The following set of equations based on the above, permits the ambient temperature throughout a day j to be calculated as follows:

For $-180 < \omega \leq \omega_S$

$$T_a(j,\omega) = T_{aM}(j-1) - \frac{T_{aM}(j-1) - T_{am}(j)}{2}[1 + \cos(a\omega + b)] \tag{20.42}$$

with $a = \dfrac{-180}{\omega_S + 330}$ and $b = -a\omega_S$

For $\omega < \omega_S \leq 30$

$$T_a(j,\omega) = T_{am}(j) + \frac{T_{aM}(j) - T_{am}(j)}{2}[1 + \cos(a\omega + b)] \tag{20.43}$$

with $a = \dfrac{180}{\omega_S - 30}$ and $b = -30a$

For $30 < \omega \leq 180$

$$T_a = T_{aM}(j) - \frac{T_{aM}(j) - T_{am}(j+1)}{2}[1 + \cos(a\omega + b)] \tag{20.44}$$

with $a = \dfrac{180}{\omega_S + 330}$ and $b = -(30a + 180)$

To apply these equations, it is necessary to know the maximum temperature on the previous day, $T_{aM}(j-1)$, and the minimum temperature of the following day, $T_{am}(j+1)$. If these data are unavailable, then it can be assumed, without introducing too much error, that they equal those for the day in question.

20.7 EFFECTS OF THE ANGLE OF INCIDENCE AND OF THE DIRT

The reflectance and transmittance of optical materials depends on the angle of incidence. Glass covers of solar collectors are not an exception and therefore the optical input of photovoltaic modules is affected by their orientation with respect to the sun, due to the angular variation of the glass reflection. Theoretical models, based on the well-known Fresnel formulae, have been developed for clean surfaces. The most popular formulation is from ASHRAE [32]. For a given incidence angle, θ_S, it can be described by the simple expression

$$FT_B(\theta_S) = 1 - b_0\left(\frac{1}{\cos\theta_S} - 1\right) \tag{20.45}$$

where $FT_B(\theta_S)$ is the relative transmittance, normalised by the total transmittance for normal incidence, and b_0 is an adjustable parameter that can be empirically determined for each type of photovoltaic module. If this value is unknown, a general value $b_0 = 0.07$ may be used. The effect of the angle of incidence on the successfully collected solar radiation can be calculated by applying equation (20.45) to the direct and circumsolar irradiances, and by considering an approximated value, $FT = 0.9$, for the isotropic diffuse and reflected radiation terms. Figure 20.17 shows a plot of $FT_B(\theta_S)$ versus θ_S. It presents