POLITECNICO DI TORINO

Honors thesis

Master of Science in Sustainable Architecture

Abstract

The verification of illuminance conditions in confined spaces: simplified approaches vs. advanced approaches

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December 2020

The following research moves from the significant role that daylight plays in human life. The daylight's advantages are considerable (substantial) for human health, productivity and concentration capacity. They are also relevants for energy saving. The daylight's main qualities are its extreme chromatic variability and the continuous availability of unlimited resource.

In architecture, light helps to create space, to define its shapes and textures and to give character to an environment. For an architect, daylight is a resource that can be used as a functional, expressive or symbolic tool.

Natural light has always been employed as a method to design and for this reason there are three major distinctions between these: rules of thumbs, that are empirical principles based on room proportions; static metrics, such as the Daylight Factor, that take into account different aspects such as obstructions, glass transmission and the position of the opening in the wall, with the limitation of the overcast sky condition, thus excluding the real potential of natural light; finally, there are some more innovative metrics which take advantage of simulations based on the real climatic conditions of the project site, more realistic, although they are more complex than the previous ones.

From a regulatory point of view, different attempts have been made over the years to unify these metrics in order to establish from a design point of view the correct contribution of natural light inside the environment. In Europe we can dwell on the recent EN 15193-1: 2017 and EN 17037: 2018 to get a complete picture of how to design taking full advantage of daylight, both energy and performance benefits. The first standard introduces the LENI methodology to evaluate the energy efficiency of lighting systems, while the second introduces an indicator to evaluate glare. At the Italian level we find discrepancies at municipal level on how to calculate natural light.

This thesis is based on the experience shared with the FULL research group of the Polytechnic of Turin that has proposed to support the City of Turin in the revision of its Energy Annex, in an attempt to redefine and simplify it. In fact, a new indicator has been developed to mediate between the RAI (Rapporto Aereo-Illuminante) of 1/8, currently also used for lighting checks, and the DFm (Daylight Factor), which is considered too complicated to check and for this reason is often not used.

For this purpose, a parametric study was carried out in which the DFm was analytically calculated on an environment taken as a sample in which the transmission of the glass and the size of the glass surface vary. Different types of obstructions were considered and they were placed at different distances, taking into consideration the Turin urbanistic scenario, in order to consider different obstruction angles until 900 different configurations were obtained. As a result of this research a new index is created: it is called "Daylight Index" DI.

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