Table 4 .... Conductivities, Conductances, and Resistances of Building and Insulating Materials (*Continued*)
(Design Values)[a]

Material	Description	Density (Lb per Cu Ft)	Mean Temp F	Conductivity (k)	Conductance (C)	Resistance[b] (R) Per inch thickness (1/k)	Resistance[b] (R) For thickness listed (1/C)
MASONRY MATERIALS CONCRETES	Cement mortar	116		5.0	—	*0.20*	—
	Gypsum-fiber concrete 87½% gypsum, 12½% wood chips	51		1.66	—	*0.60*	—
	Lightweight aggregates including expanded shale, clay or slate; expanded slags; cinders; pumice; perlite; vermiculite; also cellular concretes	120		5.2	—	*0.19*	—
		100		3.6	—	*0.28*	—
		80		2.5	—	*0.40*	—
		60		1.7	—	*0.59*	—
		40		1.15	—	*0.88*	—
		30		0.90	—	*1.11*	—
	Sand and gravel or stone aggregate (oven dried)	20		0.70	—	*1.43*	—
	Sand and gravel or stone aggregate (not dried)	140		9.0	—	*0.11*	—
	Stucco	140		12.0	—	*0.08*	—
		116		5.0	—	*0.20*	—
MASONRY UNITS	Brick, common[c]	120	75	5.0	—	*0.20*	—
	Brick, face[c]	130	75	9.0	—	*0.11*	—
	Clay tile, hollow:						
	1 cell deep 3 in.	—	75	—	1.25	—	*0.80*
	1 cell deep 4 in.	—	75	—	0.90	—	*1.11*
	2 cells deep 6 in.	—	75	—	0.66	—	*1.52*
	2 cells deep 8 in.	—	75	—	0.54	—	*1.85*
	2 cells deep 10 in.	—	75	—	0.45	—	*2.22*
	3 cells deep 12 in.	—	75	—	0.40	—	*2.50*
	Concrete blocks, three oval core:						
	Sand and gravel aggregate 4 in.	—	75	—	1.40	—	*0.71*
	8 in.	—	75	—	0.90	—	*1.11*
	12 in.	—	75	—	0.78	—	*1.28*
	Cinder aggregate 3 in.	—	75	—	1.16	—	*0.86*
	4 in.	—	75	—	0.90	—	*1.11*
	8 in.	—	75	—	0.58	—	*1.72*
	12 in.	—	75	—	0.53	—	*1.89*
	Lightweight aggregate (expanded shale, clay, slate or slag; pumice) 3 in.	—	75	—	0.79	—	*1.27*
	4 in.	—	75	—	0.67	—	*1.50*
	8 in.	—	75	—	0.50	—	*2.00*
	12 in.	—	75	—	0.44	—	*2.27*
	Concrete blocks, rectangular core.[j]						
	Sand and gravel aggregate						
	2 core, 8 in. 36 lb.[k]	—	45	—	0.96	—	*1.04*
	same with filled cores[l]	—	45	—	0.52	—	*1.93*
	Lightweight aggregate (expanded shale, clay, slate or slag, pumice):						
	3 core, 6 in. 19 lb.[k]	—	45	—	0.61	—	*1.65*
	Same with filled cores[l]	—	45	—	0.33	—	*2.99*
	2 core, 8 in. 24 lb.[k]	—	45	—	0.46	—	*2.18*
	Same with filled cores[l]	—	45	—	0.20	—	*5.03*
	3 core, 12 in. 38 lb.[k]	—	45	—	0.40	—	*2.48*
	Same with filled cores[l]	—	45	—	0.17	—	*5.88*
	Stone, lime or sand	—	75	12.50	—	*0.08*	—
	Gypsum partition tile:						
	3 × 12 × 30 in. solid	—	75	—	0.79	—	*1.26*
	3 × 12 × 30 in. 4-cell	—	75	—	0.74	—	*1.35*
	4 × 12 × 30 in. 3-cell	—	75	—	0.60	—	*1.67*
METALS	(See Chapter 4, Table 2)						
PLASTERING MATERIALS	Cement plaster, sand aggregate	116	75	5.0	—	*0.20*	—
	Sand aggregate ½ in.	—	75	—	10.00	—	*0.10*
	Sand aggregate ¾ in.	—	75	—	6.66	—	*0.15*
	Gypsum plaster:						
	Lightweight aggregate ½ in.	45	75	—	3.12	—	*0.32*
	Lightweight aggregate ¾ in.	45	75	—	2.67	—	*0.39*
	Lightweight agg. on metal lath ¾ in.	—	75	—	2.13	—	*0.47*
	Perlite aggregate	45	75	1.5	—	*0.67*	—
	Sand aggregate	105	75	5.6	—	*0.18*	—
	Sand aggregate ½ in.	105	75	—	11.10	—	*0.09*
	Sand aggregate ¾ in.	105	75	—	9.10	—	*0.11*
	Sand aggregate on metal lath ¾ in.	—	75	—	7.70	—	*0.1*
	Sand aggregate on wood lath	—	75	—	2.50	—	*0.40*
	Vermiculite aggregate	45	75	1.7	—	*0.59*	—
ROOFING	Asbestos-cement shingles	120	75	—	4.76	—	*0.21*
	Asphalt roll roofing	70	75	—	6.50	—	*0.15*
	Asphalt shingles	70	75	—	2.27	—	*0.44*

