door-air and conditioned-space design dry-bulb temperatures *minus* 5 Fahrenheit degrees. In some cases it may be that the air temperature in the adjacent space will correspond closely to the outdoor air temperature at all times. Under these latter conditions, the heat gain through the partition will be periodic in nature, and the value of a shaded wall should be used from Table 15.

For floors directly in contact with the ground, or over an underground basement that is neither ventilated nor warmed, the heat transfer may be neglected for cooling-load estimates.

LOAD FROM OUTSIDE AIR, VENTILATION AND INFILTRATION

Ventilation. Data for determining the necessary ventilation rate have been presented previously in this chapter. Ventilation required is primarily dependent upon the number of occupants and upon the materials and apparatus within the space which may give off odors. For spaces having ceiling heights 10 ft or less, the total requirement should be checked against the volume, and in no case should the ventilation air rate be less than one air change per hour. In spaces having ceilings higher than 10 ft where the occupant load is low, a check calculation can be made against the volume of the space below an assumed 10 ft ceiling.

Infiltration must never be counted upon to provide ventilation, because on still days there will be little or no infiltration.

Infiltration. The principles of infiltration calculations have been discussed in Chapters 10 and 11, with emphasis on the heating season. For the cooling season, infiltration calculations are usually limited to doors and windows.

To compute cooling-load infiltration for windows by the crack method, use the data of Table 2, Chapter 10, for a wind velocity of 10 mph. Note that for double-hung windows the length of crack is three times the width plus twice the height; while for metal-sash windows the crack length is the total perimeter of the movable or ventilating sections. In calculating window infiltration for an entire structure, it is not necessary to consider the total crack length on all sides of the building, for the wind would not act simultaneously on all sides at once. In no case, however, should less than half of the total crack length be figured. A knowledge of the prevailing wind direction will aid judgment in this consideration.

Cooling-load infiltration for doors[16] may be obtained from Table 3, Chapter 10. For conditions other than those covered, the notes appended to Table 3 will provide a basis for estimates. The tabulated data may also be used as the basis of estimates for interior doors between an air-conditioned and a non-air-conditioned space.

Infiltration load must be included whenever the new air introduced through the system is not sufficient to maintain excess pressure within the enclosure to prevent the infiltration. Whenever economically feasible, it is desirable to introduce sufficient outdoor air through the air-conditioning equipment to maintain a constant outward escape of air, and thus eliminate the infiltration portion of the load. The pressure maintained must, of course, be sufficient to overcome wind pressure through cracks and door openings. When this condition prevails it is not necessary to include any infiltration load. When the quantity of new air introduced through the cooling equipment is not sufficient to build up the required pressure to offset infiltration, the entire infiltration load should be included in the cooling load calculations.

Total Outside Air Load. To determine the design cooling load caused by the introduction of outside air, the maximum rate of outside-air entry is first established. In some applications the use of special exhausters from the conditioned space may add to the outdoor-air requirements in determining the maximum rate. Once this design quantity is established, and with the design indoor and outdoor air states known, the cooling load may be computed. There are several methods in use, the more accurate of these require rather detailed calculations. Refer to Chapter 3, under section on Cooling Load, and Chapter 29 in section on Apparatus-Dew Point. The following equations are considered to be sufficiently accurate for use at usual design conditions, as their accuracy is within 1 per cent.

$$\textit{Sensible Load} \quad q_s = Q \times 60 \times 0.244 \times 0.075 \left(1 - \frac{0.00923}{0.62}\right)(t_o - t_i)$$

$$= Q \times 1.08\,(t_o - t_i), \text{ Btu per hour} \qquad (13)$$

$$\textit{Latent Load} \quad q_o = Q \times 60 \times 0.075 \times 1076\,(W_o - W_i)$$

$$= Q \times 4840\,(W_o - W_i), \text{ Btu per hour} \qquad (14)$$

$$\textit{Total Load} \quad q_t = q_s + q_o \qquad (15)$$

where Q = rate of entry of outside air, cubic feet per minute.

t_o = outdoor dry-bulb temperature, Fahrenheit degrees.

t_i = indoor dry-bulb temperature, Fahrenheit degrees.

W_o = outdoor humidity ratio, pounds moisture per pound of dry air.

W_i = indoor humidity ratio, pounds moisture per pound of dry air.

0.075 = standard air density, pounds per cubic foot.

0.244 = a constant approximating the specific heat of dry air corrected for moisture Btu per (pound) (Fahrenheit degree).

1076 = a factor approximating the average Btu released in condensing one pound of water vapor from air.

Standard air weight (0.075 lb per cu ft) is recommended for use in all calculations, as this is the basis for rating fans and its consistent use keeps all parts of the calculations in conformity.

HOW OUTSIDE AIR LOAD AFFECTS ROOM LOAD

Actually the outdoor air used for ventilation would pass through the conditioning equipment and be cooled and dehumidified to a lower temperature and humidity ratio than room conditions before entering the room; but for heat-balance purposes the cooling load chargeable to the outdoor air is that corresponding to the difference between the outdoor and indoor air conditions.

One important purpose of the cooling load estimate is to determine the conditions and quantity of air supplied to the space. All the various sensible and latent heat loads within the space must be included. Infiltration must be included in the space load since this air enters the doors and windows, and its heat and moisture load must be offset by the introduction of cooler, dryer air to the space. However, since ventilation air is taken through the conditioning equipment and cooled, this portion does not become a part of the space load. To determine the total load on the refrigeration machine, the ventilation air load must be included in the grand total load.

Example 10. For outdoor design conditions of 95 F dry-bulb and 75 F wet-bulb, and indoor design conditions of 80 F dry-bulb and 67 F wet-bulb, and for the supply