Passive thermal performance prediction and multi-objective optimization of naturally-ventilated underground shelter in Malaysia

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Abstract

The impact of global warming has urged a prudent spending of energy in the building sector nowadays. In general, a typical HVAC system consumes about 60%-70% of the total energy consumption of a building. Therefore, designing an energy-efficient HVAC system is essential to alleviate the worsening greenhouse effect. Recent research works have reported that geothermal energy coupled with optimal insulation is the best approach in minimising the energy consumption. Thus, we attempted to analyse the thermal performance of a naturally-ventilated underground shelter in a hot and humid country such as Malaysia. We proposed an optimal design to enhance the sustainability of the low-energy building. The model was numerically simulated using CFD, and a statistical surrogate model was implemented for obtaining the optimal design. The findings indicated that the room temperature of the shelter was significantly lower than the outdoor temperature during the hottest month and vice-versa during the coldest month. Moreover, the proposed optimal design showed about 3.4% increase in ventilation rate and about 2.8% decrease in room temperature as compared to the previous design. In general, the current work could be used as a guideline for designing low-energy building in Malaysia. (C) 2018 Elsevier Ltd. All rights reserved.

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