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Development of a coupled model for air and water flow through unsaturated soils: Simulation of an axis-translation technique procedure

Victor Scartezini Terra[1], **Gilson de Farias Neves Gitirana Jr**[2] and **Tayane Andrade Assuncão**[3]
[1]University of Rio Verde, Brazil
[2]Federal University of Goias, Brazil
[3]University Paulista, Brazil

Flow problems in unsaturated soil mechanics can be laid in several engineering problems, such as transient analysis of slope stability, volume change in collapsible and expansive soils, earth dam projects, among others. To simulate these problems, plenty of partial differential equations (PDEs) simulating water and air flow through soils can be found on the literature, such as the equations developed by Fredlund and Gitirana Jr (2005) and Ba-Te (2004). This paper aims to develop a formulation based on PDEs governing the coupled flow of water and air phase through unsaturated soils. The equations obtained here are implemented in a PDE solver named FlexPDE, version 6 (PDE Solutions, 2007). To verify the developed FlexPDE model, a benchmark analysis is made by comparing the results from FlexPDE with the results obtained with the package AIR/W from the GeoStudio software (GEO-SLOPE International, 2012). The benchmark analysis consists of a simulation of the axis-translation technique for determination of the matric suction in unsaturated soil. A one-dimensional analysis is made considering a cylindrical soil sample with 2 cm of high. Then the axis-translation technique is simulated by applying a controlled air pressure on the top of the domain. Between the several constitutive relation models that can be found in the literature, the equations of van Genuchten (1980) and Mualem (1976) for the soil-water characteristic curve and for the permeability equations were adopted in this paper. The results show that the FlexPDE model works well in the simulation of the coupled flow of air and water phase through the unsaturated soil. An observation is made related to some problems founded on the AIR/W package in transient analysis with very low timesteps.

Biography

Victor Scartezini Terra has completed his Master's degree from Federal University of Goias. He is an Adjunct Professor at University of Rio Verde.

victorzini@gmail.com

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