Table 4 .... Conductivities, Conductances, and Resistances of Building and Insulating Materials (*Concluded*)
(Design Values)[a]

Material	Description	Density (Lb per Cu Ft)	Mean Temp F	Conductivity (k)	Conductance (C)	Resistance[b] (R) Per inch thickness (1/k)	Resistance[b] (R) For thickness listed (1/C)
ROOFING (*Continued*)	Built-up roofing ⅜ in.	70	75	—	3.00	—	*0.33*
	Slate ½ in.	—	75	—	20.00	—	*0.05*
	Wood shingles	—	75	—	1.06	—	*0.94*
SIDING MATERIALS (ON FLAT SURFACE)	Shingles						
	Asbestos-cement	120	75	—	4.76	—	*0.21*
	Wood, 16 in. 7½ in. exposure	—	75	—	1.15	—	*0.87*
	Wood, double, 16-in., 12-in. exposure	—	75	—	0.84	—	*1.19*
	Wood, plus insul. backer board ¼ in.	—	75	—	0.71	—	*1.40*
	Siding						
	Asbestos-cement, ¼ in., lapped	—	75	—	4.76	—	*0.21*
	Asphalt roll siding	—	75	—	6.50	—	*0.15*
	Asphalt insulating siding (½ in. bd.)	—	75	—	0.69	—	*1.46*
	Wood, drop, 1 × 8 in.	—	75	—	1.27	—	*0.79*
	Wood, bevel, ½ × 8 in., lapped	—	75	—	1.23	—	*0.81*
	Wood, bevel, ½ × 10 in., lapped	—	75	—	0.95	—	*1.05*
	Wood, plywood, ⅜ in., lapped	—	75	—	1.59	—	*0.59*
	Structural glass	—	75	—	10.00	—	*0.10*
WOODS	Maple, oak, and similar hardwoods	45	75	1.10	—	*0.91*	—
	Fir, pine, and similar softwoods	32	75	0.80	—	*1.25*	—
	Fir, pine, and similar softwoods ¾ in.	32	75	—	1.02	—	*0.98*
	1½ in.	32	75	—	0.49	—	*2.05*
	2½ in.	32	75	—	0.30	—	*3.28*
	3½ in.	32	75	—	0.22	—	*4.55*

Notes for Table 4

[a] Representative values for dry materials is selected by the ASHRAE Technical Committee 2.4 on Insulation. They are intended as design (not specification) values for materials of building construction in normal use. For conductivity of a particular product, the user may obtain the value supplied by the manufacturer or secure the results of unbiased tests.

