

Abstract

Electricity consumption of a residential building reaches the peak in the evening when occupants begin to turn on Air-conditioning system. This peak energy demand comes from mostly heat sink within the building thermal mass. The consequence is the unexpected high energy rate charged during peak hour (9am to 10pm). There are two main focuses for this study. The first one aims at scratching the solutions for preventing this negative impact by emphasizing on material, thickness, and window-to-wall ratio (WWR) of building's envelope at night (7pm to 6am). The second part of the study focuses on various ways to reduce the heat for each type of wall color material and WWR; such as, wall color changing, heat insulation installing, sunscreen installing, and window material changing. The experiment was setup based on conventional practices of typical residential building appearance. Results from eQUEST 3.63 (the Quick Energy Simulation Tool), a DOE 2.2 simulation software, reveals the significant differences of these variables on the building energy consumption and cooling load. Contradicting to past studies, the low U-value material does not always perform as good as expected. When the building has high WWR, low U-value wall can trap the heat within the building and increase the cooling energy demand. For the building with low WWR, the most appropriate methods for reducing heat of buildings are the installation of heat insulation and the changing of wall color, respectively. On the contrary, when WWR increases, Thermal insulation causes more cooling energy demand. As a result, changing the material of the window and installing sunscreen are more effective. Once the results are validated against full-scale measurement, the outcome of this research could help the designers selecting high performance building envelopes which, in turn, reduce both energy consumption.