properly installed. Besides the thermal conductivity there are such properties as resistance to rot, vermine and fire which should be considered in making comparisons.

Computed Transmission Coefficients

Computed heat transmission coefficients of many common types of building construction are given in Tables 3 to 13, inclusive, each construction being identified by a serial number. For example, the coefficient of transmission (U) of an 8-in. brick wall and ½ in. of plaster is 0.46, and the number assigned to a wall of this construction is *1-B*, Table 3.

Example 1. Calculate the coefficient of transmission (U) of an 8-in. brick wall with ½ in. of plaster applied directly to the interior surface, based on an outside wind exposure of 15 mph. It is assumed that the outside course is of hard (high density) brick having a conductivity of 9.20, and that the inside course is of common (low density) brick having a conductivity of 5.0, the thicknesses each being 4 in. The conductivity of the plaster is assumed to be 3.3, and the inside and outside surface coefficients are assumed to average 1.65 and 6.00, respectively, for still air and a 15 mph wind velocity.

Solution. k (hard high density brick) = 9.20; x = 4.0 in.; k (common low density brick) = 5.0; x = 4.0 in.; k (plaster) = 3.3; x = ½ in.; f_i = 1.65; f_o = 6.0. Therefore

$$U = \frac{1}{\frac{1}{6.0} + \frac{4.0}{9.20} + \frac{4.0}{5.0} + \frac{0.5}{3.3} + \frac{1}{1.65}}$$

$$= \frac{1}{0.167 + 0.435 + 0.80 + 0.152 + 0.606}$$

= 0.46 Btu per hour per square foot per degree Fahrenheit difference in temperature between the air on the two sides.

The coefficients in the tables were determined by calculations similar to those shown in Example 1, using Fundamental Formulae 3, 4 and 5 and the values of k (or C), f_i, f_o and a indicated in Table 2 by asterisks. In computing heat transmission coefficients of floors laid directly on the ground (Table 10), only one surface coefficient (f_i) is used. For example, 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 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 the so-called board form 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.

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 $\left(\frac{1}{k}\right)$ or Resistance $\left(\frac{1}{C}\right)$	Authority
	Cement	Fine Aggregate 0-No. 4	Coarse Aggregate No. 4-½	Slump	Per Cent Voids					
Sand and Gravel, Concrete	1	2.00	2.75	0	11.5	144.7	75.06	13.10	0.08	(4)
	1	2.75	4.50	0	10.9	145.7	74.77	12.90	0.08	(4)
	1	3.50	5.50	0	11.2	144.5	75.00	13.20	0.08	(4)
	1	2.00	2.75	5	13.9	142.5	75.50	12.10	0.08	(4)
	1	2.00	2.75	5	13.9	142.5	74.74	12.40	0.08	(4)
	1	2.75	4.50	5	14.6	141.1	73.30	12.40	0.08	(4)
	1	2.75	4.50	5	14.6	141.1	74.89	12.10	0.08	(4)
	1	3.50	5.50	5	14.7	139.2	74.50	12.85	0.08	(4)
	1	3.50	5.50	5	14.7	139.2	75.15	12.50	0.08	(4)
	Avg. Value for Sand and Gravel Concrete					142.3	—	12.62	—	—
Limestone Concrete	1	2.00	2.75	0	16.6	135.3	74.87	11.20	0.09	(4)
	1	2.75	4.50	0	15.4	137.8	75.18	12.00	0.08	(4)
	1	3.50	5.50	0	16.3	136.4	74.75	11.50	0.09	(4)
	1	2.00	2.75	3	20.9	130.1	74.85	10.50	0.10	(4)
	1	2.75	4.50	3	23.4	126.0	74.45	10.00	0.10	(4)
	1	3.50	5.50	3	23.4	127.3	75.26	9.79	0.10	(4)
	Avg. Value for Limestone Concrete					132.15	—	10.83	—	—
Cinder Concrete	1	2.00	2.75	0	18.2	103.6	75.26	4.63	0.22	(4)
	1	2.75	4.50	0	19.9	98.7	75.71	4.30	0.23	(4)
	1	3.50	5.50	0	21.4	92.0	75.72	3.73	0.27	(4)
	1	2.00	2.75	3	22.8	101.4	74.95	4.89	0.20	(4)
	1	2.75	4.50	3	26.0	94.0	75.20	4.38	0.23	(4)
	1	3.50	5.50	3	24.4	94.4	75.55	4.24	0.24	(4)
	Avg. Value for Cinder Concrete					97.35	—	4.86	—	—
Haydite	1	2.00	2.75	0	18.0	80.7	74.82	4.15	0.25	(4)
	1	2.75	4.50	0	19.8	75.0	75.75	3.78	0.26	(4)
	1	3.50	5.50	0	21.8	71.7	74.82	3.67	0.27	(4)
	1	2.00	2.75	4	21.2	78.8	74.76	4.38	0.23	(4)
	1	2.75	4.50	4	22.2	72.4	75.39	3.89	0.26	(4)
	1	2.75	4.50	4	22.2	72.4	75.49	3.86	0.26	(4)
	1	3.50	5.50	4	23.9	71.0	75.46	4.00	0.25	(4)
	Avg. Value for Haydite					74.57	—	3.96	—	—

AUTHORITIES:

[1]U. S. Bureau of Standards, tests based on samples submitted by manufacturers.

[2]A. C. Willard, L. C. Lichty, and L. A. Harding, tests conducted at the University of Illinois.

[3]J. C. Peebles, tests conducted at Armour Institute of Technology, based on samples submitted by manufacturers.

[4]F. B. Rowley, tests conducted at the University of Minnesota.

[5]A.S.H.V.E. Research Laboratory.

[6]E. A. Allcut, tests conducted at the University of Toronto.

[7]Lees and Charlton.

*Recommended conductivities and conductances for computing heat transmission coefficients.

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

[a]For additional conductivity data see Chapters 3 and 15, 1937 *A.S.R.E. Data Book*.

[b]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 haydite blocks.

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

[d]See A.S.H.V.E. Research Paper, Conductivity of Concrete, by F. C. Houghten and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932).

[e]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.

[f]Not compressed.

[g]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.