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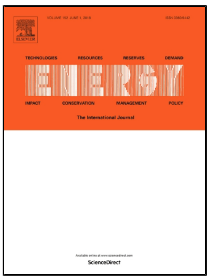

Solar facade module for nearly zero energy building

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Solar facade module for nearly zero energy building

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Abstract

Buildings consume 40% of the total primary energy use worldwide and it could increase if no energy efficiency measures are taken. Diffusion of nearly zero energy buildings is among building energy efficiency measures in many countries. Synergy of energy reduction in buildings and efficiency increase in district heating and cooling networks is part of Smart Energy Systems. Utilisation of solar energy is part of nearly zero energy buildings concept. The main aim of this research is to carry out numerical and experimental study of storage capacity and the dynamic behaviour of a solar facade module that can accumulate solar energy to reduce heating and cooling loads in nearly zero energy building. In this study, the first part of the climate adaptive facade element – solar facade module is developed: the point focus imaging Fresnel lens is employed for concentrating solar beam on copper plate with fins which is used as heat transfer enhancer to phase change material. Results show that the dynamics of heat flows and accumulation processes in the facade module are very complex due to highly changing outdoor and indoor conditions. The indoor temperature difference in the range of 0.5°C and 9°C is observed between the opaque reference wall and the solar facade module depending on the time of the day and season.

Keywords: climate adaptive building shell, solar wall, zero energy buildings, energy efficiency in buildings, Fresnel lens, phase change materials

1. Introduction

Buildings account for 40% of the total primary energy use worldwide [1]. International Energy Agency predicts that if no energy efficiency improvements are carried out in the building sector, energy consumption might increase by 50% in 2050[2].

Promotion and diffusion of low energy buildings and zero energy buildings are considered as one of energy efficiency policy tools in many countries [2]. In the new paradigm of energy systems, buildings are part of Smart Energy Systems where they are integrated into electricity, heating and cooling infrastructures [3]. Technology changes in district heating and cooling systems interact with energy consumption in buildings, e.g. reduction of unfeasible investments in building energy efficiency measures, use of excess thermal solar energy, heat recycling or renewable energy sources at a lower cost, more buildings connected to the same district heating network, lower supply temperatures in the district