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Sunlight Autonomy (SA) for building facades

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Daylight has been a driver of urban and architectural form across climates. In the past century, metrics were introduced to describe performance such as minimum sunlight hours and the daylight factor. Means of assessment and related requirements were introduced in different contexts for sunlight/daylight. Some methods aimed to bridge the gap between inside-out such as the Vertical Sky Component (VSC) and the recent rethinking based on Aperture-based Daylight Modelling (ABDM). However, each daylighting method goes with its pros and cons. In addition, more advanced or combined simulations from research have overlooked the designer's perspective. For example, if the method is sufficiently understood by the designer, and/or actionable and therefore informs the design process. This study aims to introduce a new daylight metric for buildings as an early design stage methodology to bridge daylight inside/out –between buildings and urban developments. A traditional method like Sunlight (unit of hours) applies to both buildings and open spaces. Sunlight assessment can be time-consuming and has limitations when carried out on paper. Computation-based approaches and 3D models can support its effective use and reduce the time and errors of the process. Sunlight has also a higher versatility than other methods in terms of scope of the analysis, scale, geometrical complexity, and analysis period e.g., an hour, a day, season, year or user specified. Results can be presented cumulatively in hours, averaged, or as a percentage. Thus, the assessment can be easily understood by all stakeholders. In addition, sunlight can be used to design for the densification of cities, green spaces, and outdoor comfort provision. Case studies are illustrated by mapping results onto model geometry. Despite the versatility of sunlight, it also goes with uncertainty in interpretation for designers. As an improvement, simulations can be customized to a standard (e.g., EN 17037 Daylight in Buildings) with existing visual scripting tools such as Grasshopper. The three levels of performance (1.5, 3, and 4 hours) in EN 17037 can be used to derive spatial metrics for building performance. We propose a new metric called Sunlight Autonomy (SA) for building facades. SA can be defined as the percentage of façade area (m2) that is above a performance level e.g., 1.5 hours. Other ways to conceptualize SA on an annual basis can be a) the percentage of days that receive more than 1.5 hours of direct sun, or b) the percentage of time that direct sun hits the grid point. Then, the spatial SA (sSA) is the percentage of façade area above a defined threshold i.e., a) of hours/day or b) of time/daylight hours. We suggest that SA assessments on 3D models with the European Daylight Standard restrictions can reduce uncertainty and enhance the performance comparability of projects. It can also serve as a flexible and new evaluation method for designers and planning authorities. Further work should investigate more latitudes and urban typologies for recommendations of the SA metric.

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Keyword 2

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