

and the difference between surface and air temperatures will be found in Reference 5. (See also Chapter 24.)

The convection part of the surface conductance is affected markedly by air movement. This is illustrated by Fig. 4, which shows the results of tests⁶ made on 12 in. square samples of different materials at a mean temperature of 20 F, and for wind velocities up to 40 mph. These conductances include the radiation portion of the coefficient which, for the conditions of the tests, was about 0.7 Btu per (hr) (sq ft) (F deg). More recent tests⁷ on smooth surfaces show that surface length also affects significantly the convection part of conductance; the average value decreases as the surface length increases. Moreover, observations⁸ of the magnitude of low temperature radiant energy received from outdoor surroundings show that only under certain conditions may the out-of-doors be treated as a black body radiating at air temperature.

Because of these factors, the selection of surface conductance coefficients for a practical building becomes a matter of judgment. In calculating the overall heat transmission coefficients for the walls, etc., of Tables 7, 8, 9, 15, 16, 17, 18, 19, and 21, 1.65 has been selected as an average inside surface conductance, and 6.0 as an average outside surface conductance for a 15 mph

TABLE 4. VARIATION IN SURFACE CONDUCTANCE COEFFICIENT FOR VERTICAL SURFACES WITH DIFFERENT TEMPERATURES OF SURROUNDING SURFACE

SURROUNDING SURFACE TEMPERATURE	75 F	70 F	69 F	60 F	50 F
Convection—Btu per (hr) (sq ft) ..	6.6	6.6	6.6	6.6	6.6
Radiation—Btu per (hr) (sq ft)...	4.4	8.6	9.6	17.0	24.9
Total—Btu per (hr) (sq ft).....	11.0	15.2	16.2	23.6	31.5

wind. Both values combine the effects of convection and radiation, and are applicable to ordinary building materials. They should not be used for low emissivity surfaces such as bright metal. Values of U for windows in Table 20 have been computed from somewhat different data, as described in a later section, in order to give proper weight to actual surface conductance.

In special cases, where surface conductances become important factors in the overall rates of heat transfer, more selective coefficients may be required. Principles and data given in Chapter 5, Heat Transfer, may be applied in such cases.

Air Space Conductance

The transfer of heat across an air space involves the boundary surfaces as well as the intervening air, and depends markedly on the orientation of the air space and the direction of heat flow. The coefficients given for air space conductance represent the total conductance from one surface bounding the air space to the other. The total conductance is the sum of a component due to radiation and a component due to convection and conduction combined. These components may vary independently of each other.

The radiation portion of the coefficient is affected by the temperature of the two boundary surfaces, and by their respective surface emissivities⁹; the combined effect of which is expressed by means of the *effective emissivity* E of the air space. The radiation component is not affected by the thickness of the space or by its orientation or direction of heat flow. The

heat transfer by convection and conduction combined, however, is markedly affected by the orientation of the air space and the direction of heat flow, is significantly affected by the temperature difference across the space and in some cases by the thickness of the space; and is affected to only a small extent by the mean temperature of its surfaces. For air spaces usually employed in building construction, the radiation and convection-conduction components may vary independently of each other.

Table 1, Section B, gives the thermal conductances and resistances of air spaces of uniform thickness and moderately smooth surfaces, based on

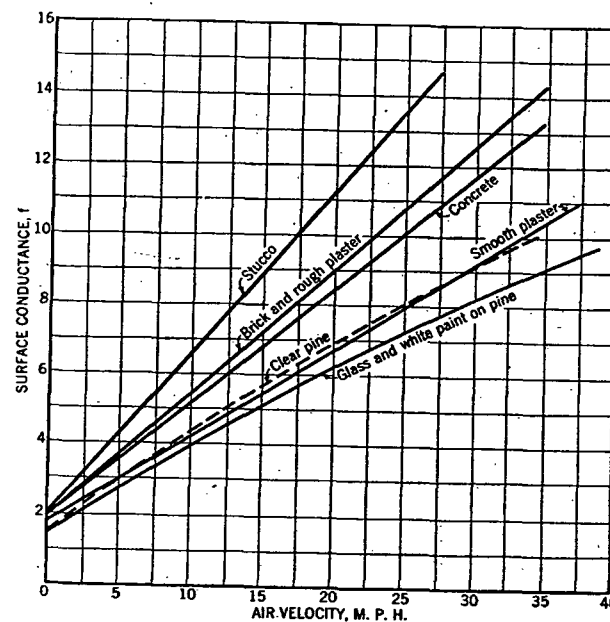


FIG. 4. CURVES SHOWING RELATION BETWEEN SURFACE CONDUCTANCES FOR DIFFERENT SURFACES AT 20 F MEAN TEMPERATURE

experimental measurements conducted at the *National Bureau of Standards*.⁹ Although the conductances of air spaces vary to some extent with thickness in the range over $\frac{3}{4}$ in., average values are tabulated for the range from $\frac{3}{4}$ in. to 4 in., for all except horizontal spaces with heat flow downward. The error involved by averaging is less than 10 percent in the extreme case and less than 5 percent in most. For more exact values Reference 9 may be consulted.

For narrow air spaces, which may be defined as those for which the product of the cube of the thickness of the space in inches times the temperature difference (Fahrenheit degrees) across the space is less than 3 for heat flow horizontally or downward, or less than 1 for heat flow upward, the conductance is the sum of the radiative heat transfer coefficient and that for conduction alone through air, since convection is practically suppressed. The radiation component can be computed by means of Equation 4 and Table 4 of Chapter 5; the conduction component can be