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Cooling load reduction effect and its mechanism in between-glass cavity and venetian blind operation during the summer season

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Abstract

The proper operation of venetian blinds in between-glass cavity airspaces is one of the most commonly used passive control techniques and can significantly reduce the cooling load and energy use in buildings. This study investigated the cooling load reduction effect of the blind integrated with the cavity operation. A full heat balance analysis was performed using EnergyPlus to provide a detailed understanding of the heat transfer mechanism that takes place around the blind and between-glass cavity. A sensitivity analysis was also carried out to evaluate the effects of different slat angles and blind operation hours. The results show that integration of the blind and between-glass cavity operations can significantly reduce the cooling load in buildings. The cooling load reduction effect of the cavity operation (by approximately 50%) was greater than that of the blind operation (by 5% to 40%, depending on slat angle and operating hours). It was found that the interzone heat transfers between the cavity and the room space and convection heat fluxes from each surface mainly contribute to the total cooling load reduction. In addition, the double-sided blind had a greater potential to reduce the cooling load compared with a conventional single-sided blind due to its greater capability of reflecting direct solar radiation and preventing diffuse solar radiation from penetrating the room space. The results of the study show that the largest reduction of cooling load can be achieved by the cavity operation, followed by the blind operation and the proper selection of operating hours for the blinds.

Keywords

venetian blinds,
between-glass cavity operation,
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heat balance method,
energy simulation

Article History

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1 Introduction

As a large portion of energy is being consumed in buildings, the need for energy saving has received increasing attention during the past decades. In particular, in Korea the energy consumption in residential buildings has increased rapidly due to changes in life styles. Korea has four distinct seasons with a hot and humid summer and a cold winter, so that heating and cooling energy accounts for large portions of total building energy usage.

Architects and engineers continue to search for better ways to improve both the quality of indoor environments quality and the energy efficiency of buildings, and much research has been done recently on these areas. The previous research has roughly categorized two methods to control the indoor environment. The first method is active control, which relies on effective energy use and a properly operated mechanical system. Although it is a convenient and accurate way to control the indoor environment, it still requires energy consumption. The second method is passive control, which takes advantage of the building's shape, structure and envelope to minimize energy usage and to maintain a comfortable indoor environment without using a mechanical system.

Ideally, the building should be designed by utilizing the passive control method to minimize the thermal load and energy consumption. Among the variety of passive control techniques, this study focuses on shading control, which is one of the most commonly used passive control techniques. The proper operation of blinds can significantly reduce the

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