

the value of U for a 1-in. yellow pine floor (actual thickness, 25/32 in.) placed directly on 6-in. concrete on the ground, is determined as follows:

$$U = \frac{1}{\frac{1}{1.65} + \frac{0.781}{0.80} + \frac{6.0}{12.0}} = 0.48 \text{ Btu per hour per square foot per degree difference}$$

in temperature between the ground and the air immediately above the floor.

Rigid insulation refers to so-called insulating board which may be used structurally, such as for sheathing. Flexible insulation refers to the blankets, quilts or semi-rigid types of insulation.

Actual thicknesses of lumber are used in the computations rather than nominal thicknesses. The computations for wood shingle roofs applied over wood stripping are based on 1 by 4 in. wood strips, spaced 2 in. apart. Since no reliable figures are available concerning the conductivity of Spanish and French clay roofing tile, of which there are many varieties, the figures for such types of roofs were taken the same as for slate roofs, as it is probable that the values of U for these two types of roofs will compare favorably.

The thicknesses upon which the coefficients in Tables 3 to 13 inclusive, are based are as follows:

Brick veneer.....	4 in.
Plaster and metal lath.....	3/4 in.
Plaster (on wood lath, plasterboard, rigid insulation, board form, or corkboard).....	1/2 in.
Slate (roofing).....	1/2 in.
Stucco on wire mesh reinforcing.....	1 in.
Tar and gravel or slag-surfaced built-up roofing.....	3/8 in.
1-in. lumber (S-2-S).....	2 3/4 in.
1 1/2-in. lumber (S-2-S).....	1 3/4 in.
2-in. lumber (S-2-S).....	1 5/8 in.
2 1/2-in. lumber (S-2-S).....	2 1/8 in.
3-in. lumber (S-2-S).....	2 3/8 in.
4-in. lumber (S-2-S).....	3 3/8 in.
Finish flooring (maple or oak).....	1 3/16 in.

Solid brick walls are based on 4 in. hard brick (high density) and the remainder common brick (low density). Stucco is assumed to be 1 in. thick on masonry walls. Where metal lath and plaster are specified, the metal lath is neglected.

The coefficients of transmission of the pitched roofs in Table 12 apply where the roof is over a heated attic or top floor so the heat passes directly through the roof structure including whatever finish is applied to the underside of the roof rafters.

It is the practice of many engineers in calculating heat losses to allow for possible defects in workmanship, poor construction and other factors which would diminish the efficiency of the insulation. The lower the theoretical wall or roof coefficient the greater will be the percentage of error due to construction defects.

Combined Coefficients of Transmission

If the attic is unheated, the roof structure and ceiling of the top floor must both be taken into consideration, and the combined coefficient of transmission determined. The formula for calculating the combined

TABLE 2. CONDUCTIVITIES (k) AND CONDUCTANCES (C) OF BUILDING MATERIALS AND INSULATORS^a

The coefficients are expressed in Btu per hour per square foot per degree Fahrenheit per 1 in. thickness unless otherwise indicated.

