air is 1.34, based on the values given in Table 1, and when increased by the factor 3 to allow for moving air, the outside surface coefficient is 3 × 1.34 or 4.02 B.t.u. per hour per square foot per degree fahrenheit difference between the surface and the air in contact with it.

The overall transmission of any wall for a wind exposure other than 15 miles per hour, can be computed by assigning the proper outside surface coefficient, but in most cases the accuracy involved does not warrant this degree of refinement, and it is sufficiently accurate to base all calculations on the one wind exposure. For example: If the heat transmission coefficient of a certain wall is 0.20 based on the outside surface coefficient of 4.02 for a 15-mile wind velocity, this coefficient would not vary more than 1 per cent, plus or minus, for a variation in the wind velocity of 5 miles per hour, plus or minus, based on data contained in Table 2. Computed coefficients are not accurate to this degree of variation in most cases, particularly when it is considered that overall coefficients will often vary to a much greater extent with the density of the materials used in the construction, the moisture content, the mean temperature, the quality of workmanship, and other factors.

Conductivities and Conductances

The majority of the conductivities and conductances of the building materials and insulations given in Tables 4, 5, 6, 7 and 8 were determined by the hot-plate method of testing.[3] Attention is called to the fact that conductivities per inch of thickness of materials or insulations do not afford a true basis for comparison, although they are frequently used for that purpose. Correct comparisons should take into consideration many different factors, including conductivities or conductances, thicknesses installed, manner of installation, etc., while the selection of an insulation should also give consideration to structural qualities, as well as material and application costs. At present there is no universally recognized method of rating insulations. Conductivities and conductances of building materials and insulations are useful to the heating engineer in determining overall coefficients of heat transmission of walls, floors, roofs and ceilings.

Computed Transmission Coefficients

As previously stated heat transmission coefficients of many common types of building construction are given in Tables 9 to 33, inclusive, each construction being identified by a serial number. For example: The coefficient of transmission (U) of a 12-in. brick wall, furring strips, and ¾-in. of gypsum plaster on metal lath, is 0.216, and the number assigned to a wall of this construction is *3-B*, Table 9.

The coefficients in these tables were determined by computations similar to those shown in Fig. 2, using the value of k (or C) indicated. The authorities for the conductivities used for computing these coefficients are given in Tables 4, 5, 6, 7 and 8. As in the case of the examples in Fig. 2, the average value of 1.34 given in Table 1 for f_i was used for all surfaces in still air. The value of f_o for outside wall and roof surfaces was taken as $3 \times f_i$, or 4.02, corresponding to a wind velocity of approxi-

[3]See *Standard Test Code for Heat Transmission through Walls* (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928).

TABLE 4. CONDUCTIVITIES (k) AND CONDUCTANCES (C) OF BUILDING MATERIALS AND INSULATIONS

Tests Conducted at the U. S. Bureau of Standards.[p] *Insulation Tests Based on Samples Submitted by Manufacturers*

Note.—THE COEFFICIENTS IN TABLES 4–8, INCL., ARE EXPRESSED IN B.T.U. PER HOUR PER SQUARE FOOT, PER 1 DEG. FAHR., PER 1 IN. THICKNESS UNLESS OTHERWISE INDICATED BY NOTE b.

