tests can be used to good advantage in checking the accuracy of the computed values.

Transmission Coefficients by Computation

Symbols and Definitions: The following symbols which are in agreement with the recommendations of the Committee on Heat Transmission of the *National Research Council* are used in the heat-transmission formulae in this chapter:

U = Thermal transmittance or overall coefficient of heat transmission and is the amount of heat expressed in B.t.u. transmitted in one hour per square foot of the wall, floor, roof or ceiling for a difference in temperature of 1 deg. fahr. between the air on the inside and outside of the wall, floor, roof or ceiling.

k = Thermal conductivity and is the amount of heat expressed in B.t.u. transmitted in one hour through 1 sq. ft. of a homogeneous material 1 in. thick for a difference in temperature of 1 deg. fahr. between the two surfaces of the material. The conductivity of any material depends on the structure of the material and its density. Heavy or dense materials, the weight of which per cubic foot is high, usually transmit more heat than light or less dense materials, the weight of which per cubic foot is low.

C = Thermal conductance and is the amount of heat expressed in B.t.u. transmitted in one hour through 1 sq. ft. of a non-homogeneous material for the thickness or type under consideration for a difference in temperature of 1 deg. fahr. between the two surfaces of the material. Conductance is usually used to designate the heat transmitted through such heterogeneous materials as plaster board and hollow clay tile.

f = Film or surface conductance and is the amount of heat expressed in B.t.u. transmitted by radiation, conduction and convection from a surface to the air surrounding it, or vice versa, in one hour per square foot of the surface for a difference in temperature of 1 deg. between the surface and the surrounding air. To differentiate between inside and outside wall (or floor, roof or ceiling) surfaces, f_i is used to designate the inside surface or film-conductance and f_o the outside surface or film-conductance.

a = Thermal conductance of an air space and is the amount of heat expressed in B.t.u. transmitted by radiation, conduction and convection in one hour through an area of 1 sq. ft. of an air space for a temperature difference of 1 deg. fahr. The conductance of an air space depends on the mean absolute temperature, the width, the position and the character of the materials enclosing it.

R = Resistance or resistivity, the reciprocal of transmission, conductance or conductivity, *i.e.*:

$\frac{1}{U}$ = overall or air-to-air resistance.

$\frac{1}{k}$ = internal resistivity.

$\frac{1}{C}$ = internal resistance.

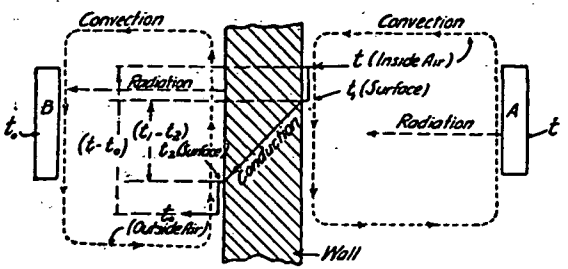
$\frac{1}{f}$ = surface or film-resistance.

$\frac{1}{a}$ = air-space resistance.

x = thickness in inches.

Fundamental Formulae: 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



A represents warm surfaces at temperature t of inside air; *B* represents cold surfaces at temperature t_o 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

surface of the wall, and *fourth*, the air temperature t_o 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_o. 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

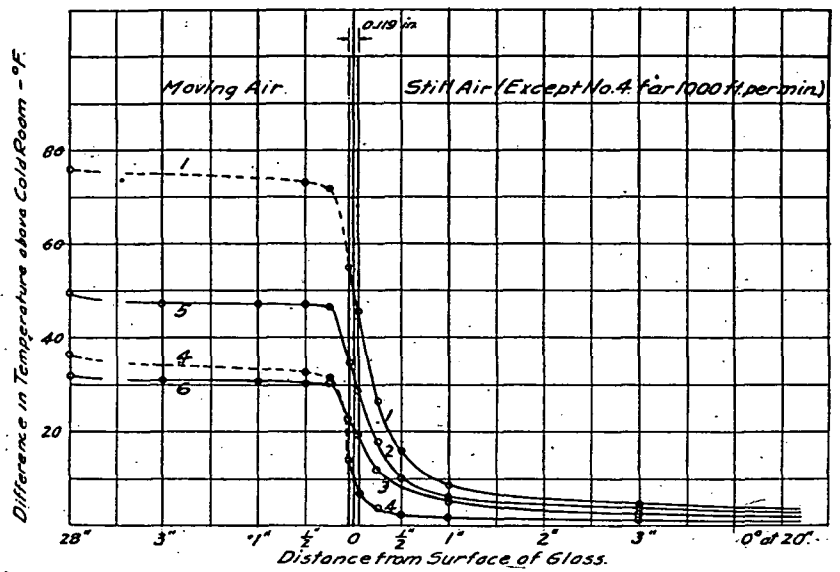


FIG. 2. TEMPERATURE GRADIENT CURVES FOR GLASS (TAKEN FROM BULLETIN NO. 24, ENGINEERING EXPERIMENT STATION, PENNSYLVANIA STATE COLLEGE)