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A simplified numerical model to assess earth to air heat exchangers

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ABSTRACT

Thanks to the high thermal inertia of the ground, the variation of soil temperature and its average value are lower than that of the ambient air during the hot months. Based on this fact, earth-to-air heat exchangers (EAHEs) have been deployed as an efficient and green approach in moderating extreme climatic conditions and producing drinkable water. As the warm ambient air passes through the underground pipes of the EAHE, its temperature decreases, and the moisture content in the air condenses into droplets of water. The obtained cooled air can be used for supplying the cooling loads of the residential sector, while the produced water can be implemented for irrigation or drinking purposes. In this study, a simple transient thermodynamic model for the application of EAHE in supplying cooling demand and potable water for the residential sector will be proposed for quick prediction of heat transfer performance in EAHEs. A MATLAB code will be developed based on this model, which can determine the water production rate and the air temperature within the underground channel. This numerical model, which benefits from its simplicity and low run-time, will be validated with the experimental data available in the literature. Using the proposed model, the impacts of the inlet air velocity, length and diameter of the buried pipes, average soil temperature, and outdoor temperature and relative humidity (RH) on the potable water production rate and the air temperature at the outlet of the EAHE will be investigated. This study would provide a design guideline that can be deployed for the preliminary application of EAHEs in supplying the fresh water and cooling loads of the residential buildings.

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