Illuminating ENGINEERING SOCIETY

Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)

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and
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FOREWORD

Assessing the dynamic qualities of a daylit space requires different methods of assessment than those that have been developed for a space that is electrically lighted. With electric lighting, average illuminance is a significant and useful metric, especially in designs that aim to provide general illumination at a predetermined target illuminance. However, in a daylit space, average illuminance has less meaning. One reason is purely spatial; for example, sidelit environments inherently have non-uniform illuminance distributions due to the geometric relation of room and aperture, and internal shading from furnishings. Typically there is a high illumination level near the window which quickly diminishes with increased distance. Another reason is both spatial and temporal; the daylight sources of sun, sky and clouds vary in luminous intensity and position each hour of the day and over the course of a year, and corresponding illumination within the space varies relative to the geometry of daylight apertures such as windows and skylights. In addition, daylight performance metrics must also consider the likely impact of daylight control devices, such as blinds or shades, which may be static, manually operated or automated.

Because daylight illumination levels are dynamic, the performance of daylight needs to be considered over time. Annual daylight performance integrates variations over one full year, including both daily and seasonal variations. Because the availability of daylight is highly dependent upon local climate conditions, especially the daily and seasonal balance of daylight provided from direct sunlight versus the sky and clouds, accounting for local climate conditions is also critical. The optimal design of a daylit system is likely to be very different for a foggy coastline location compared to a nearby inland desert.

Over the last few decades a variety of new daylighting metrics have been proposed to overcome the inability of older metrics to assess these dynamic conditions. Most of these new metrics require substantial computational power to process a large number of input variables such as building and site data, climate data, occupancy schedules, and sun control device operation. Given the range of inputs, the variations in methodology to generate these metrics can be substantial, but also not readily apparent to users.

INTRODUCTION

IES LM-83-12 was created to develop a new suite of metrics capable of describing multiple important dimensions of daylighting performance in an existing building and a new design, from concept through construction documents. The intent of these new climate-based metrics is to improve on the predictive performance of historical metrics, such as Daylight Factor[9,10,15,19] and define a consistent calculation methodology that would allow for multiple design alternatives of proposed designs, daylit buildings, and/or climatic locations to be compared, in a consistent manner.

During the metric development process, existing accepted daylight performance metrics were identified, reviewed, and assessed.[3,9] It was determined that no single metric could adequately address all of the factors involved in a successful daylighting system. The committee also concluded that a core set of useful and meaningful metrics must provide for the evaluation of an entire daylit area or building over the course of a full year, accounting for daily and yearly climatic variation, rather than the historical approach of analysis of a single point in space at a singular design condition or one point in time. In assessing candidate climate-based metrics, outputs from annual simulation methodologies that account for the dynamics of climatic variation and building operation were compared to evaluations of real spaces by both experts and occupants.

Two metrics have been developed to date, and are described in this document, which allow a daylit space to be evaluated for a one year period using two different performance parameters: sufficiency of daylight illuminance and the potential risk of excessive sunlight penetration. The first metric is Spatial Daylight Autonomy (sDA), a measure of daylight illuminance sufficiency for a given area, reporting a percentage of floor area that exceeds a specified illuminance level (e.g. 300 lux) for a specified amount of annual hours (e.g. 50% of the hours from 8AM-6PM). The second metric is Annual Sunlight Exposure (ASE), which provides a second dimension of daylight analysis, looking at one potential source of visual discomfort: direct sunlight. Both metrics use the same building information and simulation methodology to analyze hourly illumination patterns, summed for an annual period, across an analysis area. Both should be reported together to evaluate building designs. When used together, these two metrics provide a meaningful first-level understanding of how a space/design is expected to