Table 17 .... Solar Heat Gain Factors[a]—Btuh Per Square Foot—for December 21

Latitude	Sun Time[b] AM↓	N	NE	E	SE	S	SW	W	NW	Horiz	Sun Time[a]
24 Deg North	6 a.m.	—	—	—	—	—	—	—	—	—	6 p.m.
	7	2	11	37	39	18	2	2	2	4	5
	8	10	24	133	158	88	11	9	9	38	4
	9	14	15	143	199	136	15	13	13	85	3
	10	16	17	112	201	172	35	17	16	131	2
	11	17	18	55	178	188	81	18	17	164	1
	12 N	17	18	20	137	198	137	20	18	174	12 N
32 Deg North	6 a.m.	—	—	—	—	—	—	—	—	—	6 p.m.
	7	—	—	—	—	—	—	—	—	—	5
	8	7	15	97	120	71	8	7	6	18	4
	9	12	13	125	186	133	13	11	11	58	3
	10	14	15	99	197	175	41	15	13	98	2
	11	15	16	51	182	196	91	16	15	121	1
	12 N	15	16	18	145	205	145	18	16	134	12 N
40 Deg North	6 a.m.	—	—	—	—	—	—	—	—	—	6 p.m.
	7	—	—	—	—	—	—	—	—	—	5
	8	4	7	59	69	49	4	4	3	8	4
	9	9	10	102	156	115	11	9	8	33	3
	10	12	13	85	179	161	43	12	11	64	2
	11	13	14	46	172	190	94	14	13	85	1
	12 N	13	14	16	140	201	140	16	14	94	12 N
48 Deg North	6 a.m.	—	—	—	—	—	—	—	—	—	6 p.m.
	7	—	—	—	—	—	—	—	—	—	5
	8	—	—	—	—	—	—	—	—	—	4
	9	6	6	65	100	74	8	6	5	13	3
	10	9	10	68	147	135	38	10	8	32	2
	11	10	11	38	150	170	85	12	10	50	1
	12 N	10	11	13	126	181	126	13	11	54	12 N
		N	NW	W	SW	S	SE	E	NE	Horiz	←PM

[a] Values in bold face are for hours when sun is striking fenestration.
[b] Values for *morning* hours must be selected by reading *down* for the proper direction listed at the top of the columns.
[c] Values for *afternoon* hours must be selected by reading *up* for the proper direction listed at the bottom of the columns.

(*Continued from p. 508*)

Table 22. Double Glazing with Between Glass Shading. Description of the shading materials with the exception of the louvered sun screen may be found in the section discussing *Tables 20A and 20B*. The description of the louvered sun screen is:

Type 1. Green tinted, solar absorption of slat surface = 0.4, ratio of slat width to slat spacing = 1.0, slat angle = 17 deg.
Type 2. Black, solar absorption of slat surface = 0.8, ratio of slat width to slat spacing = 0.8, slat angle = 17 deg.

The Shading Coefficients for the louvered sun screen and glass combinations apply only when the sun does not shine through the louvers. During early morning hours for NE, E, and SE exposures and late afternoon hours for SW, W, and NW exposures, higher Shading Coefficients should be used. When the sun is just above the horizon, they should be increased approximately 30 percent with lesser corrections for higher altitudes. A detailed study of these types of fenestration is included in Reference 38.

Design Tables for Glass Block Walls

Data for glass block are presented in the same manner as for sheet and plate glass, insulating glass, and pattern glass. For data on glass block skylights, see Tables 28 and 29 of Chapter 26 in the 1963 ASHRAE GUIDE AND DATA BOOK and the accompanying text.

Table 24 describes the glass block patterns discussed in the following text, and gives shading coefficients to be applied to Tables 11 to 17 to calculate the instantaneous solar heat gain. To this must be added the heat gain due to air-to-air temperature difference, using U values listed in Table 18.

Table 18 .... U Values for Various Fenestration (For 7½ mph Wind)

Btuh per (Square Foot) (Fahrenheit Degree)

Type of Glass	U Value: No Shading	U Value: Shading[a]
Any Single Glass	1.06	0.81
Insulating Glass—¼ in. Air Space	0.64	0.54
½ in. Air Space	0.61	0.52
¾ in. Air Space	0.56	0.48
Prime Window Plus Storm Window —Air Space 1 in. or more	0.54[b]	0.47[b]
	No Supplementary Shading	
Double Glazing with Between-Glass Shading		
Louvered Sun Screen—in Contact with Glass	0.95	
—Separated by Air Space	0.63	
Venetian Blinds	0.44	
Glass Block Panels[c]		
Types I and II	0.56	
Types II, III, and IIIA	0.48	

[a] Values apply to tightly closed Venetian blinds, draperies, and roller shades.
[b] Values apply to storm sash with a tight air space. Air leakage present in virtually all storm windows will, in effect, increase this value.
[c] Values listed are for 7¾ × 7¾ × 3¾ in. block. For 11¾ × 11¾ × 3¾ in. block, reduce the listed value by 0.04, and for 5¾ × 5¾ × 3¾ in. block, increase the listed value by 0.04.

