Numerical Analysis of Rainfall-induced slope failure

– MUSLOC 2019 -

Jamei M* and † Hamrouni F†

* Northern Borders University
Engineering College, Kingdom Saudi Arabia
E-mail: mehjamei@yahoo.fr

† University Tunis Elmanar, National Engineering School of Tunis
Civil Engineering Laboratory
Le Belvedere 1002 Tunis, Tunisia
E-mail : fakher.hamrouni@gmail.com

ABSTRACT

Due to the climatic changes across the word, many shallow and deep landslides have been occurred in many countries. A majority of these landslides commonly originate in slopes, which are most of the time in a state of partial saturation. The rainfall is considered as one of the important factors that cause slopes instability. Serious disasters have often occurred during or just after rainfall, such as the disasters occurring in the North West of Tunisia (Béja) under humidification-drainage cycles. The capillary mechanism contributes significantly to the soil shear strength and controls the transient pore water pressure variations in unsaturated conditions. Landslides have been occurred in several types of soil and rocks, especially in clayey and sandy slopes. In order to study the effect of rainwater infiltration on slope stabilities, numerical simulations were addressed in comparison with the experimental rainfall tests performed on reduced scale sandy slope models. The experimental tests presented in focus on detailed observations of the failure process, timing, duration of soil moisture content development and pore-water pressure during the rainfall period.

The main objective of the first part is to validate the proposed hydromechanical formulation based on the extension of effective stress model to unsaturated soils, which has been efficiently applied for the physical sandy slope model. The response to rainwater infiltration under several boundary conditions was well illustrated. Cohesion reduction under humidification was considered within the proposed model. A good agreement between the numerical and experimental results was highlighted. Furthermore, the objective of the second part consists to study the capability of the proposed hydromechanical to reproduce the measurements of a study case corresponding to an identified slope where a soil is clay. The obtained numerical results confirm the limitation of the proposed model for the clay and show the BBM model considered as an extension of the Cam-Clay model for unsaturated soils.

Numerical analysis of eventually rainfall induced slope failure has been conducted using the program CODE-BRIGHT.

REFERENCES

[1] Bishop AW. “The principle of effective stress”. Tecnisk Ukeblad. Vol. 39, pp. 859-863.

[2] Jamei M, Guiras H, & Olivella S. “Analysis of slope movement initiation induced by rainfall using the Elastoplastic Barcelona Basic Model”. European Journal of Environmental and Civil Engineering. (2015)

[3] Orense Rolando P, Shimoma Suguru, Maeda Kengo, & Towhata Ikuo. Instrumented Model Slope Failure due to Water Seepage. Journal of Natural Disaster Science; Vol. 26, pp. 15-26 (2004).

[4] Vanapalli, S.K., Fredlund, D.G., Pufahl, D.E., and Clifton, A.W. “Model for the prediction of shear strength with respect to soil suction”. Canadian Geotechnical Journal; Vol. 33, pp. 379–392.