

TABLE 10. SUMMER DESIGN SOL-AIR TEMPERATURES FOR NEW YORK, N. Y.
(NORTH LATITUDE 40°46'; ELEVATION 180 Ft)

MEAN SUN TIME	SOL-AIR TEMPERATURE, t_o , FAHRENHEIT DEGREES					
	Any Surface ^a	Horizontal	North	East	South	West
Ratio ^a : $\frac{b}{f_o}$	0	0.25	0.25	0.25	0.25	0.25
12 midnight	79	79	79	79	79	79
1 a.m.	78	78	78	78	78	78
2	77	77	77	77	77	77
3	77	77	77	77	77	77
4	76	76	76	76	76	76
5	76	76	76	76	76	76
6	76	81	80	89	77	77
7	80	96	85	106	82	82
8	86	110	85	114	86	85
9	88	127	90	120	97	90
10	88	137	92	114	104	92
11	90	148	94	106	111	94
12 noon	92	155	97	97	115	98
1 p.m.	94	154	98	98	117	103
2	94	152	99	99	112	126
3	94	144	99	99	102	136
4	94	136	99	99	97	145
5	93	121	103	97	97	140
6	90	106	106	93	93	134
7	88	93	102	90	90	115
8	85	85	85	85	85	85
9	83	83	83	83	83	83
10	82	82	82	82	82	82
11	81	81	81	81	81	81
24-hr avg. t_m	84.8	106.4	88.5	92.3	90.7	96.5

^a b = surface absorptivity, dimensionless. f_o = unit convective conductance, Btu per (hr) (sq ft) (F deg)^b Values in this column are magnitudes of t_o , the outdoor air temperature.TABLE 11. SUMMER DESIGN SOL-AIR TEMPERATURES FOR LINCOLN, NEBR.
(NORTH LATITUDE 40°50'; ELEVATION 1225 Ft)

MEAN SUN TIME	SOL-AIR TEMPERATURE, t_o , FAHRENHEIT DEGREES					
	Any Surface ^a	Horizontal	North	East	South	West
Ratio ^a : $\frac{b}{f_o}$	0	0.25	0.25	0.25	0.25	0.25
12 midnight	89	89	89	89	89	89
1 a.m.	88	88	88	88	88	88
2	86	86	86	86	86	86
3	84	84	84	84	84	84
4	84	84	84	84	84	84
5	82	82	82	82	82	82
6	81	87	88	100	82	82
7	82	103	93	125	85	85
8	88	124	94	137	92	92
9	93	143	98	142	104	98
10	96	160	102	138	115	102
11	100	172	106	129	125	106
12 noon	102	178	108	115	130	108
1 p.m.	104	180	110	110	132	119
2	106	178	112	112	131	137
3	107	170	113	113	126	150
4	107	158	112	112	117	158
5	106	142	113	110	110	157
6	105	126	117	108	108	149
7	102	109	113	104	104	128
8	98	99	98	98	98	98
9	94	94	94	94	94	94
10	92	92	92	92	92	92
11	90	90	90	90	90	90
24-hr avg. t_m	94.4	121.6	98.6	105.9	102.1	106.6

^a b = surface absorptivity, dimensionless. f_o = unit convective conductance, Btu per (hr) (sq ft) (F deg).^b Values in this column are magnitudes of t_o , the outdoor air temperature.

Cooling Load

2. To adjust the data in Tables 10 and 11 for variations in t_o :a. Establish the magnitude of t'_o at the locality in question.b. Determine the difference ($t'_o - t_o$).c. Add (algebraically) the difference ($t'_o - t_o$) to the data tabulated.3. To adjust the data in Tables 10 and 11 to other magnitudes of b/f_o than 0.25:a. For New York or Lincoln, merely interpolate or extrapolate the tabulated data by direct proportion, using the column for $b/f_o = 0$.b. For other localities, first determine $t'_o = t'_o + b/f_o I'$, for $b/f_o = 0$ and $b/f_o = 0.25$. Then interpolate or extrapolate by direct proportion as before.

Sol-air data for a particular locality may be adjusted for different azimuths of the vertical surface in question in a similar manner; although, all things considered, a simple interpolation between the four points of the compass should serve for all but the most accurate calculations.

An example of the use of the tables in determining sol-air temperature is given.

Example 2. Find the summer design sol-air temperature in New York, N. Y., for a west wall which has a solar absorptivity of 0.7, at a sun time of 3:00 p. m.

Use $f_o = 4$; then $\frac{b}{f_o}$ for this wall is $\frac{0.7}{4.0}$ or 0.175.

From Table 10: for $\frac{b}{f_o} = 0$, $t_o = 94$ F; for $\frac{b}{f_o} = 0.25$, $t_o = 136$ F; and by linear interpolation for this wall:

$$t_o = 94 + \frac{0.175}{0.25} (136 - 94) = 94 + 29 = 123 \text{ F.}$$

Sol-air temperatures are especially helpful in the calculation of periodic heat transfer, as will be illustrated in the material which follows.

PRINCIPLES OF PERIODIC HEAT FLOW

Calculation principles for periodic heat flow are dealt with briefly in this section; in the section which follows, *practical tables are given to facilitate rapid design estimates*. In addition to the rate of heat entry into the outside building surface these tables take into account the following factors:

1. The thermal conductivity of material.
2. The density, specific heat and character of material.
3. Thickness of material.
4. Room air temperature.
5. Unit convective conductance between the inside surface and room air; and radiant heat transfer between the inside surfaces and other surfaces in the room.

Time Lag

The fundamental analysis of periodic heat flow is complicated when compared with steady-state calculations on account of the time-variable storage of heat from point to point through a wall or roof. The cyclic variation of outdoor conditions produces a related cyclic variation of temperature and heat flow throughout each structural section exposed to the weather. The cyclic variations undergo a progressive *shift in phase* and