How Much Sunlight Really Enters a Space?

Tural Doruk Aral and Agnieszka Małgorzata Gębura-Tetiurka

Aperture, the opening through which direct sunlight can pass into a space. Two apertures can meet the same sunlight rule yet let very different amounts of direct sun into a space over the year. We studied how designers can see that difference before a building is built.

Direct sunlight can make a space feel brighter and more connected to the outside world. Yet in dense cities, neighbouring buildings and deeply recessed apertures can block it before residents move in. This is especially important in northern climates, where the sun stays low for much of the year.

Current assessments often ask a practical question: does sunlight reach one selected point at an aperture for enough hours during a given period? This is useful for checking requirements, but an aperture is an area, not a point. Sunlight may reach a small part of a large aperture or pass through most of it. The same result can therefore hide very different sunlight conditions.

Our thesis examined two measures: the Sunlight Beam Index (SBI) and SBI-airmass. SBI measures how direct sunlight can pass through an aperture over time. It considers the sunlit part of the aperture and the direction of incoming rays: sunlight arriving straight through contributes more than sunlight coming from the side. SBI-airmass adds another adjustment. It gives less weight to low sun, because its rays travel through more atmospheric interference before reaching the building.

We tested these measures first in simplified computer models, where one design feature could be changed at a time, and then in models of real residential buildings in Swedish urban settings. Larger apertures increased SBI and SBI-airmass. Deeper recesses and neighbouring obstructions reduced them. In the simplified test model, changes in geometry and orientation produced consistent and predictable changes in SBI and SBI-airmass.

The comparison with the European standard EN 17037 showed why these matters. When the aperture became larger, the EN 17037 result could remain unchanged because sunlight was still checked at one selected point. SBI changed because it registered the larger sunlit aperture. In the urban models, similar yearly SBI values could correspond to different EN 17037 outcomes, while apertures with similar EN 17037 results could show different annual sunlight patterns.

This information can support early decisions about building orientation, aperture placement and the distance between buildings, before room layouts and final facade details are fixed. SBI and SBI-airmass do not replace existing sunlight requirements. They add a missing perspective: not only whether a home passes a sunlight check, but how much direct sunlight its apertures may actually receive through the year.