

The Institute of Geotechnical Engineering (IGS) is offering a thesis with the topic:

Numerical simulation of freeze-thaw cycles on borehole heat exchangers performance

Borehole heat exchangers (BHEs) are considered as one of the efficient underground systems of shallow heat extraction. A typical BHE consists of mostly U-shape pipes, implemented inside the cylindrical grout and a working fluid, which is running through the pipes exchanging the energy with the surrounded domain.

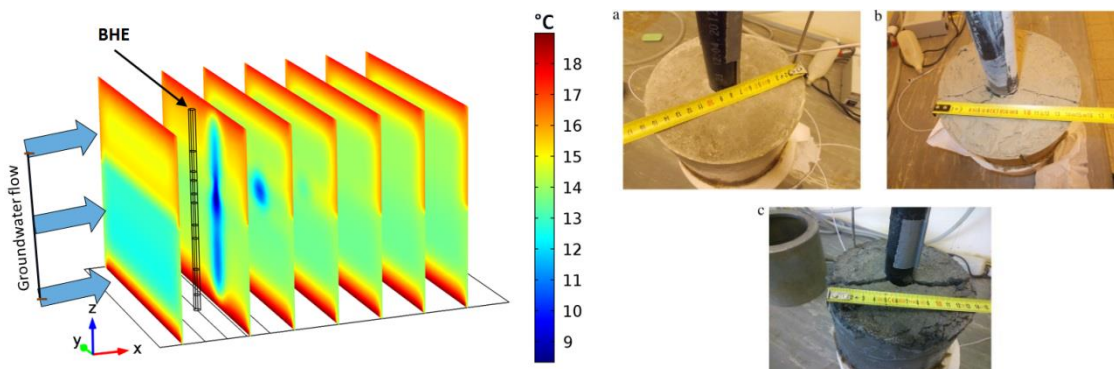


Figure 1: temperature distributions inside the soil layers(left). BHE specimen exposed to freeze and thawing cycle (right).

Based on the fact that a BHE can be operated below the freezing point of the water with anti-freeze mixture, there might be freezing happening inside the concrete. The freezing front could exceed inside the saturated soil, which surrounded the BHE, and, accordingly, freezes the soil adjacent to the BHE. Freezing changes the properties of the saturated soil around the BHE such as thermal conductivity, thermal capacity and hydraulic conductivity. Developing a model, which could be able to simulate a phase change inside the porous media, could provide valuable information referring to the behavior of such a system for designing a BHE with higher efficiency and better performance.

Topics:

- Literature review on the analytical and numerical solutions and models, which have been developed to describe and simulate freezing and thawing phenomenon in the BHE's.
- Numerical simulation of the effects of soil freezing on underground temperature variations of soil around ground heat exchangers using commercial FEM software's such as (Comsol multiphysics)

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