

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:

Brick veneer.....	4 in.
Plaster and metal lath.....	$\frac{3}{4}$ in.
Plaster (on wood lath, plasterboard, rigid insulation, board form, or corkboard).....	$\frac{1}{2}$ in.
Slate (roofing).....	$\frac{1}{2}$ in.
Stucco on wire mesh reinforcing.....	1 in.
Tar and gravel or slag-surfaced built-up roofing.....	$\frac{3}{8}$ in.
1-in. lumber (S-2-S).....	$2\frac{5}{8}$ in.
1½-in. lumber (S-2-S).....	1½ in.
2-in. lumber (S-2-S).....	1½ in.
2½-in. lumber (S-2-S).....	2½ in.
3-in. lumber (S-2-S).....	2½ in.
4-in. lumber (S-2-S).....	3½ in.
Finish flooring (maple or oak).....	1½ 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 use a minimum coefficient of 0.10 to allow for possible defects in workmanship, poor construction and other factors which would increase the heat loss. The lower the theoretical wall or roof coefficient the greater will be the percentage of error due to construction defects or failure of the insulation to perform as rated.

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 coefficient of transmission of a top floor ceiling, unheated attic space, and pitched roof per square foot of ceiling area is:

$$U = \frac{U_r \times U_{ce}}{U_r + \frac{U_{ce}}{n}} \quad (4)$$

where

U = combined coefficient to be used with ceiling area.

U_r = coefficient of transmission of the roof.

U_{ce} = coefficient of transmission of the ceiling.

n = the ratio of the area of the roof to the area of the ceiling.

In selecting the values to be used for U_r and U_{ce} it should be noted

CHAPTER 4. HEAT TRANSMISSION COEFFICIENTS

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)	RESISTIVITY ($\frac{1}{k}$) OR RESISTANCE ($\frac{1}{C}$)	AUTHORITY
MASONRY MATERIALS						
BRICK	Low density.....	---	---	5.00*	0.20	---
	High density.....	---	---	9.20*	0.11	---
BRICKWORK	Adobe.....	---	---	3.56*	0.28	(2)
	Damp or wet.....	---	---	5.00*	0.20	---
CEMENT MORTAR	Typical.....	---	---	12.00*	0.08	---
	Typical.....	---	---	12.00*	0.08	---
CONCRETE	Various ages and mixes ^d	---	---	11.35 to 16.36	---	(5)
	Concrete plank.....	76	75	2.5	4.0	(3)
Cellular	Cellular.....	40.0	75	1.06	0.94	(3)
	Cellular.....	50.0	75	1.44	0.69	(3)
Cellular	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	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	Sand and gravel.....	142.0	75	12.6	0.08	(4)
	Limestone.....	132.0	75	10.8	0.09	(4)
Cinder	Cinder.....	97.0	75	4.9	0.22	(4)
	Burned clay aggregate.....	75.0	75	4.0	0.25	(4)
Blast furnace slag aggregate	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	Expanded vermiculite aggregate.....	26.7	90	0.76	1.32	(3)
	Expanded vermiculite aggregate.....	35	90	0.86	1.16	(3)
Expanded vermiculite aggregate	Expanded vermiculite aggregate.....	50	90	1.10	0.91	(3)
	Typical.....	---	---	12.50*	0.08	---
STONE	Typical.....	---	---	12.00*	0.08	---
STUCCO	Typical.....	---	---	1.00†	1.00	---
TILE	Typical hollow clay (4 in.).....	---	---	0.64†	1.57	---
	Typical hollow clay (6 in.).....	---	---	0.60†	1.67	---
Typical hollow clay (8 in.)	Typical hollow clay (8 in.).....	---	---	0.58†	1.72	---
	Typical hollow clay (10 in.).....	---	---	0.40†	2.50	---
Typical hollow clay (12 in.)	Typical hollow clay (12 in.).....	---	---	0.31†	3.23	---
	Hollow clay (2 in.) ½-in. plaster both sides.....	120.0	110	1.00†	1.00	(2)
Hollow clay (4 in.) ½-in. plaster both sides	Hollow clay (4 in.) ½-in. plaster both sides.....	127.0	100	0.60†	1.67	(2)
	Hollow clay (6 in.) ½-in. plaster both sides.....	124.3	105	0.47†	2.13	(2)
Hollow gypsum (4 in.)	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	Solid gypsum.....	---	---	12.00*	0.08	---
	Typical flooring.....	---	---	---	---	---

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.

*Recommended conductivities and conductances for computing heat transmission coefficients.

†For thickness stated or used on construction, not per 1 in. thickness.

‡For additional conductivity data see A.S.R.E. Data Book.

§If 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.

*Recommended value. See Heating, Ventilating and Air Conditioning, by Harding and Willard, revised edition, 1932.

§See A.S.H.V.E. RESEARCH REPORT No. 915—Conductivity of Concrete, by F. C. Houghten and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 47).

¶The 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.

‡Not compressed.

*Roofing, 0.15-in. thick (1.34 lb per sq ft), covered with gravel (0.83 lb per sq ft), combined thickness assumed 0.25.