nerej
CELEBRATING 55 YEARS

An overview of daylighting and thermal simulation coupling: still more research work needed

February 24, 2010 - Green Buildings

Architects and Engineers employ Building Energy Simulation (BES) tools to determine building energy performance. BES tools such as ESP-r2 (University of Strathclyde, 2008) and EnergyPlus (Clarke and Janak, 1998; Crawley et al., 2002; US Department of Energy, 2008) help extend building design strategies to improve the energy performance of buildings. These tools have undergone strict validation procedures to ensure model and data accuracy for widespread use.

In addition, integrated or stand-alone systems are used to analyze glazing energy performance, daylighting performance, passive heating techniques, etc. Due to advancements in building science research, BES tools allow integration of stand-alone systems with BES tools for further investigation.

EnergyPlusEvaluation of the daylighting potential for a building and its addition to the existing design is critical to achieve energy savings. A number of standalone tools were developed for daylighting performance analysis, shading and/or glare analysis, etc. Several research studies were conducted independently on daylighting analysis (Lee et al., 1998; van Dijk and Oversloot, 2003; Andersen and de Boor, 2006; Window 6.1, 2007; Jenkins and Newborough, 2007; Tzempelikos and Athienitis, 2007). Yet only a few were integrated with BES tools. Although these standalone tools provided limited design and user interaction capabilities, they focused on the solar-optical properties of glazing such as spectral irradiance, illuminance, etc, focusing on energy savings.

Dynamic integration for fenestration and shading design on lighting demand and glare control uses a rapid whole-year integrated approach (Lehar and Glicksman, 2007; Walkenhorst et al., 2002; Frankzetti et al., 2004). Others include: DE-light (Hitchcock and Carroll, 2003), which uses a novel approach of interpolating between pre-calculated daylight factors for a limited number of sun positions. There is also a Windows Information System (WIS) integrated for calculating energy demand, detailed control strategy that adjusts the shading based on indoor operative temperature (Hviid et al., 2008). Yet again, these research developments focused on solar-optical properties of glazing and thereby on offsetting electrical energy consumption.

One of my research interests is synergistically balancing daylighting and solar heat gain, thereby, maximizing energy savings potential, and minimizing LCC during early stage architectural design evaluation. The purpose of this study is to develop a rapid optimization technique to bypass time-consuming "trial and error" simulations and / or traditional optimization, parametric study approach for balancing daylighting and solar heat gain for the given latitude and orientation.

See citations and more information at www.nexusboston.org/blog.