TABLE 16. DETERMINATION OF U VALUE RESULTING FROM ADDITION OF INSULATION TO UNINSULATED BUILDING SECTIONS (*Concluded*)
(*For use with Tables 13A and 13B*).

PART E. FLAT ROOFS AND CEILINGS WITH ROOF DECK

U VALUE OF ROOF WITHOUT ROOF-DECK INSULATION[a]	CONDUCTANCE C OF ROOF-DECK INSULATION					
	0.12	0.15	0.19	0.24	0.36	0.72
	U	U	U	U	U	U
0.10	0.05	0.06	0.07	0.07	0.08	0.09
0.15	0.07	0.08	0.08	0.09	0.11	0.12
0.20	0.08	0.09	0.10	0.11	0.13	0.16
0.25	0.08	0.09	0.11	0.12	0.15	0.19
0.30	0.09	0.10	0.12	0.13	0.16	0.21
0.35	0.09	0.10	0.12	0.14	0.18	0.24
0.40	0.09	0.11	0.13	0.15	0.19	0.26
0.50	0.10	0.12	0.14	0.16	0.21	0.29
0.60	0.10	0.12	0.14	0.17	0.22	0.33
0.70	0.10	0.12	0.15	0.18	0.24	0.35

[a] Interpolation or mild extrapolation may be used.

Example 4: Consider the floor-ceiling construction shown in the example at the top of Table 11, insulated with a sheet of aluminum foil, or paper faced on both sides with foil, (effective emissivity (E) of air space = 0.05) placed between the joists and dividing the air space into two equal spaces. From Table 11, the U value for the uninsulated construction is 0.18 for heat flow down for summer, and 0.23 for heat flow up for winter. Determine the coefficient U_i for:

(a) Heat flowing downward from uncooled room above to cooled space below (a summer condition) and,

(b) Heat flowing upward from heated room below to unheated space above (a winter condition).

Solution:

(a) Use Table 16 Part D, and corresponding to $U = 0.18$ in Column 1 find, in Column 11, $U_i = 0.049$. Use 0.05.

(b) Use Table 16 Part C, and corresponding to $U = 0.23$ in Column 1 find, in Column 11, $U_i = 0.124$, (by interpolation). Use 0.12.

Special Uses of Table 16

Values of U_i for insulating applications or combinations other than those indicated by the headings of Columns 2 to 14 of Table 16 can be ascertained if the table is used appropriately. For instance, going horizontally in the table from Column 2 to Column 3 is equivalent to adding ½ in. of fibrous insulation to the construction. Similarly, going from Column 2 to Column 4 adds 1½ in. of fibrous insulation to the construction. In the same way, going horizontally from Column 8 to Column 11 is equivalent to adding to a construction the insulating value of one additional highly reflective (E = 0.05) air space, and going from Column 6 to Column 12 in effect adds two non-reflective (E = 0.82) air spaces to the construction, etc.

Examples 5 and *6* show the combinational use of Table 16.

Example 5: Determine the coefficient U_i for the wall of *Example 3*, with 1½ in. of fibrous insulation added on one side of the air space.

Solution: U_i can be determined in several ways, by using Table 16 Part A, for example:

(a) By going from Column 1 to Column 2 three times, for a total of 1½ inches of insulation, as follows: enter Column 1 at 0.24 and find $U_i = 0.166$ in Column 2; enter Column 1 at 0.166 and find $U_i = 0.126$ in Column 2; enter Column 1 at 0.126 and find $U_i = 0.102$ in Column 2. Therefore, for a total of 1½ in. of insulation, use 0.10.

(b) Move simply, by going from 0.24 in Column 2 to 0.103 in Column 4. Use 0.10.

Example 6: Considering again the wall of *Example 3*, assume that one-inch blanket insulation is to be installed in mid-space, leaving equal air spaces on the two sides. The coefficient U_i is desired for two cases in which

(a) the blanket has non-reflective surfaces on both sides, so that both air spaces are non-reflective (E = 0.82) and,

(b) the blanket has one highly reflective surface, so that one of the air spaces is highly reflective (E = 0.05).

Solution:

(a) In Table 16 Part A, when U without added insulation is 0.24, U_i for one inch of fibrous insulation and one non-reflective air space, is 0.127 in Column 3. To add the second non-reflective air space, enter Column 6 at 0.127, and by interpolating find $U_i = 0.112$ in Column 9. Use 0.11.

(b) U_i for one inch of fibrous insulation and one non-reflective air space is 0.127 as in (a). To add one E = 0.05 air space, enter Column 8 at 0.127 and by interpolating find $U_i = 0.092$ in Column 11. Use 0.09.

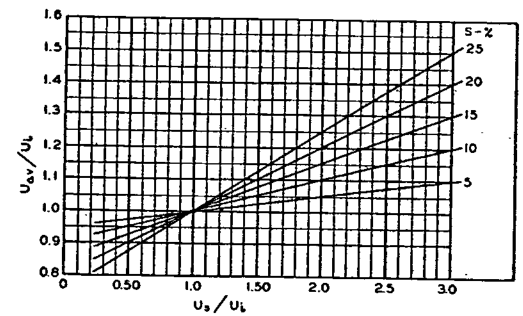

FIG. 6. CORRECTION FOR EFFECT OF FRAMING IN INSULATED BUILDING SECTIONS

U_{av} = average U value for building section.
U_i = U value for area between framing members.
U_s = U value for area backed by framing members.
S = Percentage of area backed by framing members.

CORRECTION FOR FRAMING

Correction for parallel heat flow through framing and insulated areas may be made by use of Fig. 6. Correction for the effect of framing should be applied after final U_i and U_s values have been obtained for a given construction. In many cases this correction may be omitted.

Example 7: Consider a frame wall with 2-in. blanket insulation which has a U_i value of 0.08. By calculation it is found that heat loss from the area backed by framing members (U_s) is 0.13. U_s/U_i is 1.63. From Fig. 6 if 15 percent of wall area is backed by framing, the value $U_{av}/U_i = 1.1$. U_{av} is therefore $1.1 \times 0.08 = 0.088$.

Combined Ceiling and Roof Coefficients

If the attic space between the ceiling and roof is unheated and *not ventilated*, the combined coefficient from room air below the ceiling to exterior air can be calculated from the following formula:

$$R_T = \frac{1}{U_{ce}} + \frac{1}{nU_r} \qquad (4)$$

The combined coefficient U is the reciprocal of R_T, or