make a correction for other temperatures. It has been found that the absolute mean temperature of the wall affects the coefficient materially. The coefficient increases with the absolute mean temperature.

Tests are usually run under still air conditions, which means there was no wind movement, during the test, over the surfaces of the wall. In practice, some wind movement over the exterior surface of the wall should always be allowed for; hence *still air* coefficients cannot be used in actual work as they do not provide for the normal wind movement over the outside of the building in the locality in question during the heating season. Moreover, *still air* transmission coefficients cannot be corrected to provide for moving air conditions by multiplying by a single constant factor.[2]

The coefficients of heat transmission of various types of construction as given in Tables 7 to 13, are for still air for inside walls, floors and ceilings and for a wind movement of 15 miles per hour for exterior walls and roofs and are generally applicable to heat transmission computations using equation (9). Such heat transmission coefficients are always based on the difference between the air temperatures on the inside and the outside of the wall.

Transmission Coefficients by Computation

If heat transmission coefficients are to be computed, and in many, if not most cases, they should be computed, the following analysis of the transmission of heat through a simple, solid wall is used as the basis for such computations.

The diagram in Fig. 1 exhibits four important temperatures: *First* the air temperature t inside of the building; *second*, the temperature t_1 of the inside surface of the wall; *third*, the temperature t_2 of the outside surface of the wall, and *fourth*, the air temperature t_0 outside of the building. Heat reaches or enters the inside surface of the wall by radiation and convection, since the air and objects A within the building are *always* warmer than the inside surface of the wall, when the inside air temperature t is greater than the outside air temperature t_0. This heat must then pass through the material of the wall from inside to outside surface by conduction, and is finally given off from the outside surface by radiation and convection, provided, of course, that equilibrium has been established and all four temperatures are constant.

The amount of heat reaching or entering the wall per hour depends on t and t_1 and a coefficient K_1 varying with the character of the wall material. K_1 may be defined as the B.t.u. per hour entering each square foot of wall surface per degree difference between the inside air temperature t and the inside surface temperature t_1. Hence the heat received by inner surface of the wall per hour by both radiation and convection is

$$H_1 = K_1\,(t - t_1)\,S \qquad (1)$$

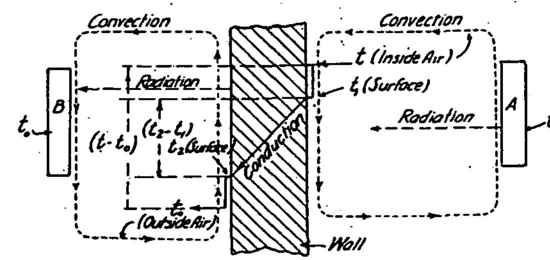
where S is the inner wall surface area in square feet and the other terms are as heretofore indicated.

[2]"Effect of Wind on Heat Transmission Coefficients" in Appendix to Section III, Code of Minimum Requirements of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

Whatever amount of heat H_1 enters the inner wall surface must be given off from the outer wall surface, so that if H_2 represents heat emitted from outer surface

$$H_1 = H_2 = K_2\,(t_2 - t_0)\,S. \qquad (2)$$

Now K_2 may not equal K_1, in which case $(t_2\text{–}t_0)$ will not equal $(t\text{–}t_1)$. Usually, in an actual wall exposed to wind on the outside, K_2 (Table 6) is greater than K_1 and $(t_2\text{–}t_0)$ must be less than $(t\text{–}t_1)$. Moreover, the heat H_c passing through the wall by conduction is equal to H_1 and H_2, and if C is the coefficient of conduction = B.t.u. transmitted per hour



A represents warm surfaces at temperature *t* of inside air; *B* represents cold surfaces at temperature t_0 of outside air. For an actual temperature gradient curve see Fig. 2.

FIG. 1. TEMPERATURE CURVE OR GRADIENT FROM AIR INSIDE TO AND THROUGH WALL TO AIR OUTSIDE, WALL MATERIAL ASSUMED AIR-TIGHT

per square foot of material per 1 in. thickness per degree difference between the surface temperatures, then

$$H_1 = H_2 = H_c = \frac{C}{x}\,(t_1 - t_2)\,S \qquad (3)$$

where x = wall thickness in inches.

These equations (1), (2) and (3) are fundamental and are used for determining values for K_1, K_2 and C for actual wall materials by test. They cannot be used for computing heat losses in an actual building, since the surface temperatures t_1 and t_2 are seldom known, although these surface temperatures can be determined in a test by means of thermocouples. Hence, for actual conditions where the only temperatures known are the inside and outside air temperatures t and t_0, it is necessary to use a transmission coefficient U = B.t.u. transmitted per hour per square foot of wall surface per degree difference between the inside and outside air temperatures. Values of U for many common types of construction are given in Tables 7 to 13. The heat H transmitted per hour from air inside to air outside is then computed as follows:

$$H = U\,(t - t_0)\,S \qquad (4)$$

and since $H = H_1 = H_2 = H_c$, the right hand members of equations (1), (2), (3) and (4) are all equal.

The coefficient U may be determined by test, or it may be computed for any wall provided values for K_1, K_2 and C are known. By proper substitution in the four equations, the unknown temperatures t_1 and t_2