MODELING a NOVEL SHALLOW GROUND HEAT EXCHANGER

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Abstract

Ground heat exchangers (GHXs) are rarely installed horizontally in linked ground source heat pumps used for space conditioning, because their energetic performance is lower than in the vertical solution. However, the horizontal one holds several advantages: it is easy to carry out and upkeep, it is more compliant with environmental regulations, and interferes marginally with groundwater systems. Moreover, the seasonal heat transfer over the soil surface resets the memory of the energy exploitation carried out by a horizontal GHX. This reflects the main difference to the vertical ground heat exchangers, whose performance is linked to a balance in heating and cooling requirements close to zero.
To maintain these advantages and improve the energetic performance, we have examined a novel geometry for horizontal GHX, consisting of a flat panel installed edgeways in a trench at shallow depth, and coupled with a heat pump for heating and cooling. COMSOL Multiphysics is used to model the three-dimensional domain with hourly time-varying boundary conditions supposed at the ground surface and the closed loop. Here, hourly heat loads due to heat pump operation are modeled as transient heat fluxes imposed on the closed loop inlet/outlet. The heat loads are assessed linking the energy requirements to the outdoor air temperature time series, and simplifying the building as a homogenous lumped system, whose internal energy variation occurs due to the heat transfer through its shell.