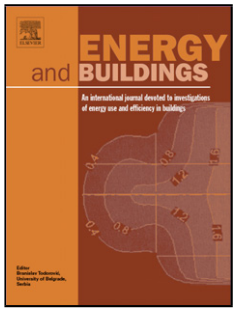

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Experimental evaluation of a concrete core slab with phase change materials for cooling purposes

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Abstract

Due to the high amount of energy consumed by the building sector, efforts need to focus not only on improving the building envelope but also on enhancing the energy efficiency of HVAC systems. In this study, an innovative technology for cooling application in buildings is evaluated. A prefabricated concrete slab incorporating phase change material (PCM) was used as internal separation in the active slab cubicle. The incorporated PCM is paraffin macro-encapsulated in aluminium tubes. The target is to use the internal slab as storage unit and as an active cooling supply to replace totally or partially conventional HVAC systems. The operational mode consists of solidifying the PCM with the outside cold air (below solidification temperature) during the night time for covering a later cooling demand. Experimental analysis shows the energy performance of the technology, as well as a comparison with a conventional cooling system.

Keywords: thermal energy storage (TES), phase change materials (PCM), concrete core slab, building, space cooling

1. Introduction

The high energy consumption rate that belongs to the building sector (40% of global energy consumed in Europe) is mainly attributed to the heating, ventilating, and air conditioning systems (HVAC). Moreover, the comfort parameters are getting stricter, especially under summer conditions. In the recent years a rise in the number of installed air-conditioning systems has been observed, resulting in peak load problems, increasing the electricity cost and affecting the energy balance [1]. The European directive on the energy performance of buildings (EPBD) promotes the inclusion of very low and close to zero energy buildings, as well as the use of renewable energies. Hence, it is critical to reduce the energy consumption of the building, especially during peak load periods.

Within this situation solar energy systems [2] and thermal energy storage [3,4] among others, are topics widely studied in the research field to achieve low energy rates in buildings. Passive strategies focused on reducing the energy demand such as thermal