Lighting Simulation in Architectural Design

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Abstract

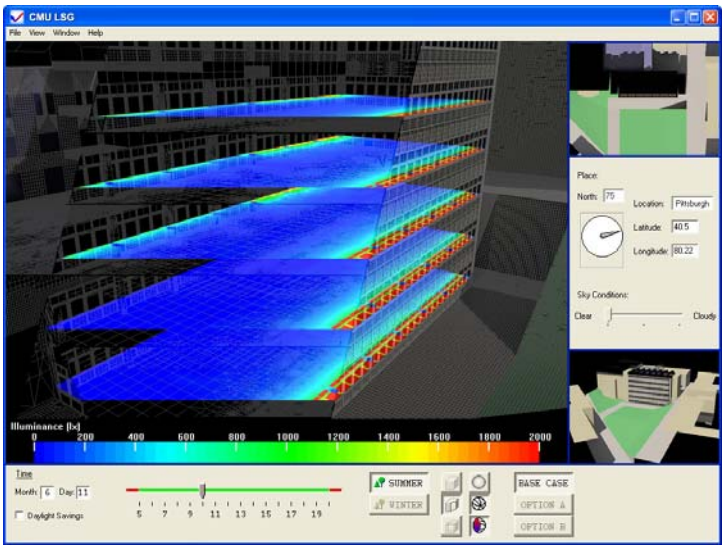
This paper outlines the use of computational lighting simulation software as a design support tool for a proposed prototypical energy efficient collaborative R&D laboratory building at Carnegie Mellon University. The study investigates the challenges of effectively applying simulations in the design decision-making process and establishes a framework which designers may apply to conduct relevant and reasonably accurate lighting performance analysis.

Introduction

Advances in computational technology have produced increasingly affordable applications that can reasonably predict the performance of lighting in terms of time and cost, two important factors affecting the pervasive use of such technology in the context of architectural design practice. Evaluations of the use of such software to predict illumination levels in building designs have shown much potential for architects. (Ubbelohde and Humann, 1998; Lau and Mistrick, 2002) The reality however is that the use of lighting simulation tools is not common in architectural practice, especially by architects in the design process as contrasted to being post design verification tools by other experts such as lighting or electrical engineers. (AIA, 2000; Wong and Lam, 1999)

The focus of this paper is to attempt via an actual case of using lighting simulation in supporting architectural design to experience and discuss the difficulty of employing simulations under such circumstances. The objective is to better define the current obstacles and help guide the development of lighting simulation software that can play a larger role in architectural design.

A description of the design objective is first defined, followed by the formulation of specific informational needs leading to the specification of the simulation task. The role of simulations in supporting rational design decision making has been justified by the need for quantitative results that involve intensive computation. However, the formulation of such supposed well defined quantitative questions is argued to be but only part of the requirements in making simulations useful or even applicable. Following this discussion, an appropriate simulation software is chosen for this exercise to conduct simulations and the difficulties that the architect may face is documented.



Prototype of a lighting visualization tool