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PII: S2352-7102(17)30835-5
DOI: https://doi.org/10.1016/j.jobe.2018.04.026
Reference: JOBE471

To appear in: *Journal of Building Engineering*

Received date: 3 January 2018
Revised date: 26 April 2018
Accepted date: 27 April 2018

Cite this article as: Leila Moosavi, Majid Zandi and Mokhtar Bidi, Experimental study on the cooling performance of solar-assisted natural ventilation in a large building in a warm and humid climate, *Journal of Building Engineering,* https://doi.org/10.1016/j.jobe.2018.04.026

Experimental study on the cooling performance of solar-assisted natural ventilation in a large building in a warm and humid climate

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Abstract

This paper investigates the cooling performance of a naturally ventilated building equipped with a solar chimney and hybrid evaporative cooling, and provides data recorded during a fourteen-day site test in an occupied office building incorporating an atrium. The efficiency of the implemented strategies was determined in terms of enhancing the indoor thermal and air movement conditions in the atrium occupied zones under different opening configurations and evaporative cooling operation times. The thermal data for the glazed atrium, together with the wind and stack-induced airflow rates, indicate that a larger exhaust opening in the solar chimney reduces the air temperature of the atrium central zone rather than the adjacent space. It increases the hours of comfort by more than 30%, with a potential significant reduction in the cooling requirements of about 12% when the building is occupied. On average, the hybrid evaporative cooling system reduces the indoor temperature by 0.7 °C and significantly decreases the thermal stratification during the afternoon. Furthermore, the amount of warm air removal through the chimney vent has an almost direct linear relationship with the wind speed when it exceeds 1.4 m/s in a favorable direction.

Keywords:

Energy, Atrium building, Solar chimney, natural ventilation, Hybrid evaporative cooling