The Hot Box test value, from *University of Minnesota*, for this wall, corrected for a 15 mph wind velocity, was $U = 0.150$ Btu per (hr) (sq ft) (F deg). The error between the calculated and test values would be

$$\frac{0.153 - 0.150}{0.150} \times 100 = 2 \text{ percent.}$$

If the effect of the tie rods were omitted from the calculations, the overall U value would be 0.103. Although the percentage of area occupied by the tie rods per square foot of wall area is $\frac{0.00048}{1.0} \times 100 = 0.048$ percent, the error between the calculated and test values would be

$$\frac{0.150 - 0.103}{0.150} \times 100 = 31 \text{ percent.}$$

In making the calculations for values of U shown in Tables 6 to 19, the following conditions have been assumed:

Equilibrium or steady-state heat transfer, eliminating effects of heat capacity.
Surrounding surfaces at ambient air temperatures.
Exterior wind velocity of 15 mph.
Surface emissivity of ordinary building materials = 0.83.
No correction for position or direction of heat flow. (Average coefficients used).
Air spaces are ¾ in. or more in width.
Variation of conductivity with mean temperature neglected.
Corrections for framing made on basis of parallel heat flow through 2 × 4 in. (nominal) studs, 16 in. on centers, the framing covering 15 percent of wall area.
Actual thicknesses of lumber assumed to be as follows:

Nominal	*Actual*	*Nominal*	*Actual*
1 in. (S-2-S)	¾ in.	3 in. (S-2-S)	2½ in.
1¼ in. (S-2-S)	1 1/16 in.	4 in. (S-2-S)	3½ in.
2 in. (S-2-S)	1½ in.	Finish flooring, (maple or oak)	13/16 in.
2½ in. (S-2-S)	2⅛ in.		

Coefficients for frame construction are corrected for the effect of framing where such correction would increase the coefficients, but not where the correction would decrease the coefficients.[11]

It should be noted that the effects of poor workmanship in construction and installation have an increasingly greater percentage effect on heat transmission as the coefficient becomes numerically smaller. Failure to meet design estimates may be caused by lack of proper attention to exact compliance with specifications. A factor of safety may be employed as a precaution when it is judged desirable.

Roof Coefficients

Computations for wood shingle roofs applied over wood stripping are based on 1 by 4 in. wood strips, spaced 2 in. apart. Values for roofs containing Spanish and French clay roofing tile are assumed the same as for slate roofs. Values for pitched roofs in Table 17 apply where the roof is over a heated attic or top floor, so that the heat passes directly through the roof structure, including any interior finish material.

Combined Ceiling and Roof Coefficients

If the attic space between the ceiling and roof is unheated, the combined coefficient from room air below the ceiling to exterior air can be calculated from the following formula:

$$R_T = \frac{1}{U_{ce}} + \frac{1}{nU_r} \tag{4}$$

and

$$U = 1/R_T \tag{5}$$

where U = combined coefficient to be used with ceiling area.
R_T = total resistance of ceiling and roof.
U_{ce} = coefficient of transmission of ceiling.
U_r = coefficient of transmission of roof.
n = ratio of roof area to ceiling area.

It should be noted that the overall coefficient U should be multiplied by the ceiling area to determine heat loss, and not by the roof area. Values of U_r and U_{ce} should be calculated using a value of 2.2 (the reciprocal of one-half the air space resistance) rather than 1.65 for the conductances of surfaces facing the attic, since the attic is equivalent to an air space.

If the attic contains windows, dormers and vertical wall spaces, and if their area is small compared to that of the roof, they may be considered part of the roof area. For accuracy, the sum of the coefficients of each individual section, multiplied by its percentage of the total area, should be used as U_r. Where attic wall areas are large, it is preferable to estimate the attic temperature as illustrated in Chapter 11, and calculate the heat loss through the ceiling by multiplying the value of U_{ce} for the ceiling by the difference in temperature above and below the ceiling.

Basement Floor, Basement Wall and Concrete Slab Floor Coefficients

The heat transfer through basement walls and floors to the ground is dependent on the temperature difference between the air within and that of the ground, on the material constituting the wall or floor, and on the conductivity of the surrounding earth. The conductivity of the earth will vary with local conditions, and is usually unknown. Tests[12] at the A.S.H.V.E. Relearch Laboratory indicate a heat flow of approximately 2.0 Btu per (hr) (sq ft) through an uninsulated contrete basement floor, with a temperature difference of 20 F between ground temperature and the air temperature 6 in. above the floor. Based on this result a coefficient of 0.10 Btu per (hr) (sq ft) (Fahrenheit degree difference) is recommended for calculation where it is desirable to allow for the small basement floor heat loss, *e.g.*, for heated basements.

For basement walls the same coefficient may be used, but due to closer proximity to the surface of the ground, the temperature difference for winter design conditions will be greater than for the floor. The test results indicate a unit area heat loss, at mid-height of the basement wall approximately twice that of the same floor area.

For concrete slab floors laid in contact with the ground at grade level, recent tests[13] indicate that for small floor areas (equal to that of a house 25 feet square) the heat loss may be calculated as proportional to the length of exposed edge rather than total area. This amounts to 0.81 Btu per (hr) (lineal foot of exposed edge) (Fahrenheit degree difference between the inside air temperature and the average outside air temperature). It should be noted that this may be appreciably reduced by insulating under the ground slab, and also along the edges between the floor and the abutting walls. See also sections on Basement Temperatures and Heat Loss, and on Floor Heat Loss in Basementless Houses, in Chapter 11.