the air is still (no wind), then for the same material f_i and f_o are the same, and $f_i = f_o$; but if the outside air is in motion, then f_o is always greater than f_i and will increase as the wind velocity increases. Values for f_i in still and moving air have been determined for various building materials at the University of Minnesota under a coöperative research agreement with the Society[1]. The range of values for ordinary building materials is comparatively small and for practical purposes may be assumed constant for either still air or any given wind velocity, particularly in view of the fact that the surface resistances usually comprise only a small part of the total resistance of the construction, except in the case of thin, highly conductive walls. In determining basic heat transmission values for building construction, it is customary to use that value of f_o which will occur when a 15-mph wind blows parallel to the outer surfaces considered.

TABLE 1. CONDUCTANCES OF AIR SPACES[a] AT VARIOUS MEAN TEMPERATURES

MEAN TEMP DEG FAHR	CONDUCTANCES OF AIR SPACES FOR VARIOUS WIDTHS IN INCHES						
	0.128	0.250	0.364	0.493	0.713	1.00	1.500
20	2.300	1.370	1.180	1.100	1.040	1.030	1.022
30	2.385	1.425	1.234	1.148	1.080	1.070	1.065
40	2.470	1.480	1.288	1.193	1.125	1.112	1.105
50	2.560	1.535	1.340	1.242	1.168	1.152	1.149
60	2.650	1.590	1.390	1.295	1.210	1.195	1.188
70	2.730	1.648	1.440	1.340	1.250	1.240	1.228
80	2.819	1.702	1.492	1.390	1.295	1.280	1.270
90	2.908	1.757	1.547	1.433	1.340	1.320	1.310
100	2.990	1.813	1.600	1.486	1.380	1.362	1.350
110	3.078	1.870	1.650	1.534	1.425	1.402	1.392
120	3.167	1.928	1.700	1.580	1.467	1.445	1.435
130	3.250	1.980	1.750	1.630	1.510	1.485	1.475
140	3.340	2.035	1.800	1.680	1.550	1.530	1.519
150	3.425	2.090	1.852	1.728	1.592	1.569	1.559

[a] Thermal Resistance of Air Spaces, by F. B. Rowley and A. B. Algren (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929).

The conductances of air spaces at various mean temperatures and widths, for ordinary building materials, are given in Table 1. These results were likewise obtained at the University of Minnesota under a coöperative research agreement with the Society.

Values for k and C_a, the conductivity and conductance of building materials and insulations, are given in Table 2 as taken from the published values of various investigators. It should be noted that values of k and C_a as well as of U are dependent on the mean temperature, and it is therefore desirable that the investigator determine heat-transmission values under conditions approximating those existing under actual conditions. Recommended values for calculating the coefficients of transmission of various types of construction are marked by an asterisk in Table 2.

[1] Surface Conductances as Affected by Air Velocity, Temperature and Character of Surface, by F. B. Rowley, A. B. Algren and J. L. Blackshaw (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930). See also references at end of chapter.

TABLE 2. CONDUCTIVITIES (k) AND CONDUCTANCES (C_a) 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_a)	Res st'y ($\frac{1}{k}$) or Resistance (R)	Authority
MASONRY MATERIALS						
Brick	Common	.....	...	5.00*	0.20	...
	Face	.....	...	9.20*	0.11	...
	Damp or wet	.....	...	5.00[b]	0.20	(2)
Brickwork	Typical	.....	...	12.00*	0.08	...
Cement Mortar	Typical	110.0	75	5.20*	0.19	(3)
Cinder Concrete	Typical (8 in.)	.....	...	0.62†*	1.61	...
Cinder Blocks[c]	" (12 in.)	.....	...	0.51†*	1.96	...
Concrete	Typical	.....	...	12.00*	0.08	...
	1-2-4 mix	143.0	69	9.46	0.11	(4)
	Various ages and mixes[d]	.....	...	11.35 *to* 16.36	.....	(5)
	Cellular	40.0	75	1.06	0.94	(3)
	"	50.0	75	1.44	0.69	(3)
	"	60.0	75	1.80	0.56	(3)
	"	70.0	75	2.18	0.46	(3)
	Typical gypsum fiber concrete, 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)
Concrete Blocks[e]	Typical (8 in.)	.....	...	1.00†*	1.00	...
	" (12 in.)	.....	...	0.80†*	1.25	...
	Special concrete block made with an aggregate of hardened clay—4 x 8 x 16 in., 3 cores, 18% voids	74.0	...	0.66†	1.51	(3)
	Special concrete block made with an aggregate of hardened clay—8 x 8 x 16 in., 4 cores, 35% voids	74.5	...	0.30†	3.33	(3)
Stone	Typical	.....	...	12.50*	0.08	...
Stucco	"	.....	...	12.00*	0.08	...
Tile	Typical hollow clay (4 in.)	.....	...	1.00†*	1.00	...
	" " " (6 in.)[f]	.....	...	0.64†*	1.57	...
	" " " (8 in.)[f]	.....	...	0.60†*	1.67	...
	" " " (10 in.)[f]	.....	...	0.58†*	1.72	...
	" " " (12 in.)[f]	.....	...	0.40†*	2.50	...
	" " " (16 in.)[f]	.....	...	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	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.)	.....	...	0.46†*	2.18	...
	Solid gypsum	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	...

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 Chorlton.

*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 Table 14, Page 63, *1934 A.S.R.E. Data Book.*

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

[c] One air cell in the direction of heat flow.

[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. 37, 1931).

[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.