determine the heat equivalent to evaporate the required amount of water vapor, which may be calculated by the equation:

$$H_l = Q\,d\left(\frac{m_i - m_o}{7000}\right) h_{fg} \qquad (5)$$

where

H_l = heat required to increase moisture content of air leaking into building from m_o to m_i, Btu per hour.
Q = volume of outside air entering building, cubic feet per hour.
d = density of air at temperature t_i, pounds per cubic foot.
m_i = vapor density of inside air, grains per pound of dry air.
m_o = vapor density of outside air, grains per pound of dry air.
h_{fg} = latent heat of vapor at m_i, Btu per pound.

If the latent heat of vapor (h_{fg}) is assumed to be 1060 Btu per pound, Equation 5 reduces to

$$H_l = 0.0114\,Q\,(m_i - m_o) \qquad (5a)$$

Equations 4a, 4b and 5a may also be used for determining the sensible and latent heat gains due to infiltration in cooling load computations.

SELECTION OF WIND VELOCITIES

The effect of wind on the heating requirements of any building should be given consideration under two heads:

1. Wind movement increases the heat transmission of walls, glass, and roof, affecting poor walls to a much greater extent than good walls.
2. Wind movement materially increases the infiltration (inleakage) of cold air through the cracks around doors and windows, and even through the building materials themselves, if such materials are at all porous.

Theoretically as a basis for design, the most unfavorable combination of temperature and wind velocity should be chosen. It is entirely possible that a building might require more heat on a windy day with a moderately low outside temperature than on a quiet day with a much lower outside temperature. However, the combination of wind and temperature which is the worst would differ with different buildings, because wind velocity has a greater effect on buildings which have relatively high infiltration losses. It would be possible to work out the heating load for a building for several different combinations of temperature and wind velocity which records show to have occurred and to select the worst combination; but designers generally do not feel that such a degree of refinement is justified.

It has been the practice for many years in estimating air leakage by the crack method to use the *average* wind velocity during the months of December, January and February. This *average* wind velocity may not necessarily correspond with that occurring during periods when the outside design temperature prevails, the latter being not an *average* but rather a near extreme, that is, a specified number of degrees above the lowest temperature recorded in the locality involved. Therefore instead of using the aforementioned *average* wind velocity, it is the practice of some designers to use in all cases a wind velocity of 15 mph together with the proper design temperature. Although a 15 mph wind velocity is higher than the general average wind velocity during December, January and February in various United States cities, this and higher wind velocities frequently occur during periods of outside temperature corresponding to the design temperature. It should be added that this wind velocity

also corresponds with that on which the heat loss coefficients in Chapter 6 are based, although the effect of variations in wind velocity on the infiltration losses is generally much greater than the effect of wind velocity on the heat loss by transmission through walls. Therefore, pending further investigation of this subject, either the average during December, January and February or a 15 mph wind velocity may be used at the discretion of the designer. Where the air change method is used for estimating infiltration losses, the wind velocity is not considered.

Exposure Factors: Many designers use empirical exposure factors to increase the calculated heat loss of rooms or spaces on the side or sides of the building exposed to the prevailing winds. However, according to a survey made in 1943, many Guide users have found that the use of exposure factors is not necessary as the Guide method of calculating heat losses provides an ample heat loss allowance. Therefore exposure factors may be regarded as *factors of safety* for the rooms or spaces exposed to the prevailing winds, to allow for additional capacity for these rooms or spaces, or to *balance the radiation*, particularly in the case of multistory buildings. Although the exposure allowance is frequently assumed to be 15 per cent, the actual allowance to be made, if any, must to a large extent be a matter of experience and judgment of the designer, since there are at present no authentic test data available from which rules could be developed for the many conditions encountered in practice.

As stated previously, the value of U in the tables of Chapter 6 is based on a wind velocity of 15 mph and the surface resistance for this wind velocity (0.17) is sufficiently low that higher wind velocities will decrease the surface resistance to a negligible degree and therefore have only a slight effect on the average over-all coefficient. On the other hand, infiltration losses vary almost directly as the wind velocity, as will be apparent from the factors in Table 2 of Chapter 8. The more exact method therefore would be to differentiate among the various exposures more accurately by calculating the infiltration and transmission losses separately for the different sides of the building, using different assumed wind velocities for the infiltration losses on the various sides of the building.

AUXILIARY HEAT SOURCES

The heat supplied by persons, lights, motors and machinery should always be ascertained in the case of theaters, assembly halls, and industrial plants, but allowances for such heat sources must be made only after careful consideration of all local conditions. In many cases, these heat sources should not be allowed to affect the size of the installation at all, although they may have a marked effect on the operation and control of the system. In general, it is safe to say that where audiences are involved, the heating installation must have sufficient capacity to bring the building up to the stipulated inside temperature before the audience arrives. In industrial plants, quite a different condition exists, and heat sources, if they are always available during the period of human occupancy, may be substituted for a portion of the heating installation. In no case should the actual heating installation (exclusive of heat sources) be reduced below that required to maintain at least 40 F in the building.

Electric Motors and Machinery

Motors and the machinery which they drive, if both are located in the room, convert all of the electrical energy supplied into heat, which is