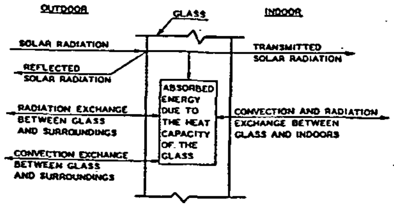

Fig. 2 .... Instantaneous Heat Balance for a Glass or Glass Block Section

sent the $[F_D I_D + F_d I_d]$ term in Equation 2 for this one type of glass. Valnes in bold-face type (Tables 11 through 17) are for hours when the sun is striking the fenestration, light-face type for fenestration in the shade.

In the prediction of the heat transfer due to difference in indoor and outdoor air temperatures a reasonable outdoor design temperature must be chosen. Table 1 lists outdoor dry-bulb temperatures for summer conditions. These values may be used for June through September with good accuracy. For other months, lower temperatures apply. Data in this regard are limited, and the choice of temperature must be determined based on local weather experience. Winter design data for heating should not be used for estimating winter cooling requirements. Somewhat higher temperatures close to the maximum expected for each month are recommended.

U values for all common fenestration are shown in Table 18 for a wind speed of $7\frac{1}{2}$ mph.

Tables 19 through 22 present *Shading Coefficients* for commonly used combinations of flat glass and shading devices. The Shading Coefficient is the ratio of the heat gain due to transmitted and absorbed solar energy by the fenestration being considered to the heat gain due to transmitted and absorbed solar energy by unshaded double-strength sheet glass.

For most types of fenestration, the Shading Coefficient remains constant within the normal accuracy of air-conditioning load predictions. In the instances where this is not the case, the variations are explained in the text. The equation for total heat transfer (Equation 2) may be written in the alternate form:

$$[q/A] = S[F_{Di} I_D + F_{di} I_d] + [U(t_o - t_i)] \quad (3)$$

where

q/A = instantaneous rate of heat transfer, Btu per (hour) (square foot).
S = Shading Coefficient for fenestration being considered.
F_{Di}, F_{di} = ratio of the solar heat gain for double strength sheet glass to the incident direct and diffuse solar radiation, respectively, dimensionless.
I_D, I_d = incident direct and diffuse solar energy, respectively, Btu per (hour) (square foot).
U = overall coefficient of heat transmission, Btu per (hour) (square foot) per (Fahrenheit degree).
t_o, t_i = outdoor and indoor air temperature, respectively, Fahrenheit.

This equation in block form becomes:

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

Brief discussions of each table of Shading Coefficients follow.

Table 19. Single Glass and Insulating Glass—No Shading. Shown in this table are Shading Coefficients for the types of glass in common use as fenestration. Each is identified by type, nominal thickness, and approximate transmittance of normal incident direct solar energy. Generally each glass manufacturer publishes or is able to furnish upon request these three items regarding each glass he produces. The Shading Coefficients listed in the column headed *Glass in Sun* should be used with the Solar Heat Gain Factors shown in bold face type in Tables 11 through 17 The coefficients shown in the column headed *Glass in Shade* should be used with the light face values.

Values in Table 19 may be interpolated or extrapolated. If the normal incident solar transmittance of a type of glass not listed is known, a simple plot of solar transmittance versus Shading Coefficient will yield the Shading Coefficient for the unlisted glass type. This applies to all types of single glass and insulating glass when the inner pane is regular sheet or plate glass. Insulating units are normally manufactured in this manner.

Tables 20A and 20B. Single Glass with Indoor Shading. When some sun control is incorporated with glass fenestration, small differences in the solar transmittance and absorptance properties of the glass become negligible from a practical air-conditioning load viewpoint. It is reasonable to group various glass types as is done in these tables.

Table 20A gives Shading Coefficients for Venetian blinds and roller shades. Table 20B gives Shading Coefficients for draperies. Specific physical and thermal properties of the shading devices included in Tables 20A and 20B are shown in Table 23. If the properties of the actual shading device to be used are not specifically known, the value in Table 20A or 20B which most closely approximates these properties should be used. Care should be used in interpolating and extrapolating values in Tables 20A through 22.[38–40]

Draperies of fabric materials may be defined as to the color or shade of the yarn, i.e., light, medium, or dark, and also the weave of the fabric in regard to the open area occurring between the yarns or fibers. The light, medium, and dark colors of the yarns is in terms of light reflectance. Yarn reflectance differs from fabric reflectance because of the openness of the weave. To obtain yarn reflectance, divide the overall fabric reflectance by the term one minus the openness factor. The weave of the fabric may be classified as open, semi-open, and closed, expressed as a percentage of open area to overall area of the fabric.

