

Abstract

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Effectiveness of Passive Roof Treatments on Existing Residential Buildings in Egypt: A Simulation-Based Comparative Study

Climate change and global warming are considered the main challenges that encounter the planet. Energy consumption, as a major cause, has reached a threatening threshold which necessitates major changes in conventional trends. Residential buildings are the most common building type with highest energy consumption within the different building sectors. In hot climate such as that of Egypt, energy consumption in existing residential building sector is highly dedicated towards mechanical cooling systems in order to maintain thermal comfort for occupants. Untreated roofs in conventional residential buildings are responsible for the excessive heat gain and for the rise in the energy consumption of top floors. Roof retrofit of existing residential buildings has been Selected as a promising field that could contribute in reducing energy consumption for hot climate zones. The research aims to identify the most appropriate passive roof treatment that provides highest energy savings for the top floor of existing residential buildings in Egypt. A comparative analysis of various roof treatments has been conducted using simulation results of Design Builder and using typical weather data of three different cities in Egypt Cairo, Alexandria, and Asyut. A residential benchmark has been Selected as the base case of this study to represent Egyptian residential building stock. Simulation results of the benchmark have been initially validated against electricity bills before the application of any roof treatments. Five passive roof treatments were compared for the three different cities Green roof, cool roof, roof pond, thermally-insulated roof, and shaded roof. Based on the simulation results, passive roof treatments could save from 9% to 46% of the cooling energy consumption in Cairo, and from 8% to 36% in Alexandria and from 7% to 51% in Asyut annually. Green roof treatment with 10cm depth is considered the best among the five passive roof treatments with highest energy savings. All the roof treatments provide their least energy savings in Alexandria since the climate is not too hot and more humid with less evaporative cooling potentials.