

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 application².

The heat flow in summer through various types of roofs and walls has been measured by the A.S.H.V.E. Laboratory. The curves in Fig. 2, give the heat flow through the inside surface of roofs³ with details of the construction of the roofs tested. The conditions for which these results are given are: solar radiation for 40 deg north latitude on August 1 as given in Fig. 1 and Table 4; outdoor design temperature reaching a maximum of 95 F as shown by the temperature curve in Fig. 2 and an indoor temperature of 75 F.

Curves in Fig. 3 were prepared by the A.S.H.V.E. Laboratory from

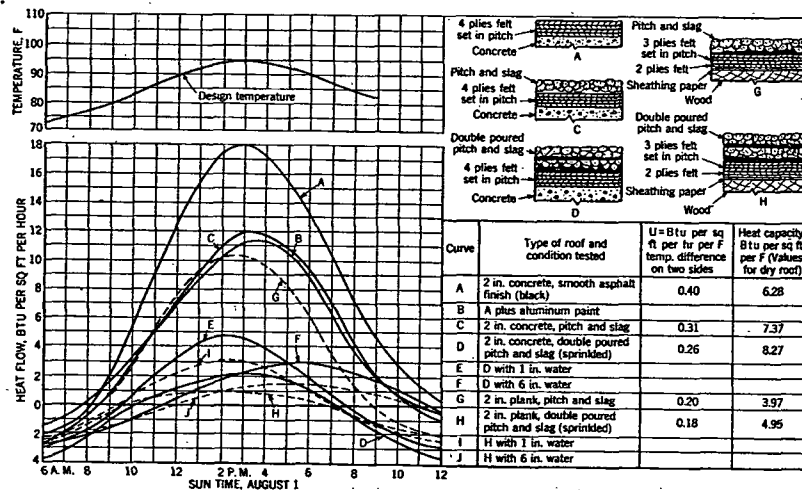


FIG. 2. RELATION BETWEEN TIME AND HEAT FLOW THROUGH INSIDE SURFACE OF HORIZONTAL ROOFS CORRECTED TO DESIGN DAY OF AUGUST 1

recent tests made there and show the heat flow through the inside surface of three types of walls for various orientations⁴. The results are given for the following conditions: 90 per cent of the solar radiation given in Fig. 1 and Table 4 for 40 deg north latitude on August 1; outdoor design tem-

²A.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. M. Pugh and Paul McDermott (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 231). Effect of Heat Storage and Variation in Outdoor Temperature and Solar Intensity on Heat Transfer Through Walls, by J. S. Alford, J. E. Ryan and F. O. Urban (A.S.H.V.E. TRANSACTIONS, Vol. 45, 1939, p. 369). Periodic Heat Flow in Building Walls Determined by Electrical Analogy Method, by Victor Paschke (A.S.H.V.E. JOURNAL SECTION, Heating, Piping and Air Conditioning, February, 1942, p. 133). Summer Comfort Factors as Influenced by the Thermal Properties of Building Materials, by C. O. Mackey and L. T. Wright, Jr. (A.S.H.V.E. JOURNAL SECTION, Heating, Piping and Air Conditioning, December, 1942, p. 750).

³A.S.H.V.E. RESEARCH REPORT No. 1157—Summer Cooling Load as Affected by Heat Gain Through Dry, Sprinkled and Water Covered Roofs, by F. C. Houghten, H. T. Olson and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 46, 1940, p. 231).

⁴A.S.H.V.E. RESEARCH REPORT No. 1195—Heat Gain Through Walls and Roofs as Affected by Solar Radiation, by F. C. Houghten, E. C. Hach, S. I. Taimuty and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 48, 1942, p. 91).

perature reaching a maximum of 93 F as shown by the temperature curve in Fig. 3 and an indoor temperature of 78 F and 50 per cent relative humidity.

The heat flow shown in Figs. 2 and 3 is a combination of normal transmission and solar radiation transmission and is the total heat flow through the wall or roof. Due to the heat capacity of walls and roofs there is a time lag⁵ in the transmission of heat through them as shown by the curves. For the types of construction covered in Figs. 2 and 3 and for the conditions indicated, the heat flow through the inside surface at any given time can be read directly. For other types of construction, the curves may be used as a guide in estimating the heat flow. The time lag for

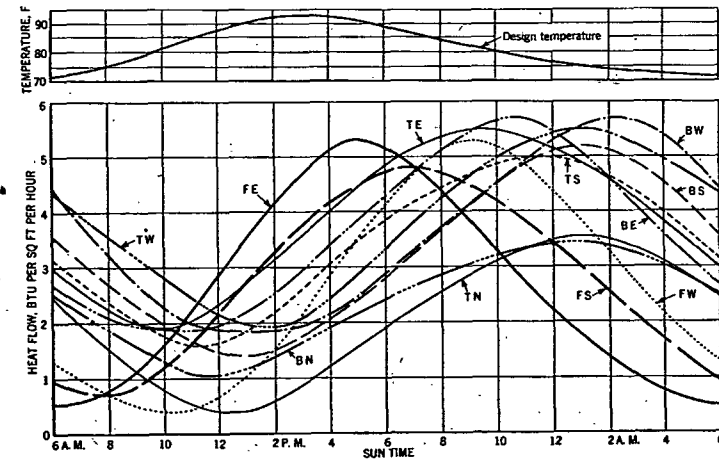


FIG. 3. RELATION BETWEEN TIME AND HEAT FLOW THROUGH THE INSIDE SURFACE OF WALLS OF DIFFERENT CONSTRUCTION AND ORIENTATION ON A 93 F DESIGN DAY WITH 90 PER CENT OF DESIGN SOLAR RADIATION

Walls BE, BS, BW and BN—12 in. solid brick and plaster facing east, south, west and north respectively. Walls TE, TS, TW and TN—4 in. brick veneer, 8 in. tile and plaster facing east, south, west and north respectively.

Walls FE, FS and FW—4 in. brick veneer, building paper, 1/4 in., matched sheathing, 2 x 4 in. studs, metal lath and plaster facing east, south and west respectively.

other types of construction is included in Table 6 which was prepared by the A.S.H.V.E. Laboratory from data collected by it and by other authorities.

Solar Radiation Transmitted Through Glass

Windows present a problem somewhat different from that of opaque walls, because they permit a large percentage of the solar energy to pass through. A small amount is reflected and a portion is absorbed by the glass. The amount absorbed depends upon the character and thickness of the glass and the angle between it and the sun's rays. The temperature of the glass is raised by the absorbed heat and this heat is then delivered

⁵Loc. Cit. Note 2.