

Making the rough assumption that the *neutral zone*³ is located at mid-height of a building, and that the temperature difference is 70 F, the following formulae 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 neglected.

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

b = distance if *below* mid-height.

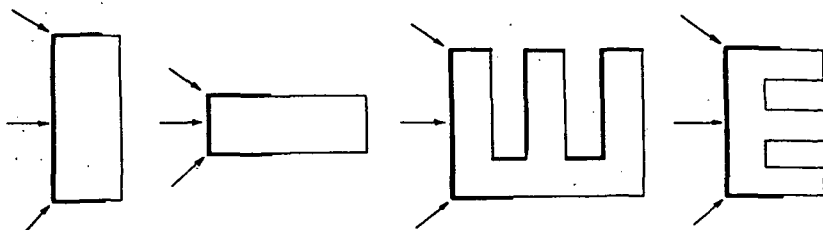


FIG. 8. DIAGRAM SHOWING PART OF PERIMETER OF BUILDING (IN HEAVY OUTLINE) FOR WHICH INFILTRATION IS TO BE FIGURED AT HIGHER RATE ON ACCOUNT OF EXPOSURE TO PREVAILING WINDS

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

Example. If $M = 20$, the equivalent wind velocity at a height of 180 ft from the ground for a building 200 ft high would be

$$M_e = \sqrt{20^2 - 1.75 \times 80} = 16 \text{ mph}$$

For a window on the ground floor:

$$M_e = \sqrt{20^2 + 1.75 \times 100} = 24 \text{ mph}$$

For buildings of unusual height, Equation 1 would indicate negative infiltration at the highest stories which condition may, at times, actually exist, although probably greater wind velocities should be figured at such extremely high levels.

AIR CHANGE METHOD OF ESTIMATING INFILTRATION

The amount of air leakage is sometimes roughly estimated by assuming a certain number of air changes per hour for each room, the number of changes assumed being dependent upon the type, use and location of the room, as indicated in Table 3.

³See *Neutral Zone in Ventilating*, by J. E. Emswiler (A.S.H.V.E. TRANSACTIONS, Vol. 32, 1926).

TABLE 3. AIR CHANGES TAKING PLACE UNDER AVERAGE CONDITIONS EXCLUSIVE OF AIR PROVIDED FOR VENTILATION

KIND OF ROOM OR BUILDING	NUMBER OF AIR CHANGES TAKING PLACE PER HOUR
Rooms, 1 side exposed.....	1
Rooms, 2 sides exposed.....	1½
Rooms, 3 sides exposed.....	2
Rooms, 4 sides exposed.....	2
Rooms with no windows or outside doors.....	½ to ¾
Entrance Halls.....	2 to 3
Reception Halls.....	2
Living Rooms.....	1 to 2
Dining Rooms.....	1 to 2
Bath Rooms.....	2
Drug Stores.....	2 to 3
Clothing Stores.....	1
Churches, Factories, Lofts, etc.....	½ to 3

HEAT REQUIRED FOR WARMING UP AIR ENTERING BY INFILTRATION

Because of the influx of cold air by infiltration, provision must be made for the heat required to warm this air to room temperature. The heat required is given by the following equation:

$$H_i = 0.24 Q d (t - t_o) \quad (3)$$

where

H_i = Btu per hour required for heating air leaking into building from outside temperature t_o to inside temperature, t .

Q = cubic feet of air entering per hour at inside temperature, t .

d = density (pounds per cubic feet) of air at inside temperature, t .

t = inside temperature at the proper level.

t_o = outside air temperature for which heating system is designed.

0.24 = specific heat of air.

It is sufficiently accurate to take $d = 0.075$ lb in which case the equation reduces to

$$H_i = 0.018 Q (t - t_o) \quad (4)$$

While a heating reserve must be provided to warm inleaking air on the windward side of a building, this does not necessarily mean that the heating plant must be provided with a reserve capacity, since the inleaking air, warmed at once by adequate heating surface in exposed rooms, will move transversely and upwardly through the building, thus relieving other radiators of a part of their load. The actual loss of heat of a building caused by infiltration is not to be confused with the necessity for providing additional heating capacity for a given space. Infiltration is a disturbing factor in the heating of a building, and its maximum effect (maximum in the sense of an average of wind velocity peaks during the heating season, above some reasonably chosen minimum) must be met