

**UNDERGROUND FLOW THROUGH A POROUS MEDIUM AND MODELING  
GROUND HEAT EXCHANGERS**

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**Abstract**

Vertical or Borehole Ground Heat Exchangers (GHEs) constitute a major form of Geothermal Energy Systems (GES). When groundwater flows in the sub-layers past the borehole, the heat injection rates of the GHE can be considerably affected. Here, a mathematical model is constructed for regimes with or without groundwater, allowing for the presence of porous media regions. The problem is solved through a Finite Element Method in the FlexPDE software environment, which is first validated with experimental data from a Thermal Response Test (TRT) carried out in Lakatameia, Cyprus. The validated model is then employed to study the thermal behavior of vertical GHEs and the effect of factors such as (a) BH radius, (b) U-tube diameter, (c) U-tube leg and BH centers distance, (d) grout thermal conductivity and (e) groundwater velocity.