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.

HEAT EQUIVALENT OF AIR ENTERING BY INFILTRATION

The heat required to warm cold, outside air, which enters a room by infiltration, to the temperature of the room is given by the following equation:

$$H_i = 0.24\,Q\,d\,(t - t_o) \tag{3}$$

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 foot) 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

$$H_i = 0.018\,Q\,(t - t_o) \tag{4}$$

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 by a properly distributed reserve of heating capacity, which reserve, however, is not in use at all places at the same time, nor in any one place at all times.

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PROBLEMS IN PRACTICE

1 ● What are the causes of infiltration (or exfiltration) and how do they act on a building?

The wind and temperature differences create differences between internal and external pressures which cause air to flow through any openings in the walls.

2 ● Why is it essential to consider this in heating calculations?

The inflowing air displaces inside heated air and must be heated up to the internal temperature.

3 ● Where is it necessary to consider infiltration created by temperature difference?

In tall, single-story buildings and in multi-story buildings where the floors are not adequately isolated.

4 ● Why is the infiltration in a building less than that determined in laboratory tests?

In laboratory tests, the indicated wind velocity is measured by the difference in pressure on the two sides of a single wall, window, or object tested. In a building, an internal back pressure is built up between its walls to a point where outflow on the lee side is equal to inflow on the windward side and this back pressure reduces the actual inflow below that determined in the laboratory for a comparable wind.

5 ● Is heat loss by infiltration through walls of importance?

Only in the case of simple walls or poorly constructed compound walls.

6 ● What measurements are required to calculate the heat loss through double-hung wood windows?

Sash crack (equal to the sash perimeter plus the meeting rail) and frame crack (equal to the frame perimeter).

7 ● What is the basis for selecting the wind velocity and outside temperature to be used in making infiltration calculations?

Weather Bureau records. The wind velocity taken is the average during the three coldest months and the temperature used is the lowest on record for the given locality.

8 ● How does the temperature difference influence the heat loss in a tall building?

The chimney effect caused by the temperature difference operates to produce a head that will add to the effect of the wind at lower levels and subtract from it at higher levels.

9 ● For a wind velocity of 15 mph and a building 180 ft high, calculate the effective wind velocity at the ground floor and at a height of 150 ft.

a. At the ground floor the effective wind velocity would be

$$M_e = \sqrt{15^2 + 1.75 \times 90} = 19.6 \text{ mph}$$