west walls overlap each other due to scattered sky radiation on the west wall during the forenoon and on the east wall during the afternoon. This phase relationship has an important bearing on the cooling load. Failure to consider the periodic 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

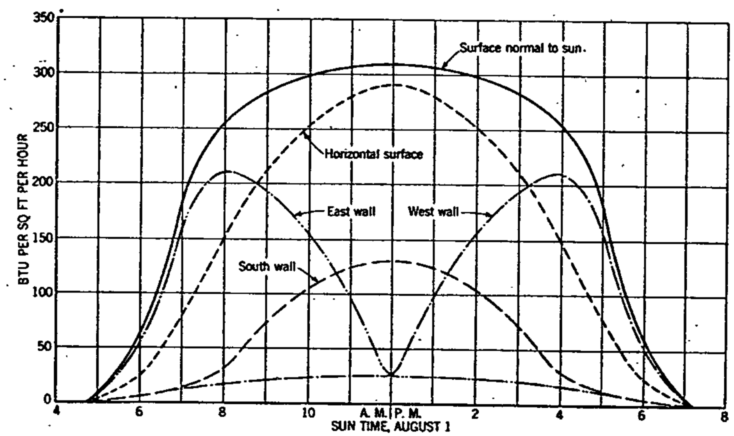

FIG. 1. SOLAR INTENSITY NORMAL TO SUN ON HORIZONTAL SURFACE AND ON WALLS FOR AUGUST 1 AT 40 DEG NORTH LATITUDE

involved are too complex for practical application[2]. A method embodying an approximate determination of the maximum contribution to the cooling load due to heat transfer from the inside surface of a wall exposed to solar radiation has been developed[3].

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 roofs[4] 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

[2]A.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 Paschkis (A.S.H.V.E. TRANSACTIONS, Vol. 48, 1942, p. 75). 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. TRANSACTIONS, Vol. 49, 1943, p. 148).

[3]Periodic Heat Flow—Homogeneous Walls or Roofs, by C. O. Mackey and L. T. Wright, Jr. (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, September, 1944, P. 546).

[4]A.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).

TABLE 2. SOLAR RADIATION (DIRECT PLUS SKY) IMPINGING AGAINST WALLS HAVING SEVERAL ORIENTATIONS AND A HORIZONTAL SURFACE

For 30 Deg North Latitude on August 1

Sun Time	Intensity of Solar Radiation, Btu per Sq Ft per Hour							
	Northeast	East	Southeast	South	Southwest	West	Northwest	Horizontal Surface
5:20	0	0	0	0	0	0	0	0
6:00	37	47	23	4.5	4.5	4.5	4.5	11
7:00	119	145	91	11	11	11	11	64
8:00	153	207	149	17	17	17	17	147
9:00	130	194	158	35	21	21	21	213
10:00	86	152	143	63	23.5	23.5	23.5	262
11:00	35	94	85	80	25.5	25.5	25.5	290
12:00	26	26	65	85	65	26	26	300
1:00	25.5	25.5	25.5	80	85	94	35	290
2:00	23.5	23.5	23.5	63	143	152	86	262
3:00	21	21	21	35	158	194	130	213
4:00	17	17	17	17	149	207	153	147
5:00	11	11	11	11	91	145	119	64
6:00	4.5	4.5	4.5	4.5	23	47	37	11
6:40	0	0	0	0	0	0	0	0

TABLE 3. SOLAR RADIATION (DIRECT PLUS SKY) IMPINGING AGAINST WALLS HAVING SEVERAL ORIENTATIONS AND A HORIZONTAL SURFACE

For 35 Deg North Latitude on August 1

Sun Time	Intensity of Solar Radiation, Btu per Sq Ft per Hour							
	Northeast	East	Southeast	South	Southwest	West	Northwest	Horizontal Surface
5:07	0	0	0	0	0	0	0	0
6:00	43	49	27	4.5	4.5	4.5	4.5	13
7:00	121	151	97	11	11	11	11	72
8:00	147	207	155	25	17	17	17	151
9:00	120	194	169	49	21	21	21	213
10:00	71	152	156	83	23.5	23.5	23.5	245
11:00	28	94	129	103	25.5	25.5	25.5	288
12:00	26	26	84	109	84	26	26	298
1:00	25.5	25.5	25.5	103	129	94	28	288
2:00	23.5	23.5	23.5	83	156	152	71	245
3:00	21	21	21	49	169	194	120	213
4:00	17	17	17	25	155	207	147	151
5:00	11	11	11	11	97	151	121	72
6:00	4.5	4.5	4.5	4.5	27	49	43	13
6:53	0	0	0	0	0	0	0	0