

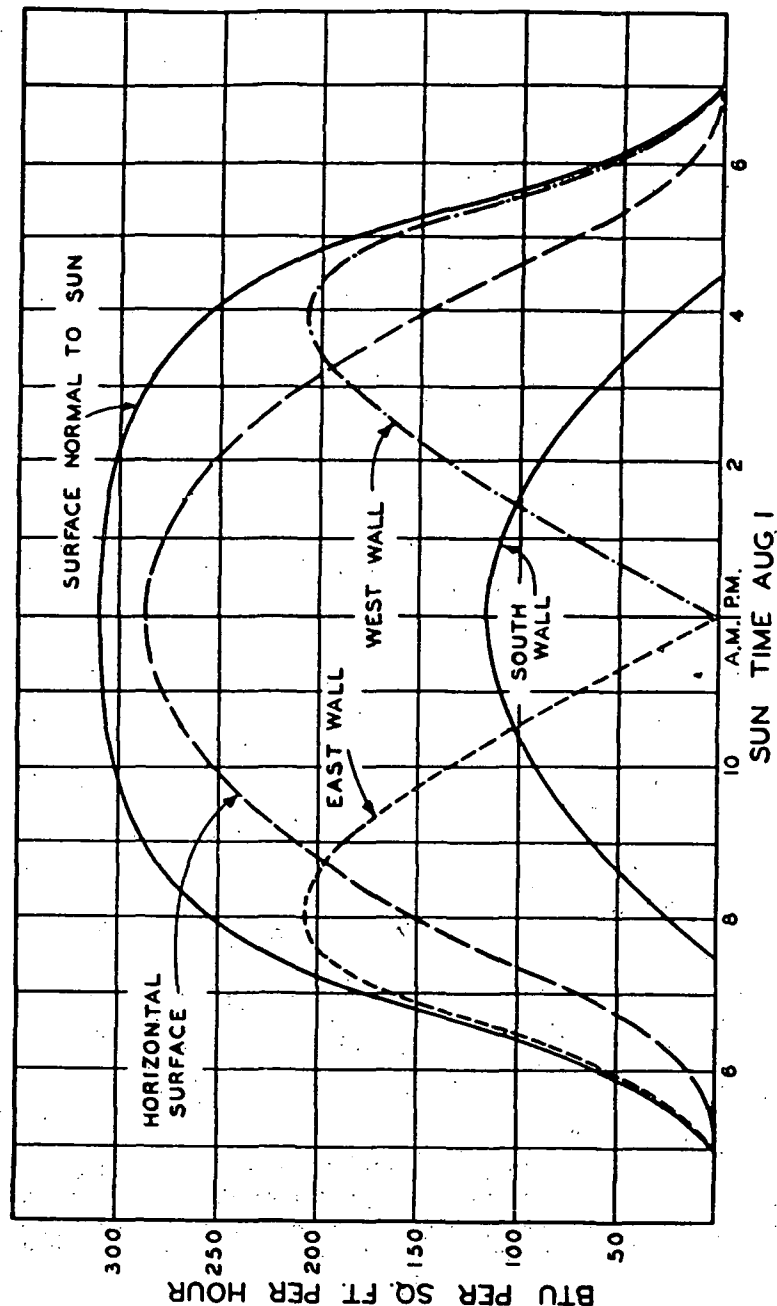


FIG. 1. CURVES GIVING SOLAR INTENSITY NORMAL TO SUN, ON HORIZONTAL SURFACE AND ON WALLS FOR AUGUST 1

manner similar to that described in Chapter 7 (except that flow of heat is reversed) by means of the formula:

$$H_t = AU(l_o - t) \quad (1)$$

where

- H_t = heat transmitted through the material of wall, glass, floor, etc., Btu per hour.
- A = net inside area of wall, glass, floor, etc., square feet.
- t = inside temperature, degrees Fahrenheit.
- l_o = outside temperature, degrees Fahrenheit.
- U = coefficient of transmission of wall, glass, floor, etc., Btu per hour per square foot per degree Fahrenheit difference in temperature (Tables 3 to 13, Chapter 5).

Solar Heat Transmission

Calculations of the solar heat transmitted through walls and roofs are difficult to determine because of periodical character of heat flow and time lag due to heat capacity of construction.

The variation in solar intensity normal to sun in Btu per square foot per hour on a horizontal surface, and on east, west, and south walls is given in Fig. 1. The curves are drawn from A.S.H.V.E. Laboratory data obtained by pyrheliometer, are based on sun time and apply for a perfectly clear day on August 1 at a north latitude of 40 deg. A study of these curves discloses the periodic relationship and wide variation in solar intensity on various surfaces. It will be observed that both the roof and south wall radiation curves are in exact phase relationship with each other and that whereas the east and west wall radiation curves overlap those for roof and south wall, they do not overlap each other. This phase relationship has an important bearing on the cooling load. Failure to consider the periodical character of heat flow resulting from diurnal movement of the sun and the lag due to heat capacity of the structure, which determine the timing and magnitude of the heat wave flowing through the wall, may result in a large error in load calculations.

The values of solar intensity appearing in Fig. 1 must not be confused with the actual heat transmission through the wall for much of the solar radiation impinging against the outer surface fails to pass through the wall. Instead it is delivered to the outside air by reflection, radiation, convection and conduction. A mathematical solution for the determination of solar heat transmission has been developed but the equations involved are too complex for practical application.¹ From results of this investigation and earlier studies,² the Research Laboratory has prepared Tables 2, 3, 4 and 5 which give the solar intensity (I) for various hours of the day on walls of various orientations and horizontal surfaces. These values are shown for north latitudes from 30 to 45 deg.

Since the amount of solar intensity actually transmitted through a surface depends upon the nature of the exterior surface of wall or roof construction, it is necessary, in order to determine actual amount of solar

¹A.S.H.V.E. RESEARCH REPORT No. 923—Heat Transmission as Influenced by Heat Capacity and Solar Radiation, by F. C. Houghten, J. L. Blackshaw, E. W. Pugh and Paul McDermott (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 231).

²A.S.H.V.E. RESEARCH REPORT No. 853—Absorption of Solar Radiation in its Relation to the Temperature, Color, Angle and Other Characteristics of the Absorbing Surface, by F. C. Houghten and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930, p. 137).