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Experimental assessment of the thermal behavior of a living wall system in semi-arid environments of central Mexico

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ABSTRACT

The City of Queretaro is located in a semi-arid region that receives an elevated annual solar radiation (2200 kWh/m^2 in AVG) with high UV factor indices (6+ in AVG) and a low rainfall accumulated throughout the year (550 mm in AVG), which represents a serious problem that affects the environment, buildings and finally people. The aim of this work is to illustrate the behavior of living walls and their beneficial effects under such semi-arid environments in central Mexico.

The present study monitored two experimental huts, built with the most common materials used for Housing in Mexico. In one of them a living wall was placed at the south façade, while the other served as a control bare wall. Temperature and humidity sensors were located inside the huts and between the wall layers. Data about inside and outside conditions of the buildings were collected to evaluate: (a) temperature reduction inside huts; (b) rainfall and water demand of the living wall; (c) temperature and solar radiation transfer on buildings. Results demonstrate that living walls on such climate conditions, help to improve time and percentage of loss/heat gain of the enclosure, increase permeable green surfaces and favor social interaction.

1. Introduction

The construction of social housing in Mexico has historically been determined by budget; the smaller the budget, the smaller the house. The size of the house as a result serves as the principal guiding axis for the design and construction of Mexican social housing, following government guidelines; in 1930 social properties had to meet a minimum floor area of 44 m^2, this then increased gradually to its historic peak of 58 m^2 in 1980 and currently stands at 38 m^2 [1–3]. Moreover, the design and construction is also influenced by the geographic location of Mexico, which falls on the boundary of three tectonic plates, increasing the probability of natural disasters such as earthquakes. As a result, structural safety can be considered as the second most important guiding axis in design and construction. Subsequently, bioclimatic design and thermal comfort conditions are often neglected and not considered to be of great importance to housing developers [4].

The Mexican Institute of the National Fund for Workers' Housing (INFONAVIT) is a public entity which manages a national housing fund, made up of a 5% salary contribution from all private employees in Mexico. With this fund, INFONAVIT then grants mortgage loans, and acts as an intermediary between housing developers and families who are interested in buying a home. To ensure social housing meets a good quality standard, INFONAVIT uses inspection companies, who determine that the properties and housing developments are completed under certain quality parameters. The inspection companies have to certify a "Unique Technical Dictum" of habitability [5], which evaluate the following criteria:

- If the house and the housing development have electricity.
- If the house and the housing development have potable water.
- If the housing and the housing development have drainage and sewerage.
- If the house and the housing development have adequate physical and security conditions.
- Note there is a further section entitled "Report of attributes and ecotechnology solutions for energy saving". Buildings can gain quality points for these features, but, unlike the others, this criteria is not mandatory.

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