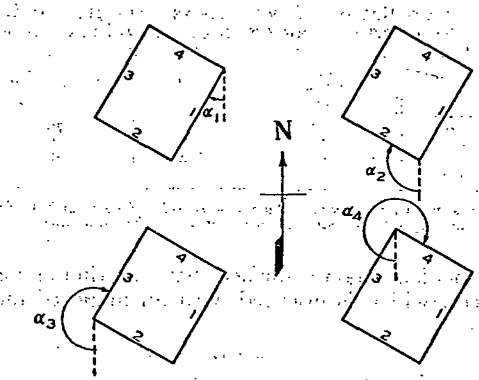

FIG. 3. DEFINITION OF AZIMUTH

The azimuth angle α is always measured clockwise from the south to the exterior side of the wall in question.

energy to the sky and to the surroundings. The heat balance on an outer surface, for a unit time interval, may be expressed as follows:

$$\left\{\begin{array}{l}\text{Heat entering}\\ \text{outer surface}\end{array}\right\} = \left\{\begin{array}{l}\text{Incident direct}\\ \text{solar radiation}\end{array}\right\} + \left\{\begin{array}{l}\text{Incident sky}\\ \text{radiation}\end{array}\right\} - \left\{\begin{array}{l}\text{Reflected direct}\\ \text{radiation}\end{array}\right\} - \left\{\begin{array}{l}\text{Reflected sky}\\ \text{radiation}\end{array}\right\} - \left\{\begin{array}{l}\text{Radiation emitted}\\ \text{to sky by surface}\end{array}\right\} \pm \left\{\begin{array}{l}\text{Air-to-surface}\\ \text{convection}\end{array}\right\} \quad (2)$$

The convective heat transfer may be either to or from the surface, depending upon whether the air temperature is higher or lower than the surface temperature. No term has been included to represent radiation exchange with other objects in the surroundings, as this effect is not usually of significant magnitude relative to the others.

In practical calculations, the *difference* between incident and reflected radiation is computed by multiplying the incident radiation by a factor called the absorptivity or the emissivity; see Table 6 and Equation 3, Chapter 5. Convection is calculated as explained in Chapters 5 and 6.

The daytime radiation emitted to the sky by a surface is not usually calculated as a separate item in practical air-conditioning work. Its effect may be roughly accounted for by an adjustment of the magnitude of the absorptivity factor for solar radiation, and this approach is often followed in making emissivity measurements for building materials exposed to the sun and sky. During the night, however, the emitted radiation becomes very important.

TABLE 7. VALUES OF K FOR HORIZONTAL PLANES IN NORTH LATITUDES[a] DURING THE PERIOD MAY 2-AUGUST 10

Local Mean Sun Time[b]		North Latitude—Degrees					
A.M.	P.M.	25	30	35	40	45	50
5	7	——	——	——	.034	.070	.106
6	6	.145	.171	.196	.220	.242	.262
7	5	.365	.382	.395	.406	.414	.418
8	4	.570	.578	.581	.580	.574	.564
9	3	.747	.746	.740	.729	.712	.689
10	2	.882	.876	.863	.843	.817	.785
11	1	.967	.957	.940	.915	.884	.845
12		.996	.985	.966	.940	.906	.866

[a]Figured for solar declination of 20 deg. [b]The relation between local mean sun time and civil time may be obtained from Weather Bureau offices in various localities.

