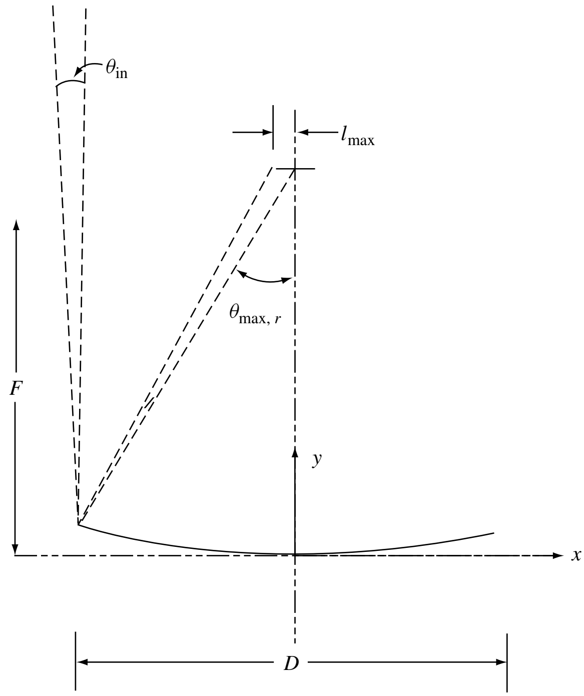


**Figure 11.23** Cross section of a parabolic reflective concentrator

Now consider a ray that arrives at a small angle $\theta_{in}$ to the normal axis. It can be calculated that it will intercept the receiver at a distance $s$ from the focus given by

$$s = \frac{r \sin\theta_{in}}{\cos\theta_r} = \frac{2F \sin\theta_{in}}{\cos\theta_r (1 + \cos\theta_r)}$$

This shows that $s$ increases as one moves toward the rim, increasing $\theta_r$. Clearly, the rays hitting the rim at $x = D/2$ will have the largest $s$. Noting that the total receiver size, $S$, required to capture all rays up to incident angles of $\pm\theta_{max,in}$ is $S = 2s_{max}$, gives

$$S = \frac{4F \sin\theta_{max,in}}{\cos\theta_{max,r}(1 + \cos\theta_{max,r})} = D\frac{\sin\theta_{max,in}}{\cos\theta_{max,r} \sin\theta_{max,r}}$$

For a two-dimensional parabolic trough, the concentration ratio is $C = D/S$, giving

$$C = \cos\theta_{max,r} \frac{\sin\theta_{max,r}}{\sin\theta_{max,in}}$$

It is interesting to note that the maximum concentration for a parabola without a secondary occurs at a rim angle of 45° (which corresponds to an $f$-number of 0.6) and is

$$C = \frac{1}{2}\frac{1}{\sin\theta_{max,in}}$$