Passive air cooling system and solar water heater with Phase Change Material for low energy buildings in hot arid climate

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Abstract:

Solar energy is considered alternative crucial to fulfilling the increasing of energy requirements. Passive cooling systems are considered alternatives to mechanical ventilation systems. In this work, a highlight for a solar chimney with water heater and Phase Change Material is applied as a passive solar technique for cooling building integrated with short wind tower for low energy building in the hot arid climate. This paper aims to investigate the performance of new passive air condition system with the solar chimney and solar water heater as a full system for cooling air and heating water to be applied during day and night time based on the improvement of the solar chimney in Assiut climate, Egypt. Measurements, for air temperatures and surface temperature of the aluminium and air velocity inside the chimney, water temperature and room temperature were conducted with different solar radiations to evaluate the panel performance and room thermal comfort. The findings show a minimum airflow rate in the chimney after sunset equal to 0.69 kg/s to provide fresh cold air during a hot day with a water temperature equal 58 °C and 40 °C during 2 pm and after sunset respectively. Also, integration of solar chimney and PCM with cooling wind tower achieves a significant reduction for room air temperature between 8 and 4 k during day and night time respectively and the condition within the comfort range of Predicted Mean Vote (PMV) especially night time. The results provided information to integrate this new low energy compact passive air cooling and water heating system for the housing projects of the upper floor in a hot arid climate in Egypt.

Keywords:

Phase Change Material Solar Chimney Passive air cooling system Multi-Wall Carbon NanoTubes Water heater

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