portions making up the total may vary, independently of the others, thus affecting the total conductance. The heat transfer by radiation between two surfaces is controlled by the character of the surfaces (emissivity), the temperature difference between them, and the solid angle through which they *see* each other. The heat transfer by convection and conduction is controlled by the roughness of the surface, by air movement, and temperature difference between the air and the surface.

The importance of the effect of temperature of *surrounding surfaces* on the surface conductance, due to the effect on radiation, is illustrated in Table 2, which applies to a vertical surface at 80 F, with ambient air at 70 F and with radiation exchange corresponding to an effective emissivity of 0.83.[4]

In many cases, because the heat resistance of the internal parts of the wall is high compared with the surface resistance, the surface factors are of minor importance. In other cases, *e.g.*, single glass windows, the surface resistances constitute almost the entire resistance and are therefore very important. An analysis of various factors affecting surface conductance and the difference between surface and air temperatures will be found in Reference 5. (See also Chapter 23.)

The convection part of the surface conductance is affected markedly

TABLE 2. 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

by air movement. This is illustrated by Fig. 4, which shows the results of tests[6] 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 tests[7] 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, observations[8] 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. Surface conductances are shown in Tables 3 and 4. *In calculating the overall heat transmission coefficients for the walls, etc., of Tables 5 through 15, the appropriate indoor and outdoor surface coefficients given in Table 4 for Air Surfaces have been used.* 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. For exposed reflective surfaces refer to Table 3 Section A and to footnotes under Table 16.

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

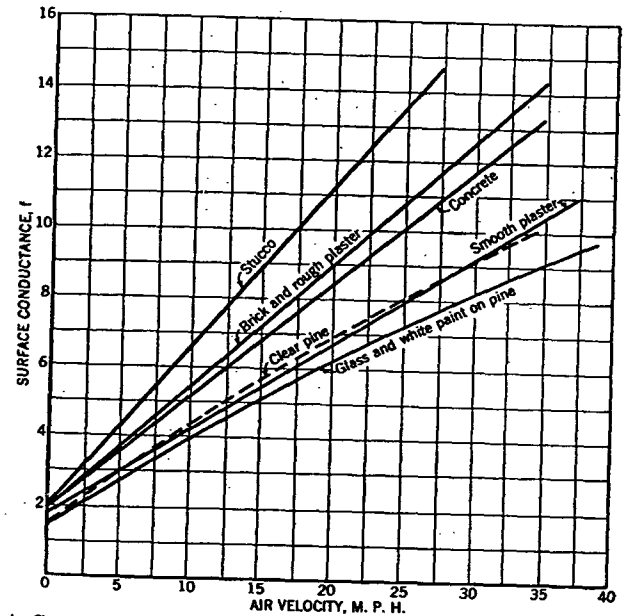

FIG. 4. CURVES SHOWING RELATION BETWEEN SURFACE CONDUCTANCES FOR DIFFERENT SURFACES AT 20 F MEAN TEMPERATURE

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 emissivities ϵ, 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 3, Section B, gives the thermal conductances and resistances of air spaces of uniform thickness and moderately smooth surfaces, based on