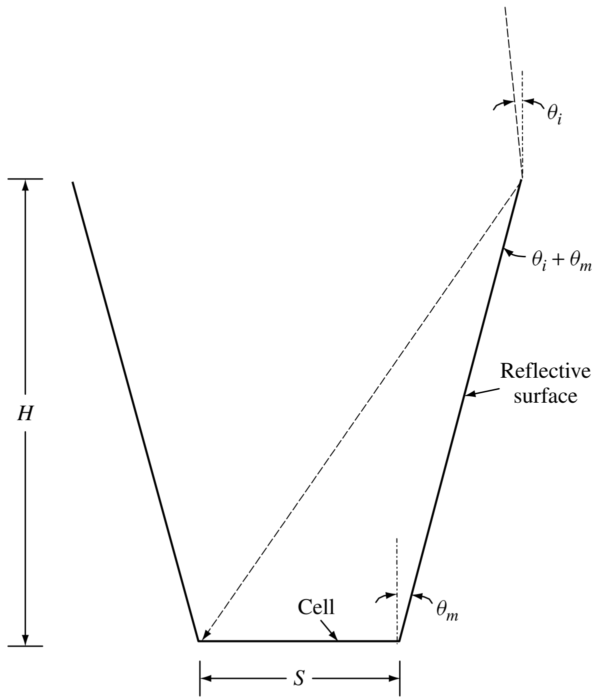

Figure 11.27 Geometry of a v-trough concentrator

Interestingly, if one allows for multiple reflections, then the v-trough approaches an ideal concentrator for small θ_m [51]. This results, however, in a very tall, narrow structure with many reflections. In contrast, the CPC has a maximum of one reflection.

Two-axis v-trough concentrators are made either by rotating the v-trough about its central vertical axis, forming an inverted truncated cone, or by combining two v-troughs at right angles, forming an inverted truncated pyramid. The resulting two-axis concentration approaches the square of the above numbers; however, as in the two-axis CPC, some of the rays within θ_i will not strike the receiver. The rotational version produces some regions of high intensity under certain illumination conditions as the light is focused off the cylindrical surface, whereas the square version does not suffer from this effect. Two-axis v-troughs are often used as secondary concentrators in conjunction with point-focus Fresnel lenses. With proper design, they can also smooth the flux profile over that obtained with the Fresnel alone.

11.4.6 Refractive Lenses

Refractive lenses are a common alternative to reflective lenses. Such a lens is shown in Figure 11.28.

The lens can be analyzed by ray-tracing using Snell's law. In the case we have shown, a plano-convex lens with the flat surface facing upwards, the analysis can be expedited using Fermat's principle, which states that rays at the focus all travel the same