

from it at higher levels. On the other hand, the wind velocity at lower levels may be somewhat abated by surrounding obstructions. Furthermore, the chimney effect is reduced in multi-story buildings by the partial isolation of floors, thereby preventing free upward movement, so that wind and temperature difference may seldom cooperate to the fullest extent. Making the rough assumption that the *neutral zone*⁶ is located at mid-height of a building, and that the temperature difference is 70 F, Equations 1 and 2 may be used to determine an equivalent wind velocity to be used in connection with Tables 1 and 2 that will allow for both wind velocity and temperature difference:

$$M_e = \sqrt{M^2 - 1.75 a} \quad (1)$$

$$M_e = \sqrt{M^2 + 1.75 b} \quad (2)$$

where

M_e = equivalent wind velocity to be used in conjunction with Tables 1 and 2.

M = wind velocity upon which infiltration would be determined if temperature difference were disregarded.

a = distance of windows under consideration from mid-height of building if above mid-height, feet.

b = distance if below mid-height, feet.

The coefficient 1.75 allows for about one-half the temperature difference head.

For buildings of unusual height, Equation 1 would indicate negative infiltration at the highest stories, which condition may, at times, actually exist.

Sealing of Vertical Openings

In tall, multi-story buildings, every effort should be made to seal off vertical openings such as stair-wells and elevator shafts from the remainder of the building. Stair-wells should be equipped with self-closing doors, and, in exceptionally high buildings, should be closed off into sections of not over 10 floors each. Plaster cracks should be filled. Elevator enclosures should be tight and solid doors should be used.

If the sealing of the vertical openings is made effective; no allowance need be made for the chimney effect. Instead, the greater wind movement at the greater heights makes it advisable to install additional heating surface on the upper floors above the level of neighboring buildings, this additional surface being increased as the height is increased. One arbitrary rule is to increase the heating surface on floors above neighboring buildings by an amount ranging from 5 per cent to 20 per cent. This extra heating surface is required only on the windward side and on windy days, and hence automatic temperature control is especially desirable with such installations.

In stair-wells that are open through many floor levels although closed off from the remainder of each floor by doors and partitions, the stratification of air makes it advisable to increase the amount of heating surface at the lower levels and to decrease the amount at higher levels. One rule is to calculate the heating surface of the entire stair-well in the usual way and to place 50 per cent of this in the bottom third, the normal amount in the middle third and the balance in the top third.

⁶Neutral Zone in Ventilation, by J. E. Emswiler (A.S.H.V.E. TRANSACTIONS, Vol. 32, 1926, p. 59).

CHAPTER 6

Heating Load

Transmission Heat Losses, Infiltration Heat Losses, Inside Temperatures, Outside Temperatures, Attic Temperatures, Temperatures in Unheated Spaces, Ground Temperatures, Basement Temperatures and Heat Losses, Heat Losses Through Ceilings and Roofs, Selection of Wind Velocities, Auxiliary Heat Sources, Intermittently Heated Buildings, Residence Heat Loss Problems

IN the design of a heating system, an estimate must be made of the maximum probable heat loss of each room or space to be heated, based on maintaining a specified inside air temperature during periods of minimum selected design weather conditions. The heat losses may be divided into two groups, namely (1) the transmission losses or heat losses through the confining walls, floor, ceiling, glass or other surfaces and (2) the infiltration losses or heat losses due to air leakage through cracks and crevices, around doors and windows, opening of doors and other sources of interchange of air between the inside and outside.

TRANSMISSION HEAT LOSSES

The basic formula for the loss of heat by transmission through any surface is given in Equation 1.

$$H_t = AU(t - t_o) \quad (1)$$

where

H_t = heat loss transmitted through the wall, roof, ceiling, floor or glass, Btu per hour.

A = area of wall, glass, roof, ceiling, floor or other exposed surfaces, square feet.

U = coefficient of transmission, air to air, Btu per hour per square foot per degree Fahrenheit temperature difference (Chapter 4).

t = inside temperature near surface involved which may not necessarily be the so-called breathing line temperature, degrees Fahrenheit.

t_o = outside temperature, or temperature of adjacent unheated space or of the ground, degrees Fahrenheit.

Example 1. Calculate the transmission loss through an 8 in. brick wall having an area of 150 sq ft if the inside temperature (t) is 70 F and the outside temperature (t_o) is -10 F.