Enhancement of stack ventilation in hot and humid climate using a combination of roof solar collector and vertical stack

ABSTRACT

In the hot and humid climate, stack ventilation is inefficient due to small temperature difference between the inside and outside of naturally ventilated buildings. Hence, solar induced ventilation is a feasible alternative in enhancing the stack ventilation. This paper aims to investigate the effectiveness of a proposed solar induced ventilation strategy, which combines a roof solar collector and a vertical stack, in enhancing the stack ventilation performance in the hot and humid climate. The methodology selected for the investigation is physical experimental modelling which was carried out in the actual environment. The results are presented and discussed in terms of two performance variables: air temperature and air velocity. The findings indicate that the proposed strategy is able to enhance the stack ventilation, both in semi-clear sky and overcast sky conditions. The highest air temperature difference between the air inside the stack and the ambient air (Ti−To) is achieved in the semi-clear sky condition, which is about 9.9 °C (45.8 °C–35.9 °C). Meanwhile, in the overcast sky condition, the highest air temperature difference (Ti−To) is 6.2 °C (39.3 °C–33.1 °C). The experimental results also indicate good agreement with the theoretical results for the glass temperature, the air temperature in the roof solar collector's channel and the absorber temperature. The findings also show that wind has significant effect to the induced air velocity by the proposed strategy.

Keyword: Stack ventilation, Solar induced ventilation, Hot humid climate, Temperature, Air velocity