Geotechnical structures under realistic field conditions are usually influenced with complex interactions of coupled hydromechanical behavior of porous materials. In many geotechnical applications, however, these important coupled interactions are ignored in their constitutive models. Under coupled hydromechanical behavior, stress in porous materials causes volumetric change in strain, which causes fluid diffusion; consequently, pore pressure dissipates through the pores that results in the consolidation of porous material.

The objective of this research was to demonstrate the advantages of using hydromechanical models to estimate deformation and pore water pressure of porous materials by comparing with mechanical-only models. Firstly, extensive literature survey was conducted about hydro-mechanical models based on Biot's poroelastic concept. Derivations of Biot's poroelastic equations will be presented. To demonstrate the hydromechanical effects, a numerical model of poroelastic rock materials was developed using COMSOL, a commercialized multiphysics finite element software package, and compared with the analytical model developed by Wang (2000). Secondly, a series of sensitivity analyses was conducted to correlate the effect of poroelastic parameters on the behavior of porous material. The results of the sensitivity analysis show that porosity and Biot's coefficient has dominant contribution to porous material behavior. Thirdly, a coupled hydromechanical finite element model was developed for a real-world example of embankment consolidation. The simulation results show excellent agreement to field measurements of embankment settlement data.

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The public is welcome to attend.