Coupled THM modeling of energy micro–pile behavior

Diana Salciarini*, Federica Ronchi* and Claudio Tamagnini†

*Department of Civil and Environmental Engineering
Università degli Studi di Perugia
Via G. Duranti, 93 06125 Perugia, Italy
e-mail: diana.salciarini@unipg.it, claudio.tamagnini@unipg.it

ABSTRACT

The paper presents the results of a parametric study in which a series of fully coupled, 3D thermo–hydro–mechanical (THM) FE analyses has been conducted to investigate the effects of the heating/cooling cycles on a single energy pile of small diameter (micro–pile) installed in saturated, fine grained soils. This study has been performed during the design stage of an innovative geotechnology – the energy micro–pile – currently under development at the University of Perugia for the exploitation of low–entalphy geothermal energy in the retrofitting of existing buildings [1].

The FE simulation program has been focused mainly on the evaluation of such crucial aspects of the energy pile design as the assessment of mechanical effects induced in the pile and the soil during thermal loading conditions and the effect of varying thermal properties of the soil on the thermal input/output of the pile. The constitutive equations adopted for the non–isothermal porous medium are Fourier's law for heat conduction, Darcy's law for pore water flow, and an isotropic hardening elasto–plastic constitutive model for fine–grained soil developed within the general framework of plasticity with generalized hardening [2], incorporating thermal hardening and softening mechanisms.

To obtain a partial validation the THM model, the numerical predictions are compared with some preliminary observations made on a full–scale instrumented energy micropile currently under testing at the geotechnical engineering laboratory of the University of Perugia. The results of the comparison are encouraging and provide some insight for the improvement of the model.

REFERENCES

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