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Energy performance of a medium scale green roof system installed on a commercial building using numerical and experimental data recorded during the cold period of the year

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ABSTRACT

The aim of this study is to investigate the energy performance of a medium scale green roof system installed on a two-story commercial building in Athens, Greece and its possible contribution to the mitigation of the urban heat island phenomenon. For the purpose of this research, in-situ measurements of temperature and humidity took place during the cold period of the year. The surface temperature of the conventional concrete floor of the roof was found to be up to 21.9 K higher than the one of the planted area during the day, while at the first hours of the day, the surface temperature of the green roof appeared to be up to 1.6 K higher than the one of the cement floor of the roof. Differences of the surface temperatures of the varying plants of the green roof were measured and led to a proposal of an optimum selection among them for the best performance of such a green roof system. Furthermore, simulations for this building were performed by using the EnergyPlus program. It was calculated that thanks to the installation of the green roof system, the indoor air temperature, for a non air conditioned status of the building, was decreased up to 1.1 K during a typical summer day and was increased up to 0.7 K during a typical winter day. Lastly, an overall saving of 15.1% for a whole year on the energy consumption of the building was calculated.

1. Introduction

In recent years, cities with high building construction rate face the urban heat island phenomenon, which describes the significant higher ambient temperatures in the cities comparing to the air temperatures in their peripheral [1]-[8]. A thorough investigation of urban heat island effect in Athens, Greece confirms its existence in summer and in winter period as well, which has serious impact on the energy consumption of buildings for cooling and heating [5],[6]. Green roof systems (G.R.S.) is an effective technology that is being used, mostly the latest years, in order to mitigate the urban heat island effect, to ameliorate the air quality in the cities by increasing their green areas and ,as well as, to reduce the energy consumption of

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