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The potential influence of building optimization and passive design strategies on natural ventilation systems in underground buildings: The state of the art

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Abstract

Most of the underground buildings rely on mechanical ventilation system for achieving an acceptable indoor thermal comfort level. In order to alleviate the greenhouse effect, it is essential to incorporate a passive system in an underground building to reduce the overall building energy consumption. From the perspective of the indoor occupant, the Indoor Environmental Quality (IEQ) should be maintained at a reasonable level as well if the passive system is used in a building ventilation system. The above problem could be addressed by devising an integrated design procedure that combines both underground building simulation and design optimization methods. The review of this topic, however, is rather scarce in the open literature. Thus, this review paper assesses existing scientific literatures that address the potential influence of building optimization and passive design strategy on the control of IEQ level. The topics covered in this review paper are histories and design considerations of underground buildings, consideration factors required, concept of building ventilation system, IEQ level assessments reported by buildings' occupants, critical element in building optimization and passive design strategy in the underground building. From the current review, we have found that integrating both optimization approach and passive design strategy into building performance simulation is a promising technique in improving the IEQ level of the underground building. Moreover, the adoptions of soil and natural ventilation can effectively reduce the energy consumption in underground conditioning system. Indeed, there are several important factors that should be taken into account while designing an underground building. Also, there are a few passive designs that can improve thermal comfort and reduce energy consumption in underground buildings. All in all, the primary target of this paper is to assist building engineers and designers in designing an energy-efficient underground building. Meanwhile, the acceptable IEQ level could be maintained.

Keywords

Author Keywords: Underground building; Indoor Environmental Quality (IEQ); Building optimization; Passive building design

KeyWords Plus: COMPUTATIONAL FLUID-DYNAMICS; INDOOR ENVIRONMENTAL-QUALITY; AIR HEAT-EXCHANGER; THERMAL COMFORT; CROSS-VENTILATION; ENGINEERING DESIGN; CFD SIMULATION; WIND-TUNNEL; MULTIOBJECTIVE OPTIMIZATION; NUMERICAL OPTIMIZATION

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