adequate distribution and ventilation, it may be increased by using a lower entering temperature. Air motion has a cooling effect on the individual, and ordinarily the air quantity circulated should provide an overall air change in the conditioned space in not less than 5 min or more than 12 min. Best results are secured when the entering air temperature and method of distribution permit uniform mixture of air without excessive motion in the occupied zone.

After air temperatures are established, the heat loss from ducts may be approximated (see Chapter 42). The resulting temperature drop can be calculated by solving Equation 2.

$$\Delta t = \frac{H_d}{60\,d \times 0.24 \times Q} \tag{2}$$