Building and Environment 77 (2014) 61–76

Contents lists available at ScienceDirect

Building and Environment

journal homepage: www.elsevier.com/locate/buildenv

Experimental study of the thermal-energy performance of an insulated vegetal façade under summer conditions in a continental mediterranean climate

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ARTICLE INFO

Article history:
Received 16 November 2013
Received in revised form
19 March 2014
Accepted 21 March 2014
Available online 28 March 2014

Keywords:
Experimental measurements
Continental Mediterranean climate
Summer conditions
Insulated vegetal façade
Thermal-energy performance

ABSTRACT

The use of vegetal systems in façades affects the reduction of the buildings' energy demand, the attenuation of the urban heat island (UHI) and the filtration of pollutants present in the air. Even so, up to now the knowledge about the effect of this type of systems on the thermal performance of insulated façades is limited. This article presents the results of an experimental study carried out in a vegetal façade located in a continental Mediterranean climate zone. The objective is to study the effect of a vegetal finishing, formed by plants and substrate, on the thermal-energy performance of an insulated façade under summer conditions.

To this effect, the thermal data obtained from two full-scale experimental mock-ups of the same dimensions and composition of the enclosure and only different in the south façade's enclosure where one incorporates a vegetation layer are compared and analysed.

The results show that, in spite of the high thermal resistance of the enclosure, the effect of the vegetation is very positive, particularly in the warmer hours of the day. Therefore, vegetal façades can be used as a passive cooling strategy, reducing the consumption of energy for refrigeration and improving the comfort conditions of the users.

1. Introduction

As a consequence of the growing interest in energy saving and environmental sustainability in buildings, in recent years many studies have been carried out about the potential of vegetal façades in this field [1–8].

Several researches have shown that the use of vegetal systems in the façade affects positively the reduction of the buildings' energy demand [7,9–12], the attenuation of the urban heat island (UHI) [13–16] and the filtration of pollutants present in the air [17,18].

Concerning the reduction of the buildings' energy demand, in a research study conducted in a hot and humid climate, Chen et al. [7] showed the potential of the Living Wall Systems (LWS) in lowering buildings' energy use. One of the aims of the research was to compare the energy use of two identical experimental prototypes on a summer day. The only existing difference between them was that the west façade of one of them was covered with Living Wall System modules. Both spaces had identical air-conditioning systems running at 24 °C for 24 h. Results showed that the energy use of the space with the LWS was 12% less than the energy use of the space with the bare wall. Perini et al. [9] studied the potential of vertical greening systems as passive cooling techniques, by evaluating the contribution of vegetation to the improvement of the thermal behaviour of the building envelope. In particular, the influence of the vegetation on wind speed and its effects on the thermal resistance of the façades were analysed. The experiment was conducted in Netherlands by comparing three different vertical greening systems with bare façades next to them. Results showed that depending on the system, the wind speed reduction varies from 0.43 m/s to 0.55 m/s measuring at 0.1 m in front of the façades. As a consequence of this reduction, wind speed measured next to the vertical greening systems was in each case lower than 0.2 m/s, which implies that the exterior surface resistance (Re) could be equalized to the interior surface resistance (Ri), raising the total thermal resistance of the façade in 0.09 m^2K/W. Touceda et al. [10]

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http://dx.doi.org/10.1016/j.buildenv.2014.03.019
0360-1323/

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