Factor of safety in a partially saturated slope inferred from hydromechanical continuum modeling

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Abstract

Rainfall weakens an earth slope and triggers mass movement. Relevant triggering mechanisms are complex and include reduction of capillary pressure due to increased saturation and frictional drag on the sediment induced by fluid flow. Physics-based continuum models utilizing modern computational tools are useful for understanding the mechanisms of deformation in partially saturated slopes; however, they do not provide a scalar indicator called 'factor of safety' that measures the potential of a given slope for mass movement. In the present work, we employ sequential calculations consisting of a physics-based finite element model that couples solid deformation with fluid flow to quantify the stress and deformation fields in a steep hillside slope subjected to rainfall infiltration. This is followed by a limit-equilibrium calculation based on the method of slices that evaluates the desired factor of safety. Some results are also given showing the impact of dual porosity-dual permeability on the ensuing mechanism of deformation and failure. The field condition investigated is similar to the steep experimental catchment CB1 near Coos Bay, Oregon, which failed as a large debris flow from heavy rainfall.

About the Speaker

The main research areas of Ronaldo Borja include theoretical and computational solid mechanics, geomechanics, and geosciences. Ronaldo Borja is the author of a textbook entitled *Plasticity Modeling and Computation* published by Springer. He currently serves as editor of two high-impact journals in his field, the *International Journal for Numerical and Analytical Methods in Geomechanics* published by Wiley, and *Acta Geotechnica* published by Springer. Ronaldo Borja is the recipient of the 2016 ASCE Maurice A. Biot Medal for his work in computational poromechanics.