

The Increasing Importance of Advanced Building Simulations in a New Building Design Paradigm

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Abstract

This paper presents and discusses the increasing importance of advanced building simulations in the design of high performance buildings. A changing building design industry increasingly requires simulations to achieve high energy efficiency and sustainability, while safeguarding occupant comfort, for the built environment. The paper introduces two main numerical design tools, energy simulations (ES) and computational fluid dynamics (CFD). Much of the building industry and even many academic architecture programs have not yet embraced advanced simulations as indispensable tools of the design process and building operation, as well as an important educational focus for the next generation of architects. The paper discusses how a successful implementation of the new design paradigms based on advanced simulation tools in academia and the building industry are hampered by technology and human barriers. The paper proposes several measures to successfully overcome these barriers. Several important applications of advanced simulation are discussed such as building energy consumption; natural ventilation, dispersion of pollutants in and around buildings and occupant comfort performance.

Keywords: Paradigm shift in sustainable building design, whole building simulations, computational fluid dynamics (CFD), Leadership in Energy and Environmental Design (LEED), energy efficiency, energy codes, resource responsible building design, natural ventilation

Introduction and the urgent need for a new building design paradigm

Today's building designer faces many challenges to work out optimum designs for their customers. The overall trend favors energy efficient and resource responsible yet cost effective buildings, which also have to offer occupants with creative and livable spaces and high comfort. The conventional building design work has been focusing on a sequential work flow where the building's size, shape and configuration follow the immediate needs of the customers. Typically, under the conventional building design paradigm, energy efficiency and responsible resource on

consumption measures have not been the primary decision criteria in the early stages of the building design process. Under the prevailing building design paradigm energy efficiency and other sustainability aspects have been mainly addressed in the building outfitting stage where mechanical and electrical equipment is selected to serve a finished building design. Therefore decisions about selecting energy efficient and sustainability measures are finalized when the basic building shape and orientation has been decided upon. This process can significantly and negatively affect the building's performance.