U = coefficient of transmission, air to air, Btu per (hour) (square foot) (Fahrenheit degree temperature difference) (Chapter 9).

t_i = indoor temperature near surface involved (this may not necessarily be the so-called breathing line temperature), Fahrenheit degrees.

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

Example 4: Calculate the transmission loss through an 8 in. brick wall having an area of 150 sq ft, if the inside temperature t_i is 70 F and the outside temperature t_o is − 10 F.

Solution: The coefficient of transmission (U) of a plain 8 in. brick wall is 0.41 (Chapter 9, Table 8). The area (A) is 150 sq ft. Substituting in Equation 4:

$$H_t = 150 \times 0.41 \times [70 - (-10)] = 49200 \text{ Btu per hour.}$$

TABLE 6. FLOOR HEAT LOSS TO BE USED WHEN WARM-AIR PERIMETER HEATING DUCTS ARE EMBEDDED IN SLAB[a]
Btu per (hour) (linear foot of heated edge)

Outdoor Design Temperature, F	Edge Insulation		
	1-in. Vertical Extending Down 18 in. Below Floor Surface	1-in. L-Type Extending at Least 12 in. Deep and 12 in. Under	2-in. L-Type Extending at Least 12 in. Down and 12 in. Under
−20	105	100	85
−10	95	90	75
0	85	80	65
10	75	70	55
20	62	57	45

[a] Factors include loss downward through inner area of slab.

Transmission Loss Through Ceilings and Roofs

The transmission heat loss through top floor ceilings, attics, and roofs may be estimated by either of two methods:

1. By substituting in Equation 4 the ceiling area A, the inside-outside temperature difference ($t_i - t_o$) and the proper value of U:

   a. *Flat roofs*. Select the coefficient of transmission of the ceiling and roof from Tables 11 to 14, Chapter 9, or use appropriate coefficients in Equation 1 if side walls extend appreciably above the ceiling of the floor below.

   b. *Pitched roofs*. Select the combined roof and ceiling coefficient from Table 15, Chapter 9 or calculate the combined roof and ceiling coefficient by means of Equations 4 and 5, Chapter 9, where these formulas are applicable as explained in Chapter 9.

2. By estimating the attic temperature (based on the inside and outside design temperatures) by means of Equation 1, and substituting for t_o in Equation 4, the value of t_a thus obtained, together with the ceiling area A and the ceiling coefficient U. This applies to *pitched roofs*. In the case of *flat roofs* it is not necessary to calculate the attic temperatures, as the ceiling-roof heat loss can be determined as suggested in paragraph 1a.

INFILTRATION HEAT LOSS

The infiltration heat loss includes (1) the *sensible heat loss* or the heat required to warm the outside air entering by infiltration, and (2) the *latent heat loss* or the heat equivalent of any moisture which must be added.

Sensible Heat Loss

The formula for the heat required to warm the outside air which enters a room by infiltration to the temperature of the room, is given in Equation 5:

$$H_s = 0.240\ Qd\ (t_i - t_o) \quad (5)$$

where

H_s = heat required to raise temperature of air leaking into building from t_o to t_i, Btu per hour.

0.240 = specific heat of air.

Q = volume of outdoor air entering building, cubic feet per hour (see Chapter 11).

d = density of air at temperature t_o, pounds per cubic foot.

It is sufficiently accurate to use $d = 0.075$ in which case Equation 5 reduces to

$$H_s = 0.018\ Q\ (t_i - t_o) \quad (5a)$$

The volume Q of outside air entering per hour depends on the wind velocity and direction, the width of crack or size of openings, the type of openings and other factors, as explained in Chapter 11. Where the crack method is used for estimating leakage, it is more convenient to express the air leakage heat loss in terms of the crack length:

$$H_s = B\ L\ (t_i - t_o) \quad (5b)$$

where

B = air leakage per (hour) (foot of crack) (Chapter 11) for the wind velocity and type of windows or door crack involved, multiplied by 0.018.

L = length of window or door crack to be taken into consideration, feet.

Example 5: What is the infiltration heat loss per hour through the crack of a 3 x 5 ft average, double-hung, non-weatherstripped, wood window, based on a wind velocity of 15 mph? Assume inside and outside temperatures to be 70 F and zero, respectively.

Solution: According to Table 2, Chapter 11, the air leakage through a window of this type (based on $\frac{1}{16}$ in. crack and $\frac{3}{64}$ in. clearance) is 39 cu ft per (ft of crack) (hour). Therefore, $B = 39 \times 0.018 = 0.70$. The length of crack L is $(2 \times 5) + (3 \times 3)$, or 19 ft; $t_i = 70$ and $t_o = 0$. Substituting in Equation 5b,

$$H_s = 0.70 \times 19 \times (70 - 0) = 931 \text{ Btu per hour.}$$

Crack Length to be Used for Computations

For designers who prefer to use the crack method, the basis of calculation is as follows: The amount of crack used for computing the infiltration heat loss should be not less than half of the total length of crack in the outside walls of the room. For a building having no partitions, air entering through the cracks on the windward side must leave through the cracks on the leeward side. Therefore, take one-half the total crack for computing each side and end of the building. In a room with one exposed wall, take all the crack; with two exposed walls, take the wall having the