Table 19 .... Shading Coefficients—Single Glass and Insulating Glass[a]—No Shading

Single Glass: Type of Glass	Nominal Thickness[b]	Solar Trans.[b]	Glass in Sun	Glass in Shade
Regular Sheet, Regular Plate	⅛, 3/16	0.86	1.00	1.00
	¼	0.80	0.95	0.95
	3/8	0.75	0.91	0.91
	½	0.71	0.88	0.88
Heat-Abs[d] Sheet, Heat-Abs[d] Plate	7/32	0.51	0.71	0.78
	¼	0.46	0.67	0.74
	¾	0.34	0.57	0.64
Grey[c] Sheet	⅛	0.59	0.78	0.78
	5/32	0.74	0.90	0.90
	7/32	0.45	0.66	0.66
	7/32	0.71	0.88	0.88
	¼	0.67	0.86	0.86
Grey[c] Plate	11/32	0.52	0.72	0.72
	¼	0.47	0.70	0.70
	⅜	0.33	0.56	0.56
	½	0.24	0.50	0.50

Insulating Glass[a]: Type of Glass	Nominal Thickness[b,e]	Solar Trans.[b]: Outer Pane	Solar Trans.[b]: Inner Pane	Glass in Sun	Glass in Shade
Regular Sheet Out, Regular Sheet In	3/32, ⅛	0.86	0.86	0.90	0.84
Regular Plate Out, Regular Plate In	¼	0.80	0.80	0.83	0.77
Heat-Abs[d] Plate Out, Regular Plate In	¼	0.46	0.80	0.56	0.53
Grey[c] Plate Out, Regular Plate In	¼	0.46	0.80	0.56	0.53
Grey Plate[c] with Sun Control Film Out, Regular Plate In	¼	0.23	0.80	0.42	0.44

[a] Refers to factory-fabricated units with 3/32, ¼, or ½ in. air space or to prime windows plus storm windows.
[b] Refer to manufacturer's literature for values.
[c] Thickness of each pane of glass, not thickness of assembled unit.
[d] Heat absorbing sheet does not meet radiant transmittance requirements of Federal Specification DD-G-451a. Heat absorbing plate meets these requirements.
[e] Glare-reducing glasses other than grey in color will have approximately equal shading coefficients for equal solar transmittances. Consult manufacturer's data for specific product values.

Example 8: Find the total instantaneous heat gain through a west wall of 8-in. hollow glass block of Type III at 4:00 p.m. and 40 deg north latitude on August 21. The design temperatures are 75 F indoors and 95 F outdoors.

Solution: The gain due to solar radiation is found by multiplying the solar heat gain factor listed in Table 13 for a west wall at 3 p.m., *one hour earlier than the design time*, by the shading coefficient from Table 24. Then add the heat gain due to air-to-air temperature difference, using the U value selected from Table 18.

The total instantaneous heat gain is:

$$q = 180 \times 0.33 + 20 \times 0.48 = 69.0 \text{ Btu per (hr) (sq ft)}$$

Effect of Outside Shading Devices

Detailed discussions of outside shading devices may be found in References 39 and 42. As a general consideration shading devices such as awnings, exterior louvered sun screens and overhangs will reduce the total solar gain by approximately 80 percent for sunlit exposures. This value applies when the glass is completely shaded by the shading device and assumes the installation allows free air movement between the shading device and the glass. The approximate equation for total heat transfer when exterior shading is used may be written as follows:

$$[q/A] = 0.20S[F_{Di}I_D + F_{di}I_d] + [U(t_o - t_i)] \qquad (4)$$

See Equation 3 for definition of terms. For medium and high rise structures the previously mentioned references should be studied to provide more precise values.

The above equation in block form becomes:

$$\left[\begin{matrix}\text{Total heat transfer} \\ \text{through the glass}\end{matrix}\right] = 0.20\left[\begin{matrix}\text{Shading} \\ \text{Coefficient}\end{matrix}\right] \times \left[\begin{matrix}\text{Solar Heat} \\ \text{Gain Factor}\end{matrix}\right] + \left[\begin{matrix}\text{Heat transfer due to} \\ \text{differences in outdoor and} \\ \text{indoor air temperatures}\end{matrix}\right]$$

Roof Overhang, Canopies, and Other Horizontal Projections

In some cases, a considerable reduction in heat transfer through windows can be attained by the use of a suitable horizontal projection. This is particularly true for S, SE, and SW orientations. Table 25 lists the required projections to produce a shadow height of 10 ft on a window or wall. The projection necessary for other shadow heights can be found by direct ratio. For example, a shadow height of 5 ft would require one-half the projection needed for a shadow height of 10 ft. Note that the table is for the period from April 11 through September 1.

The choice of projection should not necessarily be based on providing complete shading during all daylight hours. Reference should be made to Tables 11 through 22 to determine during which hours of the day the solar gain is sufficiently large to indicate the desirability of exterior shading. This and the architectural practicability of the required projection should be deciding factors.