[b] Resistance values are the reciprocals of *C* before rounding *C* off to two decimal places.

[c] See also Insulating Materials, Board.

[d] Includes paper backing and facing if any. In cases where the insulation forms a boundary (highly reflective or otherwise) of an air space, refer to Table 2, Section B and Table 3, to obtain the insulating value of the air space for the appropriate effective emissivity and temperature conditions of the space.

[e] Conductivity varies also with fiber diameter. See also Factors Affecting Thermal Conductivity and Fig. 1, Chapter 22, pp. 382-383.

[f] These are values for aged board stock. For discussion on the change in conductivity with age of Refrigerant 11 expanded urethane see Chapter 22, Factors Affecting Thermal Conductivity pp. 382.

[g] Insulating values of acoustical tile vary depending on density of the board and on the type, size, and depth of the perforations. An average conductivity *k* value is 0.42.

[h] The U. S. Department of Commerce, *Simplified Practice Recommendation for Thermal Conductances Factors for Preformed Above-Deck Roof Insulation*, No. R 257-55, recognizes the specification of roof insulation on the basis of the *C* values shown. Roof insulation is made in thicknesses to meet these values. Therefore, thickness supplied by different manufacturers may vary depending on the conductivity *k* value of the particular material.

[i] Face brick and common brick do not always have these specific densities. When the density is different from that shown, there will be a change in the thermal conductivity.

[j] Data on rectangular core concrete blocks differs from the above data on oval core blocks due to core configuration, different mean temperatures and possibly differences in unit weights. Weight data on the oval core blocks tested is not available.

[k] Weights of units approximately 7⅝ in. high and 15½ in. long. These weights are given as a means of describing the blocks tested, but conductance values are all for one square foot of area.

[l] Vermiculite, perlite or mineral wool insulation. Where insulation is used vapor barriers or other precautions must be considered to keep insulation dry.

(*Continued from p. 425*)

and Structures Report BMS 151, National Bureau of Standards. In order to provide a reasonable factor of safety to account for departures of constructions from requirements and practices, some may wish, to moderately increase the calculated *U* values of the insulated walls, floors, and ceiling sections obtained from Table 16 before making corrections for framing (as indicated in Fig. 4). Where reflective air spaces are involved in building construction, and their thermal resistance values constitute a major share of the installed resistance of the insulation, increases of *U* values up to 10 percent for applications where heat flow is horizontal or upward, and up to 20 percent where heat flow is downward, appear reasonable, on the basis of present information.

INSULATED CONSTRUCTIONS—HOW TO USE TABLE 16

In Tables 5 through 15, *U* values are given for many common types of building wall, floor, and ceiling constructions. For any of these constructions that contain an air space, the tabulated *U* value is based on the assumption that the air space is empty, and that its surfaces are of ordinary building materials of low thermal reflectivity, such as wood, masonry, plaster, or paper. Considerable benefit in reducing the heat transmission coefficient of a construction can be effected by the application of thermal insulating materials in the air space.

Table 16 provides a means of determining, without calculation, the *U* value of the between-framing area of this type of construction with the added insulation installed in the air space. Column 1 of Table 16 refers to the *U* values of uninsulated constructions as taken from Tables 5 through 15. Columns 2 to 14 of the table give corresponding coefficients U_i for the constructions with various insulating applications in the between-framing air space, as indicated by the column headings. Table 16 is in 5 parts (A, B, C, D, and E), corresponding to the type of building element and the direction of heat flow. Each part is based on temperature conditions generally considered appropriate for the case.

Any and all *U* values are based on a series of assumptions as to nominal characteristics. Common variations in conditions, materials, workmanship, etc., can introduce much greater variations in *U* values than the variations resulting