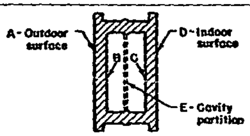
Table 18 . . . . Description of Glass Block Patterns



Hollow Glass Block Used for Vertical Walls

Type I —Smooth Face
- A, D: Smooth
- B: Wide vertical ribs or flutes
- C: Wide horisontal ribs or flutes
- E: None

Type II —Semi-Light Diffusing
- A, D: Narrow vertical ribs or flutes
- B, C: Etched or stippled
- E: None

Type III—Light Diffusing
- A, D: Narrow vertical ribs or flutes
- B, C: Etched or stippled
- E: Glass fiber screen

Type IV —Light Diffusing
- A, D: Close pitch deep horizontal corrugations
- B, C: Vertical light diffusing prisms
- E: None

Type IVA—Light Diffusing
- Same as IV except corrugations vertical

Type V —Light Directing
- A, D: Close pitch deep vertical corrugations
- B, C: Horizontal light directing prisms
- E: None

Hollow Glass Block Used for Horizontal Skylights

Type VI —Light Directing (skylight)
- A: Smooth surface
- B: Light-directing prisms
- C, D: Light-diffusing surface
- E: Clear glass fiber screen

Type VII—Light-diffusing (skylight)
- A: Smooth surface
- B, C: Stippled surface
- D: Narrow-ribbed surface
- E: Green-tinted glass fiber screen

The total instantaneous heat gain is, from Equation 2a,

$$q = 86 \times 0.65 + 26 \times 1.4 = 92.3 \text{ Btu per (hr) (sq ft)}.$$

Effect of Deviations from Design Conditions

If the indoor temperature differs from 80 F, or the design outdoor dry-bulb temperature differs from 95 F, corrections can be made to the convection and radiation gain values for flat glass, rolled figured glass, and glass block according to the schedule in Table 24.

The effect of the humid industrial-type atmosphere is to cause a considerable reduction in heat gain, if all factors except solar intensity remain the same. Reference 22 gives heat gain values for four orientations at 40-deg north latitude on August 1 for several types of flat glass and glass block, and solar intensities typical of humid industrial atmospheres. These data show that the following approximate reductions, based on total gain for the day, can be expected: 20 percent for all types of glass and glass block in east or west facing walls; 10 percent for south facing flat glass; 5 percent for south facing glass block walls.

Shading of Glass Areas—Shade Factors

The shade factor is defined as the total gain from a shade-glass combination minus the convection and radiation gain from single unshaded common window glass divided by the total incident solar radiation transmitted by single unshaded common window glass. In equation form,

$$\text{Shade factor} = \frac{\begin{pmatrix}\text{Total Gain from}\\ \text{Shade Glass}\\ \text{Combination}\end{pmatrix} - \begin{pmatrix}\text{Convection \& Radiation}\\ \text{Gain from Single}\\ \text{Unshaded Common Glass}\end{pmatrix}}{\text{Total Solar Energy Transmitted by Single Unshaded Common Glass}}$$

Design shade factors for a number of combinations are listed in Table 25. The total gain for a shaded window is found by multiplying the values of Table 12 by the appropriate shade factor and adding to these values the corresponding values from Table 13.

The values for sunlit windows are average values based upon calculations for several orientations. Actually the shade factor varies somewhat with orientation and time of day, because the proportion of direct to diffuse incident solar radiation as well as the profile angle varies. Generally these variations may be neglected.

There are a number of variables affecting these ratios such as color, fit, solar altitude, and angle of incidence of the solar radiation. These values, therefore, must be considered as approximate, only, and will have to be used with considerable judgment. An inside shade is effective to the extent of its reflectivity, since the portion of the solar radiation directly transmitted by the glass that is absorbed by the shade is transferred by convection to the room air, and by radiation to the solid room surfaces.

A more complete analysis of shade factors may be found in Reference 25.

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. In Table 26 are tabulated 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 12 through 15 to determine during which hours of the day the solar gain is sufficiently large to indicate the desirability of shading. This and the architectural practicability of the required projection should be deciding factors.

