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Solar transmittance analysis of different types of sunshades in the Florida climate

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Abstract

Solar shading devices are an integral part of any building enclosure that impacts the building efficiency and indoor environment especially in the hot and humid climates like Florida. In order to design an energy efficient structure, the solar transmittance of the window-shade system needs to be determined in order to calculate how much total solar radiation they transmit. This paper presents the findings of a comparative study for evaluating the effects of different solar shading devices on the solar transmittance properties of windows with different orientations in the city of Miami, Florida. A rectangular office block was modeled and rotated clockwise in 60° interval from North to South to study the variations in the transmission properties of windows. Commercially available shading products were analyzed under three broad categories, i.e. external, interpane and internal and each type was simulated with six different orientations: North (N), Northeast (NE), Southeast (SE), South (S), Southwest (SW), Northwest (NW). The climatic data file was produced by the software METEONORM. The simulation results were compared to determine a performance metric for the primary and the total solar transmittance of each window-shade system. After selecting the most efficient solar devices, a thermal analysis was performed to estimate the reduction in cooling loads generated by improving the internal operative environment.

Keywords

solar transmittance,
shading devices,
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simulation,
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cooling loads

Article History

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1 Introduction

Shading devices are an integral part of the fenestration system because they block the sun rays before reaching the building interior and it is in fact the most efficient way of reducing overall cooling loads especially in hot and humid climatic conditions like in Florida. In an earlier study, an hourly energy simulation of a conventional single-story office building prototype in Orlando, Florida found that about 20% of the annual cooling load is attributable to solar heat gain through fenestration (Parker et al. 1997). It has been estimated that depending on the climate, shading type and orientation, there can be 23%–89% reduction in annual cooling loads (Dubois 1997). Direct solar transmission through the windows contributes to disturb the heat balance of any building (Givoni 1981). Along with providing the energy saving opportunity, use of an efficient shading device can also create the conditions for good thermal and visual comfort.

There are so many types of sunshades available in the market, but it seems that not much research has been done to study the effects of sunshades on the solar transmittance properties of windows in the Florida climate. Most of the past studies are focused on studying the energy efficiency of windows with either no shading devices (Parker et al. 1997) or with limited options of sunshades (Apte et al. 2003; Lee et al. 2004; FSEC 2007; Deru et al. 2011). Due to the need for further research in this area, the Florida Solar Energy Center conducted several research projects to investigate the performances of various shading devices (FSEC Fenestration Research program 2007).

It has been emphasized through many studies (Griffith et al. 2007; Huang and Yazdanian 2007; Haves et al. 2007) that variability of window shades and shading has a potential effect on the overall performance of windows. Some researchers have attempted to evaluate the performance of different sunshades through graphical, mathematical or analytical approaches, but again the research is limited to the basic types of sunshades (vertical or horizontal only) (El-Refaie 1987; Etzion 1992; Kabre 1999; Hiller et al. 2000).

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