Multiphysics analysis of tramway geotechnical infrastructure: numerical modelling

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Abstract

Under realistic field conditions, geotechnical infrastructures are usually influenced by complex interactions of mechanical behaviour under the action of an internal water flow. This mechanism could be the main origin of damage to embankments. This study develops a new hydro-mechanical (HM) approach based on Darcy's law model and Biot's poroelastic concept to investigate the behaviour of soil with and without geotextile under realistic conditions. The problem's numerical solution is carried out using a finite-element method. The proposed two-dimensional model was implemented in Comsol Multiphysics Software. Under coupled HM behaviour, the stress in porous materials causes a volumetric change in strain, which causes fluid diffusion. Consequently, pore pressure dissipates through the pores. To discuss the advantages of coupled HM modelling and evaluate the geotextile performance, volumetric strain, pore-water pressure, storage and displacement are compared for a mechanical, hydraulic and HM model. These analyses were undertaken in connection with a tramway embankment project in a marshy area in Sidi Bel Abbes. The simulation results show better results for geotextile and embankment in HM coupled modelling.

Keywords: embankments numerical modelling water flow