Vertical glass, which is not mounted in the plane of the building surface, is partially shaded by the setback. If a vertical window of height l and width w be set back from the plane of the building a distance s, the fraction G_f of the total area of the window which receives direct solar radiation is:

$$G_f = 1 - \frac{r_1 \tan \beta}{\cos \gamma} - r_2 \tan \gamma + \frac{r_1 r_2 \tan \beta \tan \gamma}{\cos \gamma} \qquad (5)$$

Table 19 . . . . Instantaneous Rate of Heat Gain Due to Transmitted Direct and Diffuse Solar Radiation by Unshaded Walls of 8-in. Hollow Glass Block of Type I Pattern

For Clear Atmospheres and 18 Deg Declination, North (August 1)

Note: For total instantaneous heat gain add these values to Table 21 values

Latitude	Sun Time AM → ↓		N	NE	E	SE	S	SW	W	NW
			Instantaneous Heat Gain in Btu per (hr) (sq ft)							
30 Deg north	6 a.m.	6 p.m.	4	45	55	12	2	2	2	2
	7	5	5	59	94	29	4	3	3	3
	8	4	5	42	94	38	5	4	4	4
	9	3	5	25	59	34	6	5	5	5
	10	2	6	12	27	24	9	6	6	6
	11	1	6	8	12	13	10	7	6	6
	12		6	6	7	8	9	8	7	6
40 Deg north	5 a.m.	7 p.m.	1	3	3	0	0	0	0	0
	6	6	5	50	67	17	2	2	2	2
	7	5	4	54	98	36	4	4	4	4
	8	4	5	34	90	47	5	4	4	4
	9	3	5	18	59	47	10	5	5	5
	10	2	6	8	29	35	15	5	6	6
	11	1	6	6	13	22	18	7	6	6
	12		6	6	6	13	17	13	6	6
50 Deg north	5 a.m.	7 p.m.	4	28	27	4	1	1	1	1
	6	6	5	53	77	22	3	2	2	2
	7	5	4	44	101	44	4	4	4	4
	8	4	4	26	86	57	7	4	4	4
	9	3	5	12	57	60	16	5	5	5
	10	2	5	6	29	54	25	6	5	5
	11	1	6	6	14	34	32	10	6	6
	12		6	6	6	20	34	20	6	6
		↑ PM →	N	NW	W	SW	S	SE	E	NE

where

$r_1 = s/l$, $r_2 = s/w$, β = solar altitude, and γ is the wall solar azimuth (See Fig. 1)

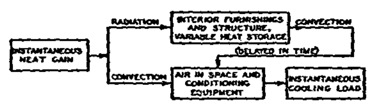
INSTANTANEOUS HEAT GAINS VS. INSTANTANEOUS COOLING LOADS

The difference between instantaneous heat gain and instantaneous cooling load has been mentioned previously; its practical importance is sufficient to warrant further consideration. Fig. 4 offers a simplified schematic illustration showing how the *radiative* part of the instantaneous heat gain is first absorbed by solid objects, and is not encountered by the conditioning equipment as a cooling load until some later time, when it finally appears in the air stream entering the equipment. While it is true that some lag also is inherent in convective heat transfer and the time required to change the air in the conditioned space, this is usually of the order of a few minutes to perhaps half an hour. Heat storage in the interior furnishings and structure increases according to the proportion of the instantaneous heat gain which is in the form of radiation, and also increases as the thermal capacitance of the objects and materials involved is increased.

Constituents of the total instantaneous heat gain which have appreciable radiation components include those due to glass areas, exposed walls and roofs, lighting, appliances and people.

A large difference in the time-incidence of the peaks between various spaces or parts of the same space indicates the necessity for zoning. In a building having an east and west exposure, where solar heat gains form a fair share of the cooling load, the times of individual zone peaks are apt to be some hours apart, and the peak load of one plus the off-peak load of the other will be substantially less than their combined peak loads. Proper zoning will permit operation to take full advantage of this condition or of similar conditions of nonsimultaneous peaks, and will result in a lower total load and in savings in equipment.

A factor similar in effect and closely related to the non-



The radiation absorbed by the interior furnishings and structure reaches the conditioning equipment after a considerable delay in time.

Fig. 4 . . . . Origin of the Difference Between the Magnitudes of the Instantaneous Heat Gain and Instantaneous Cooling Load