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. *In calculating the overall heat transmission coefficients for the walls, etc., of Tables 6 to 19, 1.65 has been selected as an average inside surface conductance, and 6.0 as an average outside surface conductance for a 15 mph 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

TABLE 4. VARIATION IN SURFACE CONDUCTANCE COEFFICIENT 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

required. Data given in Table 1, Section A, and 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; consequently, the factors influencing surface conductance play an important part in determining the conductance of the air space. The coefficients given for air space conductance represent the total conductance from surface to surface.

The radiation portion of the coefficient is affected by the difference in temperature between the boundary surfaces and by their respective emissivities, and is practically independent of depth. The convection and conduction transfer is controlled by depth and shape of the air space, the roughness of the boundary surfaces, the mean temperature, and the direction of heat flow. For air spaces usually employed in building construction, the radiation and convection factors vary independently of each other.

Table 1, Section B gives experimentally-determined conductances of vertical air spaces bounded by such materials as paper, wood, plaster, etc., having emissivity coefficients of 0.8 or higher, and having extended parallel surfaces perpendicular to the direction of heat flow. The conductances decrease as the depth is increased, but change only slightly for spaces greater than $\frac{3}{4}$ in. Air space tests reported by Wilkes and Peterson, gave conductance values for air spaces of $3\frac{5}{8}$ in. depth having boundary surfaces with emissivity values of 0.83 as follows:[9] vertical, 1.17; horizontal (heat flow upward), 1.32; horizontal (heat flow downward), 0.94. Since, in buildings, the same constructions may be used for conditions where the direction of heat flow may be in one direction or its opposite, and since much of the construction involves vertical air spaces, an average value of

1.10 Btu per (hour) (square foot) (Fahrenheit degree temperature difference) was chosen for use in calculating the overall coefficients in Tables 6 to 19 wherever air spaces $\frac{3}{4}$ in. or more in depth were involved.

If one or both boundary surfaces of an air space are faced with metals which have low emissivity surfaces, the radiant heat transfer will be greatly reduced in comparison with that occurring from surfaces of ordinary building materials. Table 1, Section C gives conductances and resistances of air spaces *bounded by one reflective surface* with an emissivity of 0.05. These values include heat transferred both by radiation and convection, but the radiation component is relatively small for the test conditions.

When insulating materials are installed with single or multiple air spaces,

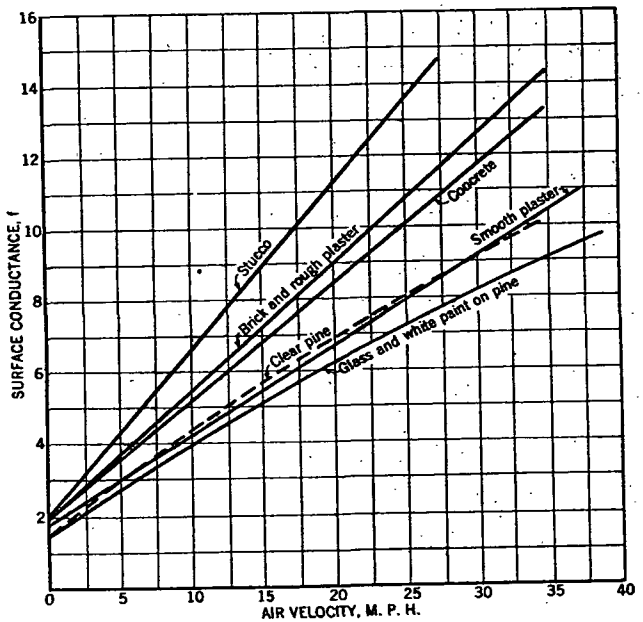


FIG. 4. CURVES SHOWING RELATION BETWEEN SURFACE CONDUCTANCES FOR DIFFERENT SURFACES AT 20 F MEAN TEMPERATURE

the position (vertical, horizontal or inclined) of the material and the direction of heat flow must be taken into consideration. For example, the resistance to *upward* heat flow is about one-third the resistance to *downward* heat flow in a horizontal position (Table 1, Section C). The difference between the conductance through vertical air spaces and that through horizontal and sloping air spaces with upward heat flow is considerably less. For upward heat flow, it is recommended that a value of 0.46 be used for the conductance of horizontal or sloping air spaces bounded on one side by reflective materials having an emissivity of approximately 0.05. The same conductance value is also recommended for similar vertical air spaces.

When considering heat transfer to and from reflective surfaces in building construction, the emissivity should be known. This can be determined directly for the long wave length radiation corresponding to average room