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Experimental and simulation studies on the vertical greenery system (VGS) and temperature mitigation in urban spaces

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Abstract

The present study aims to investigate the urban green walls effect on temperature adjustment. On this basis, this study has been carried out through field research by data logger and simulation method by Envi-met software in Tehran's with cold and warm seasons. In the experiment measurement has been done on actual specification cases of green walls and the temperature was recorded in certain points with definite distances from them. In the following, simulating green walls in the Envi-met in the same date. For confirm the validity of software in Tehran with cold semi-arid climate, the results of field research with data logger compared with the outputs of the Envi-met. The results showed that the during warm seasons around temperature of green-wall is cooler between 0.39c and 0.75c and during cold seasons is warmer between 0.39c to 1.26c. The effect of green surfaces was more remarkable in the distance of 0 to 0.5m. Hence, building VGS engenders appropriate environment with reducing temperature during warm season and increasing temperature during cold season, which could makes a proper microclimate around itself. Their effect is much more considerable exactly near them and they don't have noticeable effect after distance of half meter.

Keywords: Experimental study; Vertical greenery structures; Temperature mitigation; Urban spaces; Thermal effect.

1. Introduction

The development of urbanization and the growth of industrial activities in large cities has brought a wide range of changes in the physical characteristics of land, released heat, air pollution, temperature changes, and other meteorological parameters. With the development of urbanization after the 1930s, especially after the Second World War, local climate change appeared in cities [1,2], and their ecosystems have been changed. In addition, this speedy process of urbanization has destroyed green spaces and turned them into concrete buildings with low albedo skins. In contrast to low albedo surfaces, those with higher ones reflect solar radiation more and absorb a small part, resulting in a cooler environment [3] with lower temperatures [4]. So urban areas, which mostly included low albedo skins, remain warm in the evening while rural areas face cooler environment [5], the phenomena which is known as Urban Heat Island (UHI). The density of urban formation is also a reason for more reflections and therefore temperature rising [6-10].

Moreover, with these issues and their implications, designing urban environments needs highly attention to environmental aspects and returning nature back to urban spaces to re-establish a balanced cycle of climate parameters. Temperature control, in addition to direct impact on users' satisfaction, reduce indoor air temperature [11-13] and also reduce UHI [14-17]. As a solution for temperature control, trees and greenery can be effective by their shading and cooling effect [18-26]. It should be mentioned that although trees can be so effective, it is not always possible to plant them in dense and crowded cities [19]. Urban designers are trying to find an extra place for planting greenery. Due to loss of space, a vegetated skin can be very acceptable [27]. Green surfaces including green walls and green roofs have become a significant part of designing recently. They cause several benefits such as aesthetic benefits [28,29], absorbing pollutants [30-32], energy consumption and optimization [33-39,19]. In recent years there have been many researches investigating the performance of green roofs [40-43] while green facades [44-46] are still needs to be surveyed [26]. The main purpose of this study is investigate the effects of green walls

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