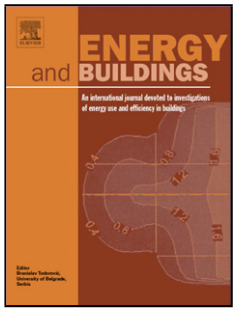

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Experimental evaluation of a cooling radiant wall coupled to a ground heat exchanger

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Highlights:

- Test of an experimental set-up of a radiant wall coupled to a ground heat exchanger
- Free-cooling can maintain the selected set-point and achieve significant savings
- Energy savings with free-cooling are sensitive to set-point temperature
- The radiant wall have peak load shifting capacity
- Operation schedule and set-point temperature are key parameters

Abstract

A building prototype was built in the experimental set-up located in Puigverd de Lleida (Spain) to study the energy performance of a radiant wall with ventilated facade cooled with a ground coupled heat-exchanger. The installed geothermal heat pump operates only as a ground coupled heat exchanger on cooling mode, thus providing free-cooling. In this case, only the circulation pumps consume power. The summer experimental campaign showed the energy savings potential and the peak load shifting ability of the system. On continuous operation and taking as reference a cubicle equipped with a conventional air-to-air heat pump, the radiant wall cooled with the ground coupled heat-exchanger achieved savings up to 54.17% and 82.08% at set-point temperatures of 24 ºC and 26 ºC, respectively. The thermal storage capacity of the system was studied in night charging test, when the cubicles were pre-cooled during night-time. During the day, the temperature raise caused by heat loads was small and the system kept the temperature inside comfort range despite it only operated overnight. However, the performance was very sensitive to set-point temperature. Free-cooling was limited by the temperatures in the boreholes, showing that with lower set-points the gradient between supply temperature and room temperature was small, and thus it required a higher water flow to achieve the necessary cooling power. Intermittent operation of the system according to different schedules also affected the radiant walls performance as they interacted with the thermal inertia of the system, which could even have a negative impact on energy use.

Keywords: TABS, Radiant Walls, Radiant Cooling, Ground Heat Exchanger

1 Introduction

There has been much concern on the energy consumption and greenhouse gases emissions on the last decades. According to the International Energy Agency (IEA) [1], buildings account for 32% of global energy use and almost 10% of total direct energy-related CO_2 emissions.