Simulation and optimisation of a ground source heat pump with different ground heat exchanger configurations for a single-family residential house

In the future there will be an increased demand for energy efficient cooling of residential buildings. Therefore it is essential to develop cooling concepts that are passive and/or using very little primary energy. A possible solution is a ground source heat pump combined with a low-temperature heating and high-temperature cooling system. The present work evaluates the performance in relation to thermal comfort and energy consumption of a GSHP with different GHE concepts. The different configurations are analyzed being part of the energy supply system of a low-energy residential house, replicated for the climatic location of Copenhagen, Denmark. The study results show no significant difference in systems’ COP values during the heating season. During the cooling season the systems with VGHEs and sub-slab GHEs have shown up to 50% higher COP values, compared to systems with HGHEs. For the studied geographical location, passive cooling by bypassing the heat pump and using only the ground heat exchanger can provide acceptable room temperatures.

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