MATERIAL	DESCRIPTION	DENSITY (LB. PER CU. FT.)	MEAN TEMP. (DEG. FAHR.)	CONDUCTIVITY (k) OR CONDUCTANCE (C)[a]
Asbestos Wood	Asbestos and cement compressed	123.0	86	2.70
Asbestos Mill Board	Pressed asbestos	60.5	86	0.84
Balsam Wool[h]	Chemically treated wood fiber between layers of paper	2.2	90	0.27
Cabots Quilt[h]	Eel grass between Kraft paper	4.6	90	0.26
Cabots Quilt[h]	Eel grass between Kraft paper	3.4	90	0.25
Celotex	Rigid insulation made from sugar cane fiber	13.2	90	0.34
Corkboard	Pure; no added binder	14.0	90	0.34
Corkboard	Pure; no added binder	10.6	90	0.30
Corkboard	Pure; no added binder	7.0	90	0.27
Corkboard (Eureka)	Asphaltic binder	14.5	90	0.32
Dry Zero[h]	Kapok between burlap or paper	1.0	90	0.24
Fibrofelt[h]	Flax and rye fiber	13.6	90	0.32
Flaxlinum[h]	Flax fiber	13.0	90	0.31
Gyplap	Gypsum between layers of heavy paper (½ in. thick)	53.5	90	2.60[b]
Hairinsul[h]	75% hair; 25% jute	6.3	90	0.27
Hairinsul[h]	50% hair; 50% jute	6.1	90	0.26
Hair Felt[h]	Felted cattle hair	13.0	90	0.26
Hair Felt[h]	Felted cattle hair	11.0	90	0.26
Insulex or Pyrocell	Cellular gypsum—dry	30.0	90	1.00
Insulex or Pyrocell	Cellular gypsum—dry	24.0	90	0.77
Insulex or Pyrocell	Cellular gypsum—dry	18.0	90	0.59
Insulex or Pyrocell	Cellular gypsum—dry	12.0	90	0.44
Insulite	Rigid insulation made from wood pulp	16.9	90	0.34
Linofelt[h]	Flax fibers between paper	4.9	90	0.28
Lith	Rock wool, flax and straw pulp with binder	14.3	90	0.40
Magnesia (Rigid)	85% magnesia, 15% asbestos	19.3	86	0.51
Plaster	Gypsum	46.2	86	2.32[i]
Regranulated cork	About ⅜ in. particles	8.1	90	0.31
Rock cork	Rock wool block with binders	16.7	86	0.37
Rock wool	Fibrous material, made from rock	10.0	90	0.27
Rock wool	Fibrous material, made from rock	14.0	90	0.28
Rock wool	Fibrous material, made from rock	18.0	90	0.29
Rock wool	Fibrous material, made from rock	21.0	90	0.30
Sawdust	Ordinary	......	86	1.04
Shavings	Ordinary	......	86	0.71
Sheetrock	Gypsum mixed with sawdust between layers of heavy paper (0.39 in. thick)	60.7	90	3.60[b]
Sprayo-Flake	Shredded paper with silica binder	4.2	94	0.28
Thermofelt[h]	Jute and asbestos fibers, felted	10.0	90	0.37
Thermofelt[h]	Hair and asbestos fibers, felted	7.8	90	0.28
Thermofill	Dry, fluffy, flaked gypsum	34.0	90	0.60
Thermofill	Dry, fluffy, flaked gypsum	26.0	90	0.52
Thermofill[h]	Dry, fluffy, flaked gypsum	19.8	90	0.35
Torfoleum	Peat moss compressed into sheet form	10.2	91.5	0.29
Woods:				
Balsa wood	Across grain	20.0	90	0.58
Balsa wood	Across grain	8.8	90	0.38
Balsa wood	Across grain	7.3	90	0.33
Cypress	Across grain	28.7	86	0.67
Maple	Across grain	44.3	86	1.10
Mahogany	Across grain	34.3	86	0.90
Virginia Pine	Across grain	34.3	86	0.96
White Pine	Across grain	31.2	86	0.78

[a]In addition to the conductivity values for the authorities listed, considerable work of importance pertaining to the heat transmission of various types of construction and materials has been done by the late Prof. John R. Allen and Prof. A. J. Wood of the Engineering Experiment Station of Pennsylvania State College.

[b]For thickness stated or used in construction, not per 1 in. thickness.

[h]Not compressed.

[i]The conductivity of plaster varies with the composition. Note range of values from 2.32 to 8.0. The average value for plaster is probably about 5.0. On account of the comparatively high conductivity of plaster and the fact that it is seldom applied more than ¾ in. thick, this material does not appreciably effect the overall transmission of a construction, excepting in the case of thin uninsulated walls.

[p]See Chapter LX, by Chas. H. Herter of the Report of the Insulation Committee, *A. S. R. E.*, Annual Meeting 1922, Revised to 1924, entitled, Heat Transmission of Insulating Materials for a more comprehensive collection of heat transmission data relating to building and insulating materials.