Geophysical Research Abstracts
Vol. 13, EGU2011-7450, 2011
EGU General Assembly 2011

Modelling the interaction of the bedrock and slope in terms of drainage and exfiltration

Amin Askarinejad (1), Patrick Bischof (1), Francesca Casini (1), Cornelia Brönnimann (2), and Sarah M. Springman (1)

(1) Institute for Geotechnical Engineering, ETH Zurich, Switzerland, (2) Laboratory of Engineering and Environmental Geology, EPF Lausanne, Switzerland

Water may infiltrate in the soil mass and reach the soil-bedrock interface during and after a rainfall event. Depending on the permeability of the bedrock, infiltrated water can generate a perched water table. This water table may either rise, increasing the degree of saturation, or decrease, causing negative pore pressures (suctions) to develop in any capillary zone. Decrease in the suction decreases the shear strength mobilised in the material, which may trigger failure. A test field (average slope of 38° and ~250 m^2 area) was selected near Ruedlingen (Canton Schaffhausen, Switzerland) where landslide triggering experiments were carried out in autumn 2008 and spring 2009. The experimental site is located in the Swiss Molasse basin. The lithological units in the area are composed of horizontally layered sandstones intersected by coloured marlstones both of the Lower Freshwater Type. Above the test site is the transition to the layered sandstones of the Upper Marine Molasse (OMM) (Brönnimann, 2010). The slope was subjected to extreme artificial rainfall in October 2008 over a period of 4 days. Some surface movements were detected during this extreme event, although failure did not occur (Springman et al., 2010). Subsequently, a range of measures were implemented, such as relocating the distribution of the sprinklers to provide more rainfall to the upper part of the slope, so that a failure was triggered in March 2009, incorporating about 130 m^3 of debris. In order to compare the experiments of 2008 and 2009, the transient process of rain water infiltration in the soil and the effect of the topography and drainage properties of the bedrock at the lower part of the slope on the pore pressure distribution are investigated. The finite element method is used to simulate the percolation process of infiltrated water into the soil. The stability of the slope is monitored at different stages of the infiltration using the limit equilibrium method of slices. Several cases were compared to study the effect of the fissure geometry and hydraulic properties. The approximate location and size of the fissures in the bedrock were determined by monitoring of spatial and temporal changes of electrical resistivity during rainfall and also visual investigations of the bedrock after the failure.

According to these simulations, the slope might have failed during the first experiment if there had been no "drainage fissures" in the lower part. Also, the interconnected fissures and the horizontal intrusion of a very permeable sandy layer in the upper part of the slope was found to affect the slope stability. Nevertheless, the impact of the drainage and horizontal fissures is different. The latter have a storage function that can delay reaching and accumulating the water at the interface of the soil and bedrock.