



Vorträge im Gästeprogramm des GRK 2075

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

03., 05. und 06.12.2018, jeweils 15:00-16:00 Uhr
Pockelsstr. 3, Seminarraum 0017

We present a computational framework to describe thermo-elasto-plastic multi-phase porous media with application to geo-environmental engineering problems.

To this aim, a mathematical model for water saturated geo-materials is derived first, based on the standard solid and fluid mechanics. Then, the model is extended to non-isothermal and variably saturated conditions within the Hybrid mixture theory using averaging theories. Quasi-static conditions or dynamics are considered. The porous medium is assumed as a multi-phase system composed of a solid matrix and open pores filled with liquid water (with or without dissolved air), water vapour and dry air. Phase change of water (evaporation-condensation) and heat transfer through conduction and convection, as well as latent heat transfer are taken into account in the model development.

The elasto-plastic behaviour of the solid skeleton is assumed homogeneous and isotropic; the effective stress state is limited by a temperature and capillary pressure dependent yield surface. Local or non-local visco-plasticity is adopted in case of rate-dependent behaviour of the solid. The finite element method is used to discretize in space and time the governing equations.

Some numerical examples will show applications of the full set of discrete equations.

03.12.: Coupled behaviour (saturated)

- Hydro-Mechanical coupling in saturated geo-materials: a mathematical model
- Thermo-hydro-mechanical coupling in saturated materials
- Numerical examples: elastic consolidation, groundwater and saturation response of a typical salt marsh of the Venice lagoon (Italy), THM behaviour of a nuclear waste disposal in a geological clay formation, strain localization in initially water saturated sands

05.12: (Thermo)-Hydro-Mechanical coupling in unsaturated soils

- Hydro-Mechanical coupling in variably saturated geo-materials: a mathematical model
- A unified approach to numerical modelling of fully and partially saturated porous materials
- Numerical examples: thermo-elasto-plastic consolidation in Boom clay, Liakopoulos benchmark test, onset of shallow landslides in pyroclastic soils due to rainfall

06.12: Finite element modelling of variably saturated soils

- Space and time discretisation of an isothermal unsaturated porous media model undergoing large elasto-plastic strains
- Finite element formulation for dynamics of non-isothermal variably porous media