Thermo-Hydro-Mechanical Behaviour of Geomaterials

A.P.S. Selvadurai
Department of Civil Engineering and Applied Mechanics
McGill University
817 Sherbrooke Street West
Montréal, QC, Canada H3A 0C3
patrick.selvadurai@mcgill.ca

The paper deals with the thermo-hydro-mechanical modelling of porous media where the skeleton can exhibit elasto-plastic effects. The consideration of plasticity effects is largely of interest to soft rocks and saturated clays that could display elasto-plastic constitutive behaviour in their skeletal responses, particularly in the small strain range (Davis and Selvadurai 2004; Pietruszczak 2010). Thermo-poro-elasto-plasticity of clays has been discussed in connection with engineered clay barriers that have been proposed for high level nuclear waste disposal endeavours and the approaches are also of interest to energy extraction by thermal stimulation of oil bearing rocks, geothermal energy extraction, frictional heating at earthquake fault zones and in the geologic disposal of carbon dioxide in supercritical form. The Cam Clay plasticity modelling of thermal failure in saturated clays in particular has been considered by Hueckel et al. (Selvadurai and Suvorov 2012; Selvadurai and Suvoroc 2014).

This paper presents a comparison of analytical and computational results for the idealized problem of the external heating of a fluid-saturated sphere with a skeletal response that can be described by elastic or elasto-plastic phenomena. The objectives of the computational studies presented in the paper are to develop a set of benchmark computational results that can be used to validate computational codes in their ability to provide inter-code validations. The development of Mandel-Cryer effects during boundary heating of the fluid-saturated sphere is used as a criterion for establishing the accuracy of predictions.

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