Table 12. Total Equivalent Temperature Differentials for Calculating Heat Gain Through Sunlit and Shaded Roofs

Description of Roof Construction[a]	Sun Time A.M. 8	10	12	P.M. 2	4	6	8	10	12
Light Construction Roofs—Exposed to Sun									
1″ Wood[b] or 1″ Wood[b] + 1″ or 2″ Insulation	12	38	54	62	50	26	10	4	0
Medium Construction Roofs—Exposed to Sun									
2″ Concrete or 2″ Concrete + 1″ or 2″ Insulation or 2″ Wood[b]	6	30	48	58	50	32	14	6	2
2″ Gypsum or 2″ Gypsum + 1″ Insulation 1″ Wood[b] or 2″ Wood[b] or 2″ Concrete or 2″ Gypsum + 4″ Rock Wool in Furred Ceiling	0	20	40	52	54	42	20	10	6
4″ Concrete or 4″ Concrete with 2″ Insulation	0	20	38	50	52	40	22	12	6
Heavy Construction Roofs—Exposed to Sun									
6″ Concrete	4	6	24	38	46	44	32	18	12
6″ Concrete + 2″ Insulation	6	6	20	34	42	44	34	20	14
Roofs Covered with Water—Exposed to Sun									
Light Construction Roof with 1″ Water	0	4	16	22	18	14	10	2	0
Heavy Construction Roof with 1″ Water	−2	−2	−4	10	14	16	14	10	6
Any Roof with 6″ Water	−2	0	0	6	10	10	8	4	0
Roofs with Roof Sprays—Exposed to Sun									
Light Construction	0	4	12	18	16	14	10	2	0
Heavy Construction	−2	−2	2	8	12	14	12	10	6
Roofs in Shade									
Light Construction	−4	0	6	12	14	12	8	2	0
Medium Construction	−4	−2	2	8	12	12	10	6	2
Heavy Construction	−2	−2	0	4	8	10	10	8	4

[a] Includes ⅜ in. felt roofing with or without slag. May also be used for shingle roof. [b] Nominal thickness of the wood.

NOTES FOR TABLE 12

Explanation: {Total heat transmission from solar radiation and temperature difference between outside and room air. Btu per (hr) (sq ft) of roof area} = {Equivalent temperature differential from above table} × {Heat transmission coefficient for summer Btu per (hr) (sq ft) (F deg)}

1. *Source.* Calculated by Mackey and Wright method (see reference list) and adjusted after studying ASHVE original test data. Estimated for July in 40 deg north latitude. (For sol-air temperatures used in calculations see Table 11.) For typical design day where the maximum outdoor temperature is 95 F and minimum temperature at night is approximately 75 F (daily range of temperature, 20 F) mean 24 hr temperature 84 F for a room temperature of 80 F. All roofs have been assumed a dark color which absorbs 90 percent of solar radiation, and reflects only 10 percent.

2. *Application.* These values may be used for all normal air conditioning estimates; usually without correction, in latitude 0 deg to 50 deg north or south when the load is calculated for the hottest weather. Note 5 explains how to adjust the temperature differential for other room and outdoor temperatures.

3. *Peaked Roofs.* If the roof is peaked and the heat gain is primarily due to solar radiation, use for the area of the roof, the area projected on a horizontal plane.

4. *Attics.* If the ceiling is insulated and if a fan is used in the attic for positive ventilation, the total temperature differential for a roof exposed to the sun may be decreased 25 percent.

5. *Corrections. For temperature difference when outdoor maximum design temperature minus room is different from 15 deg.* If the outdoor design temperature minus room temperature is different from the base of 15 deg, correct as follows: When the difference is greater (or less) than 15 deg add the excess to (or subtract the deficiency from) the above differentials.

For outdoor daily range of temperature other than 20 deg. If the daily range of temperature is less than 20 deg, add 1 deg for every 2 deg lower daily range; if the daily range is greater than 20 deg, substract 1 deg for every 2 deg higher daily range. For example, the daily range in Miami, Florida is 12 deg or 8 deg less than 20 deg, therefore, the correction is + 4 deg at all hours of the day.

Light Colors. Credit should not be taken for light colored roofs except where the permanence of the light color is established by experience, as in rural areas or where there is little smoke. When the exterior surface of roof exposed to the sun is a light color, such as white or aluminum (which absorb approximately 50 percent and reflect 50 percent of the solar radiation) add to the temperature differential for roof in shade 55 percent of the difference between the roof in sun and roof in shade. When the roof exposed to the sun is a medium color such as light grey, blue or green, or bright red, add 80 percent of this difference.

For solar transmission in latitudes other than 40 deg north, and in other months. The table values of temperature differentials will be approximately correct for a roof in the following months:

North Latitude: Latitude (deg)	Months	South Latitude: Latitude (deg)	Months
0	All Months	0	All Months
10	All Months	10	All Months
20	All Months except Nov, Dec, Jan	20	All Months except May, June, July
30	Mar, Apr, May, June, July, Aug, Sept	30	Sept, Oct, Nov, Dec, Jan, Feb, Mar
40	April, May, June, July, Aug	40	Oct, Nov, Dec, Jan, Feb
50	May, June, July	50	Nov, Dec, Jan

For other months, the total temperature differential (t_x) may be approximated by the use of the following formula:

$$t_x = t_s + \frac{I_x}{I_y}(t_v - t_s)$$

where t_s = temperature differential for the same wall in shade for desired time of day; obtained from Table 12.

I_y = maximum solar transmission through glass, Btu per (hr) (sq ft) for flat skylight in July, 40 deg north latitude (*Note:* this is maximum value irrespective of time).

I_x = same as I_y except use the maximum value for flat skylight, for month, and latitude desired for t_x.

t_v = temperature differential for particular roof exposed to sun for the desired time of day from Table 12.

(Note that this makes adjustment only for solar radiation and that there may be additional correction for outdoor temperature.)

Tables 12 and 13 are based on an equation re-arranged from Equation 5 to read:

$$\frac{q}{A} = U[t_m + \lambda(t_o{}^* - t_m) - t_i] \tag{6}$$

Let $t_m + \lambda(t_o{}^* - t_m) = t_p$, a net equivalent outdoor temperature for combined periodic and mean heat flow. Magnitudes of t_p will vary cyclically with time. Then,

$$\frac{q}{A} = U(t_p - t_i) \tag{7}$$

which is a simple form analogous to the steady state equations of Chapters 5 and 9. The rate of heat flow is obtained by multiplying the overall heat transmission coefficient of the structure by the equivalent temperature differential obtained from the tables.

Tables 12 and 13 were developed by using an outside surface conductance of 4.0 and an inside film conductance of 1.65 Btu (hr) (sq ft) (F deg). A reduction was made in the temperature differentials for roofs amounting to some 20 percent of solar radiation as explained by Stewart.[12] This was to compensate for several factors, one of which is the radiant heat lost to the