Università degli Studi di Pavia

Dipartimento di Meccanica Strutturale

in collaboration with

Centro di Simulazione Numerica Avanzata – CeSNA

Istituto Universitario di Studi Superiori

SEMINAR

Multi-physics modelling of thermo-elasto-plastic multi-phase porous materials with application to environmental engineering problems

We present a formulation for the computational analysis of thermo-elasto-plastic multi-phase porous materials based on Porous Media Mechanics, with the aim to simulate environmental engineering problems.

The numerical model is based on a fully coupled heat and multi-phase flow model in deforming porous media. The porous medium is assumed to be a multi-phase system where interstitial connected voids of the solid matrix may be filled with liquid water (with dissolved air), water vapor and dry air. To handle this multi-phase system, the general frame of averaging theories is used in deriving the governing equations. Phase change of water (evaporation-condensation, adsorption-desorption) and heat transfer through conduction and convection, as well as latent heat transfer are considered.

The elasto-plastic behavior of the solid skeleton is assumed homogeneous and isotropic; the effective stress state is limited by the temperature and capillary pressure dependent ACMEG-TS yield surface. The governing equations are discretized in space and time by means of the finite element method.

The numerical examples will show applications of the full set of equations. Validation of the implementation of the constitutive model is made by selected comparison between model simulation and experimental results for different combinations of thermo-hydro-mechanical (THM) loading paths. Application to the modeling of non-isothermal elasto-plastic consolidation in Boom clay at different partially saturated initial conditions or due to heating or desiccation is described.

Moreover, examples given involve the simulation of the onset of shallow landslides in pyroclastic soils due to rainfall, the groundwater and saturation response of a typical salt marsh of the Venice lagoon (Italy) subjected to both tide fluctuation and flooding, the THM behavior of a nuclear waste disposal in a geological clay formation and the seismic behavior of an earth dam.

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Friday 18 November, 14.00

MS1 Conference Room,

Department of Structural Mechanics,

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