h_i = film coefficient of heat transfer between fluid and internal coil surface, Btu per (hour) (square foot internal surface) (Fahrenheit degree mean temperature between fluid and surface).

k = conductivity of pipe or tube material, Btu (square foot) (hour) (Fahrenheit degree per inch thickness).

L = thickness of tube wall, inches.

MTD = abbreviation—mean temperature difference between fluid in coil and air passing over coil, Fahrenheit degrees.
NOTE: MTD—usually logarithmic mean.

MTD_a = logarithmic mean temperature difference between air and coil surface.

N = number of rows of coil depth.

n = a constant, exponent of G in Equation 8, obtained by plotting, on logarithmic coordinates, G against values of h_a. The value of n is the slope of the line.

q_s = sensible heat transferred, Btu per (hour) (square foot of coil face area).

q_t = total heat transferred by coil, Btu per (hour) (square foot of face area).

R = ratio between external and internal surface of tube.

t = average water temperature, Fahrenheit degrees.

t_1 = dry-bulb temperature of air entering coil, Fahrenheit degrees.

t_2 = dry-bulb temperature of air leaving coil, Fahrenheit degrees.

t_a = minimum dry-bulb temperature possible without dehumidification, Fahrenheit degrees.

t_{dp1} = dew-point of air entering coil, Fahrenheit degrees.

t_{dp2} = dew-point of air leaving coil, Fahrenheit degrees.

t_r = average refrigerant temperature, Fahrenheit degrees.

t_s = average temperature of external surface of coil, Fahrenheit degrees.

$\Delta t = t_s - t_r$.

U = over-all coefficient of heat transfer, Btu per (hour) (square foot of external coil surface) (Fahrenheit degrees temperature difference between fluid in coil and air flowing over coil).

V = water velocity, feet per second.

Z = a constant for use in Equation 8 obtained by plotting on logarithmic coordinates G against values of h_a.

NOTE: Numerical subscripts refer to condition entering and leaving respectively.

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CHAPTER 8

AIR LEAKAGE

Causes of Infiltration, Infiltration Due to Wind Pressure, Infiltration Through Walls, Window and Door Leakage, Crack Method, Air Change Method, Infiltration Due to Temperature Difference, Sealing of Vertical Openings

THE air leakage which takes place through various apertures in buildings must be considered in heating and cooling calculations, and properly evaluated. This *infiltration* as it is sometimes designated takes place through cracks around doors and windows, through solid walls and through fireplaces and chimneys. Although the latter sources of leakage may be considerable, they are often neglected on the assumption that dampers would be closed during periods of extreme cold weather or else that the fireplace will be in use at such times and will therefore contribute to the heat supplied and lessen the heating load.

CAUSES OF INFILTRATION

The displacement of heated air in buildings by unheated outside air is due to two causes, namely, (1) the pressure exerted by the wind and (2) the difference in density of outside and inside air because of differences in temperature. The former is generally referred to as *infiltration* and the latter as *stack* or *chimney effect*.

In either case an exact estimate of the amount of infiltration under design conditions is difficult to make. The complicating factors include (1) variations in building construction particularly as to width of crack or size of openings through which air leakage takes place, (2) the variations in wind velocity and direction, (3) the exposure of the building with respect to air leakage openings and with respect to adjoining buildings, (4) the variations in outside temperatures which influence the chimney effect, (5) the relative area and resistance of openings on the windward and leeward sides and on the lower floors and on the upper floors, and (6) the influence of a planned air supply and the related outlet vents. Tight construction is essential for preventing large heat loss due to infiltration.

INFILTRATION DUE TO WIND PRESSURE

The wind causes a pressure to be exerted on one or two sides of a building. As a result, air comes into the building on the windward side through cracks or porous construction, and a similar quantity of air leaves on the leeward side through like openings. In general the resistance to air movement is similar on the windward to that on the leeward side. This causes a building up of pressure within the building and a lesser air leakage than that experienced in single wall tests as determined in the laboratory. It is assumed that actual building leakages, owing to this building up of pressure, will be 80 per cent of laboratory test values. While there are cases where this is not true, tests in actual buildings substantiate the factor for the general case. Mechanical ventilating systems are frequently designed to produce positive or negative pressures in an enclosure which are greater or lower than prevalent wind pressures. In such designs, if the rate at which air is specified to be introduced to or removed from the enclosure by posi-