Material	Description	Density (lb per cu ft)	Mean Temp (deg Fahr)	Conductivity (k) OR Conductance (C)	Resistance ($1/k$) OR Resistance ($1/C$)	Authority
MASONRY MATERIALS						
Brick	Low density.....	---	---	5.00*	0.20	---
	High density.....	---	---	9.20*	0.11	---
Brickwork	Adobe.....	---	---	3.56*	0.28	---
	Damp or wet.....	---	---	5.00*	0.20	(2)
Cement Mortar	Typical.....	---	---	12.00*	0.08	---
	Typical.....	---	---	12.00*	0.08	---
Concrete	Various ages and mixes ^d	---	---	11.35 to	---	---
	Cellular.....	40.0	75	1.06	0.94	(3)
	Cellular.....	50.0	75	1.44	0.69	(3)
	Cellular.....	60.0	75	1.80	0.56	(3)
	Cellular.....	70.0	75	2.18	0.46	(3)
	Typical fiber gypsum, 87.5% gypsum and 12.5% wood chips.....	51.2	74	1.66*	0.60	(4)
	Special concrete made with an aggregate of hardened clay—1-2-3 mix.....	101.0	70	3.98	0.25	(3)
	Sand and gravel.....	142.0	75	12.6	0.08	(4)
	Limestone.....	132.0	75	10.8	0.09	(4)
	Cinder.....	97.0	75	4.9	0.22	(4)
	Burned clay aggregate.....	75.0	75	4.0	0.25	(4)
	Blast furnace slag aggregate.....	76.0	70	1.6	0.63	(3)
	Expanded vermiculite aggregate.....	20	90	0.68	1.47	(3)
	Expanded vermiculite aggregate.....	26.7	90	0.76	1.32	(3)
	Expanded vermiculite aggregate.....	35	90	0.86	1.16	(3)
	Expanded vermiculite aggregate.....	50	90	1.10	0.91	(3)
Stone	Typical.....	---	---	12.50*	0.08	---
	Typical.....	---	---	12.00*	0.08	---
Stucco	Typical.....	---	---	1.00*	1.00	---
	Typical hollow clay (4 in.).....	---	---	0.64*	1.57	---
Tile	Typical hollow clay (6 in.) ^e	---	---	0.60*	1.67	---
	Typical hollow clay (8 in.) ^e	---	---	0.58*	1.72	---
	Typical hollow clay (10 in.) ^e	---	---	0.40*	2.50	---
	Typical hollow clay (12 in.) ^e	---	---	0.31*	3.23	---
	Typical hollow clay (16 in.) ^e	---	---	1.00†	1.00	(2)
	Hollow clay (2 in.) 1/2-in. plaster both sides.....	120.0	110	0.60†	1.67	(2)
	Hollow clay (4 in.) 1/2-in. plaster both sides.....	127.0	100	0.47†	2.13	(2)
	Hollow clay (6 in.) 1/2-in. plaster both sides.....	124.3	105	0.46†	2.18	---
	Hollow gypsum (4 in.).....	51.8	70	1.66	0.60	(4)
	Solid gypsum.....	75.6	76	2.96	0.34	(4)
Tile or Terrazzo	Typical flooring.....	---	---	12.00*	0.08	---
	Typical flooring.....	---	---	12.00*	0.08	---

AUTHORITIES:

- ¹U. S. Bureau of Standards, tests based on samples submitted by manufacturers.
- ²A. C. Willard, L. C. Lichty, and L. A. Harding, tests conducted at the University of Illinois.
- ³J. C. Peebles, tests conducted at Armour Institute of Technology, based on samples submitted by manufacturers.
- ⁴F. B. Rowley, tests conducted at the University of Minnesota.
- ⁵A.S.H.V.E. Research Laboratory.
- ⁶E. A. Allcut, tests conducted at the University of Toronto.
- ⁷Lees and Charlton.
- ⁸Recommended conductivities and conductances for computing heat transmission coefficients.
- ⁹For thickness stated or used on construction, not per 1 in. thickness.
- ¹⁰For additional conductivity data see A.S.H.V.E. Data Book.
- ¹¹If outside surface of block is painted with an impervious coat of paint, add 0.07 to resistance for sand and gravel blocks. Add 0.18 to resistance for cinder blocks. Add 0.17 to resistance for burned clay aggregate blocks.
- ¹²Recommended value. See Heating, Ventilating and Air Conditioning, by Harding and Willard, revised edition, 1932.
- ¹³See A.S.H.V.E. RESEARCH REPORT No. 915—Conductivity of Concrete, by F. C. Houghton and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 47).
- ¹⁴The 6-in., 8-in., and 10-in. hollow tile figures are based on two cells in the direction of heat flow. The 12-in. hollow tile is based on three cells in the direction of heat flow. The 16-in. hollow tile consists of one 10-in. and one 6-in. tile, each having two cells in the direction of heat flow.
- ¹⁵Not compressed.
- ¹⁶Roofing, 0.15-in. thick (1.34 lb per sq ft), covered with gravel (0.83 lb per sq ft), combined thickness assumed 0.25.