

# Triaxial tests on frozen ground: formulation and modelling

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## ABSTRACT

Freezing and thawing of pore fluid within soils involves complex thermal, hydraulic and mechanical processes that can have significant mutual geotechnical interactions. For example, phase changes of pore fluid caused by temperature variations modify the hydraulic regime of the soil, which in turn induces mechanical deformation. At the same time, any change in the hydraulic and mechanical conditions influences the thermal processes by advection and changes of ice and water contents (Gens 2010). In this work the effects of freezing-thawing induced heave and settlement, are studied in order to obtain reliable and effective predictions to control displacements. By employing a combination of ice pressure, liquid pressure and total stress as state variable (Figure 1), a constitutive model that encompasses frozen and unfrozen behaviour with a unified effective-stress-based framework will be adopted (Nishimura et al 2009).

The approach is validated against experimental data following compression triaxial stress path under different temperature on frozen samples of yellow tuff and pozzolanas from Naples where the Artificial Ground Freezing (AGF) has been extensively as technique to excavate the station tunnels and the inclined passageways of underground construction of Line 1 through loose granular soils and the fractured soft rock below the ground water table (Viggiani and De Sanctis 2009). The performance of the coupled termo-hydro-mechanical (THM) model is validated against experimental data in order to provide valuable insight into the effectiveness of the approach. Detailed consideration is given to FE mesh design, the treatment of ice, water/ground interface boundary conditions. The THM simulation is shown to reproduce, with fair accuracy, the observed behaviour during triaxial compression and thawing.

## REFERENCES

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