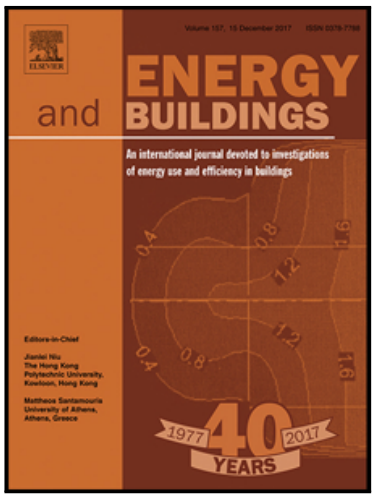

Impact of Bi-directional PV Blind Control Method on Lighting, Heating and Cooling Energy Consumption in Mock-up Rooms

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Impact of Bi-directional PV Blind Control Method on Lighting, Heating and Cooling Energy Consumption in Mock-up Rooms

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Abstract

As interest in the generation of renewable energy in buildings increases, shading devices do not limit its role in blocking the sunlight, but attach PV (photovoltaic) to blind slats for power generation. With this, there is also growing interest in how PV blind control can yield effective results on power generation and building energy consumption. The bi-directional control differed considerably from uni-directional control in the amount of PV power generation and inflow of skylight. However, the impact of lighting and air-conditioning energy consumptions by bi-directional PV blind control has not been evaluated. In this study, to identify the impact on energy performance of lighting, heating and cooling using bi-directional PV blind control, comparative measurement over the different seasons in two mock-up rooms was conducted. The energy consumptions of lighting and heating system using the bi-directional PV control were reduced by 4.62-35.50% and 2.10-11.46%, respectively, compared with those using the uni-directional PV blind control. In contrast, the energy consumptions of cooling system were increased by 6.25-14.29% due to the inflow of solar radiation. The bi-directional PV blind control can be mostly recommended throughout the year, except for clear and partly cloudy sky conditions during the summer, in the aspects of both PV power generation and energy consumption.

Keywords: Bi-Directional Blinds, Daylight, Lighting, Air-Conditioning

1. Introduction

1.1. Background and study objective

Shading devices in building facades are designed to block direct sunlight and reduce the possibility of glare for indoor occupants. Shading devices are classified as interior shading devices and exterior shading devices according to their installation location. Interior shading devices include venetian blinds and roll screens while exterior shading devices include louvers, light-shelfs and awnings. In addition, shading devices can be classified as fixed type, manual type and movable type according to their operating methods. Recently, automatic movable shading devices have become popular for the control of the shading height and blind slat angle. Following the increased popularity of shading devices with automatic control, indoor lighting and air-conditioning environments have attracted increased interest.

In general, blinds are used to block direct sunlight, which in turn can reduce the chances to save lighting energy by also