Building and Environment 46 (2011) 2287–2294

Contents lists available at ScienceDirect

Building and Environment

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

Vertical greening systems and the effect on air flow and temperature on the building envelope

Katia Perini [a,*], Marc Ottelé [b,*], A.L.A. Fraaij [b], E.M. Haas [b], Rossana Raiteri [a]

[a] Faculty of Architecture, University of Genoa, Stradone S. Agostino, 37, 16123 Genoa, Italy
[b] Faculty of Civil Engineering and Geosciences, Delft University of Technology, Stevinweg 1, 2628 CN Delft, P.O. Box 5048, The Netherlands

ARTICLE INFO

Article history:
Received 16 February 2011
Received in revised form
28 April 2011
Accepted 12 May 2011

Keywords:
Façade greening
Living wall systems
Air flow
Temperature
Energy savings
Sustainability

ABSTRACT

The use of horizontal and vertical greening has an important impact on the thermal performance of buildings and on the effect of the urban environment as well, both in summer and winter. Plants are functioning as a solar filter and prevent the adsorption of heat radiation of building materials extensively. Applying green façades is not a new concept; however it has not been approved as an energy saving method for the built environment. Vertical greening can provide a cooling potential on the building surface, which is very important during summer periods in warmer climates. In colder climates evergreen species create an external insulation layer and contribute to energy savings and loss of heat. In this study an analysis of the effect on air flow and (air and surface) temperature of vertical greening systems on the building level is presented. An experimental approach was set up to measure the temperature (air and surface) and the air flow near and on different types of green façades and a living wall system to evaluate the influence of wind velocity and its effect on the thermal resistance. A comparison between measurements on a bare façade and a plant covered façade has taken, in the beginning of autumn, to understand the contribution of vegetation to the thermal behaviour of the building envelope.

1. Introduction

The integration of vegetation on buildings, through green roofs or vertical greening, allows obtaining a significant improvement of the building's efficiency, ecological and environmental benefits. The benefits gained thanks to the use of vegetation are the subject of studies and researches starting from the seventies [3]. During this period the first projects which revolved around nature and the environment emerged such as the work of the American architect James Wines who is associated with the SITE group, Emilio Ambasz, Rudolf Doernach, and Oswald Mathias Ungers.

Green façades and living wall systems (LWS) offer numerous ecological and environmental benefits, can have a positive influence on the comfort and well being in and around the building, besides social and aesthetical value [3]. The ecological and environmental benefits of vertical greening systems, as for green roofs, concern the reduction of the heat island effect in urban areas, the air quality improvement [10] and energy savings. In fact both the growing medium and the plants themselves provide insulation and shade which can reduce, especially in Mediterranean area, energy for cooling [13].

Starting from climbing plants planted at the base of building façades, diffuse in traditional architecture since 2000 years ago, there are now several different ways for vertical greening. The many systems available on the market can be classified into façade greening and living walls systems [7].

Green façades are based on the use of climbers (evergreen or deciduous) attached themselves directly to the building surface (as in traditional architecture), or supported by steel cables or trellis. Living wall systems, which are also known as green walls and vertical gardens, are constructed from modular panels, each of which contains its own soil or other growing medium (soil, felt, perlite, etc) based on hydroponic culture, using balanced nutrient solutions to provide all or part the plant's food and water requirements [4].

Living wall systems and green façades have different characteristics that can have influence on some of the benefits like cooling and insulating properties. This comes, among other things, due to the thickness of the foliage (creating a stagnant air layer and shading the façade), water content, material properties and possible air cavities between the different layers. The role of stagnant air layers is to slow down the rate of heat transfer between the inside and outside of a building.

* Corresponding authors.
E-mail addresses: katiaperini@hotmail.com (K. Perini), M.Ottele@tudelft.nl (M. Ottelé).

0360-1323/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.buildenv.2011.05.009