TABLE 8. VALUES OF K FOR VERTICAL PLANES IN NORTH LATITUDES DURING THE PERIOD MAY 2-AUGUST 10

Latitude[a] Deg	Local Mean Sun Time[b] A.M. ↓	P.M. ↓	Azimuth Scales for Values of K in Ordinary Type[c]												
	A.M. →	P.M. →	0 180	15 165	30	45	60	75	90	105	120	135	150	165	180
30	6	6	.940	.831	.666	.455	.213	*.043*	*.296*	*.529*	*.726*	*.874*	*.962*	*.984*	*.940*
	7	5	.908	.832	.699	.518	.303	.066	*.176*	*.404*	*.605*	*.765*	*.873*	*.922*	*.908*
	8	4	.814	.770	.674	.532	.354	.151	*.061*	*.270*	*.460*	*.619*	*.735*	*.802*	*.814*
	9	3	.664	.651	.593	.495	.363	.207	.036	*.137*	*.301*	*.444*	*.557*	*.632*	*.664*
	10	2	.470	.482	.462	.410	.331	.229	.111	*.015*	*.139*	*.254*	*.352*	*.425*	*.470*
	11	1	.243	.276	.289	.283	.258	.217	.158	.089	.015	*.061*	*.132*	*.194*	*.243*
	12		.000	.045	.087	.123	.150	.168	.174	.168	.150	.123	.087	.045	.000
45	5	7	.908	.770	.579	.349	*.095*	*.165*	*.414*	*.635*	*.812*	*.934*	*.993*	*.984*	.908
	6	6	.940	.845	.693	.493	.260	.010	*.242*	*.477*	*.679*	*.835*	*.935*	*.970*	*.940*
	7	5	.908	.859	.751	.592	.393	.167	*.070*	*.302*	*.514*	*.691*	*.821*	*.895*	*.908*
	8	4	.814	.809	.750	.639	.485	.298	.090	*.123*	*.329*	*.512*	*.660*	*.763*	*.814*
	9	3	.664	.701	.689	.631	.530	.392	.228	.048	*.135*	*.309*	*.461*	*.583*	*.664*
	10	2	.470	.540	.574	.568	.524	.444	.334	.201	.054	*.096*	*.240*	*.368*	*.470*
	11	1	.243	.338	.411	.455	.468	.449	.400	.323	.225	.111	*.011*	*.131*	*.243*
	12		.000	.109	.211	.299	.366	.408	.423	.408	.366	.299	.211	.109	.000
	Time ↑	P. M. →	360	345	330	315	300	285	270	255	240	225	210	195	180
	A. M. →		180	195	210	225	240	255	270	285	300	315	330	345	360
			Azimuth Scales for Values of K in Italicized Type												

[a]Values for 30 deg latitude may be employed over the range 25 deg to 35 deg. Values for 45 deg latitude may be employed over the range 40 deg to 50 deg. Interpolation will yield values for the range 35 deg to 40 deg latitude.

[b]The relation between local mean sun time and civil time may be obtained from Weather Bureau offices in various localities.

[c]Values in ordinary type are for azimuths 0 to 180 deg. Values in italic type are for azimuths 180 to 360 deg.

Radiation Exchange with the Night Sky

When a building surface is exposed to a *clear* night sky, the net exchange of radiant energy is *from* the surface to the sky. This acts to decrease the load on an air-conditioning system. For practical calculations, it will serve to cite Brunt's equation as given by Haurwitz [4],

$$q_s = 0.173\,\varepsilon \left(\frac{T}{100}\right)^4 (0.56 - 0.47\sqrt{P_d}) \quad (3)$$

where q_s = Net radiation exchange between a surface and the night sky, Btu per (hour) (square foot).

ε = Emissivity of the surface, dimensionless (for the surface temperature involved, and *not* for solar radiation).

T = Surface temperature, (Fahrenheit degrees absolute).

P_d = Partial pressure of the atmospheric water vapor at the earth's surface, inches of mercury.

Equation 3 is not applicable to either extremely low or extremely high values of P_d; (P_d is the saturation pressure corresponding to the dew point). Clouds will decrease appreciably the magnitude of this radiation exchange. Calculations from Brunt's equation should be reduced by a factor of ⅔ to ⅓ where cloudiness is involved. For vertical surfaces the resultant should be reduced about ½.

The Sol-Air Temperature

A convenient way of combining the effects of solar and sky radiation, solar absorptivity, temperature, and air movement is to use the concept of sol-air temperature. The sol-air temperature, t_e, is the temperature of