Finite element modelling of thermo-elasto-plastic water saturated porous materials

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The purpose of this poster is to present a new finite element formulation for the hydro-thermo-mechanical analysis of elasto-plastic multiphase materials based on Porous Media Mechanics. To this end, the general ACMEG-T thermo-elasto-plastic constitutive model for saturated soils (Laloui et al. 2005, Laloui and François) has been implemented in the finite element code COMES-GEO for the analysis of non-isothermal elasto-plastic porous materials (Sanavia et al. 2006). The two-phase media is modelled as a deforming porous continuum where heat conduction and convection and water advection are taken into account (Lewis and Schrefler 1998, Gawin and Schrefler, 1996). The elasto-plastic behaviour of the solid skeleton is assumed homogeneous and isotropic; the effective stress state is limited by two temperature dependent yield surfaces, with non associated plastic flow. In the context of elasto-thermoplasticity, the constitutive model is built on concepts of bounding surface theory and multi-mechanisms plasticity. Within the finite element method for coupled problems (e.g. Lewis and Schrefler 1998), the macroscopic balance equations are discretized in space with a Galerkin procedure and integrated in time through the Generalised Trapezoidal Method. Small strains and quasi-static loading conditions are assumed.

Validation of the implemented model by selected comparison between model simulation and experimental results for different combinations of thermo-hydro-mechanical loading paths are presented. A case of non-isothermal elastic consolidation is simulated and compared with validated numerical solution (Aboustit et al. 1985). In addition, the study has been extended to a thermo-plastic consolidation with arbitrary but consistent plastic parameters in order to bring to light the contribution of thermo-plasticity in such a problem (Figure 1).

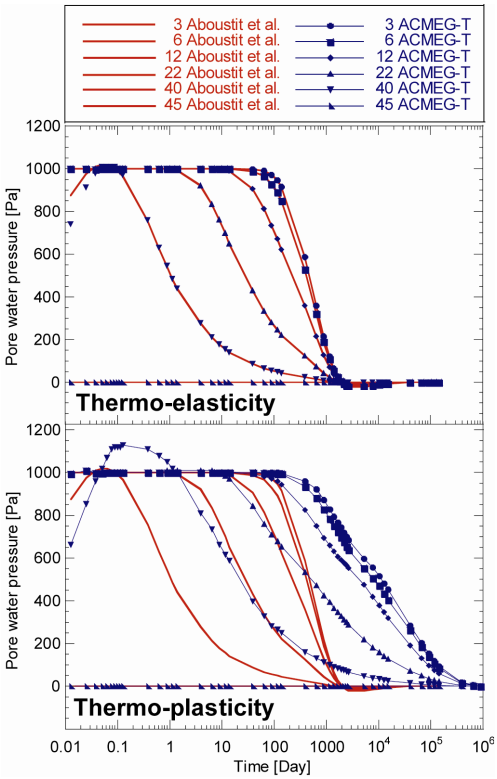

Figure 1: (a) Simulation of the Aboustit case; (b) extension to thermo-plasticity – Evolution of pore water pressure with time

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