Numerical investigation of the performance of geothermal energy piles under different soil moisture conditions

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The use of foundation structures (piles) coupled to a heat pump system, commonly referred to as geothermal energy pile (GEP) system, provides a renewable energy solution of achieving space heating and cooling in buildings; whilst also being utilised for the structural stability of the overlying structures. The system operates by exchanging the low-grade heat energy within the shallow earth surface with the building, via the circulation of heat carrier fluid enclosed in a high-density polyethylene plastic pipes. In summer, heat energy is extracted from the building and transferred into the ground to achieve space cooling. While in winter, the ground heat energy is harnessed and transferred to the building to achieve sustainable space heating. This paper investigates the thermal performance of the GEP system under the effects of factors such as initial soil pore water content and groundwater flow.

The study utilises coupled thermo-hydraulic finite element modelling and analyses to achieve the aim of this study. It was observed that the initial pore water volume and groundwater flow are very significant factors that determine the amount of heat energy that can be harnessed using the system.