A method of classifying drapery fabrics is shown in Fig. 3. The openness of a drapery fabric affects the amount of radiation and reradiation energy falling upon individuals near window areas, and thereby affecting thermal comfort. Openness also is one factor determining glare reduction, outward vision, and privacy. It should be noted that when a drapery is open, its condensed folds which may remain over the glass opening can constitute relatively effective insulation.

The shading coefficients for draperies occurring in Tables 20B and 21B correspond with the classification method of Fig. 3, and are for draperies of 100 percent fullness (twice as much width of fabric as width of space covered by the drapery).

Tables 21A and 21B. Insulating Glass with Indoor Shading. Refer to earlier text under heading *Tables 20A and 20B, Single Glass with Indoor Shading* for description of shading devices. As noted below Tables 21A and 21B, the Shading Coefficients apply for any air space thickness.

(*Continued on p. 510*)

Table 11 .... Solar Heat Gain Factors[a]—Btuh per Square Foot—for June 21

Latitude	Sun Time[b] AM↓→	N	NE	E	SE	S	SW	W	NW	Horiz	Sun Time[c]
24 Deg North	6 a.m.	35	100	102	38	5	5	5	5	20	6 p.m.
	7	43	164	178	83	10	10	10	10	74	5 p.m.
	8	36	166	194	100	15	15	15	16	140	4
	9	26	137	172	96	18	18	18	18	201	3
	10	22	91	123	73	20	20	20	20	243	2
	11	22	44	61	43	22	22	22	22	267	1
	12 N	24	24	24	24	25	24	24	24	276	12 N
32 Deg North	6 a.m.	39	120	126	49	6	6	6	6	29	6 p.m.
	7	34	162	186	94	11	11	11	11	83	5
	8	22	153	196	118	16	15	15	16	145	4
	9	18	115	172	118	19	18	18	18	201	3
	10	20	65	123	100	26	20	20	20	238	2
	11	22	27	61	67	36	22	22	22	262	1
	12 N	23	23	23	32	41	32	23	23	270	12 N
40 Deg North	6 a.m.	40	136	145	62	7	7	7	7	40	6 p.m.
	7	25	157	192	106	12	12	12	12	91	5
	8	16	138	197	134	17	15	15	16	148	4
	9	18	93	172	139	30	18	18	18	198	3
	10	20	43	122	125	48	20	20	20	231	2
	11	21	22	59	94	67	23	21	21	255	1
	12 N	22	22	22	51	73	51	22	22	262	12 N
48 Deg North	6 a.m.	36	145	159	74	8	8	8	8	50	6 p.m.
	7	17	149	193	119	12	12	12	12	97	5
	8	15	122	197	150	20	15	15	15	148	4
	9	18	71	171	159	49	18	18	18	191	3
	10	20	26	120	153	81	20	20	20	222	2
	11	20	20	57	119	103	30	20	20	242	1
	12 N	21	21	21	74	111	74	21	21	249	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.

Table 12 .... Solar Heat Gain Factors[a]—Btuh Per Square Foot—for July 21

Latitude	Sun Time[b] AM↓→	N	NE	E	SE	S	SW	W	NW	Horiz	Sun Time[c]
24 Deg North	6 a.m.	25	87	93	39	4	4	4	4	16	6 p.m.
	7	32	157	179	90	10	10	10	10	69	5
	8	25	160	200	115	13	15	15	16	137	4
	9	19	130	178	111	18	18	18	18	198	3
	10	20	82	128	90	21	21	21	21	242	2
	11	23	37	63	54	25	23	23	23	270	1
	12 N	24	24	24	26	29	26	24	24	279	12 N
32 Deg North	6 a.m.	28	106	115	52	5	5	5	5	23	6 p.m.
	7	24	154	186	104	11	11	11	11	76	5
	8	18	146	200	131	15	15	15	15	140	4
	9	18	107	177	134	22	18	18	18	196	3
	10	20	57	128	116	36	20	20	20	236	2
	11	22	24	62	81	48	22	22	22	261	1
	12 N	23	23	23	39	52	39	23	23	270	12 N
40 Deg North	6 a.m.	29	120	135	63	6	6	6	6	31	6 p.m.
	7	17	148	190	111	11	11	11	11	82	5
	8	16	131	200	145	18	15	15	15	140	4
	9	18	86	176	154	38	18	18	18	190	3
	10	20	36	126	140	65	20	20	20	227	2
	11	21	22	60	107	84	25	21	21	251	1
	12 N	21	22	22	61	91	61	22	22	258	12 N
48 Deg North	6 a.m.	27	130	149	75	7	7	7	7	39	6 p.m.
	7	13	142	192	126	11	11	12	12	86	5
	8	15	115	200	160	25	15	15	15	137	4
	9	18	65	175	172	60	18	18	18	182	3
	10	19	22	123	162	96	19	19	19	215	2
	11	20	20	59	133	119	36	20	20	235	1
	12 N	21	21	21	86	128	86	21	21	242	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.