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:

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

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

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

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 ● Why is it important in exterior walls of air space construction to place a wind stop in the outer surface?

During the heating season, air within the space is at a higher temperature than outdoor air. If cracks are present in the outer surface, a chimney action takes place which causes a continuous change of air in the space. This causes a greater heat loss through the inner wall surface for two reasons: (1) the temperature difference becomes greater and (2) the surface coefficient on the air space side is increased because of the higher air velocity. Another undesirable condition resulting from this leakage is a lowered temperature of the inside surface. The increased radiation from occupants to walls caused by this condition must be offset by higher air temperatures.

The wind stop in the outer wall surface is therefore important because:

a. It reduces the loss of heat through the wall.

b. It helps to maintain a high inner wall surface temperature.

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.