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# Creep model of unsaturated sliding zone soils and long-term deformation analysis of landslides

Liangchao Zou (1,2), Shimei Wang (1), and Yeming Zhang (1)

(1) College of Civil Engineering and Architecture, China Three Gorges University, Yichang, Hubei, China, 443002 (wwsm3044@yahoo.com.cn), (2) Division of Land and Water Resources Engineering, Royal Institute of Technology, Stockholm, Sweden, SE-10044 (lzo@kth.se)

Sliding zone soil is a special soil layer formed in the development of a landslide. Its creep behavior plays a significant role in long-term deformation of landslides. Due to rainfall infiltration and reservoir water level fluctuation, the soils in the slide zone are often in unsaturated state. Therefore, the investigation of creep behaviors of the unsaturated sliding zone soils is of great importance for understanding the mechanism of the long-term deformation of a landslide in reservoir areas. In this study, the full-process creep curves of the unsaturated soils in the sliding zone in different net confining pressure, matric suctions and stress levels were obtained from a large number of laboratory triaxial creep tests. A nonlinear creep model for unsaturated soils and its three-dimensional form was then deduced based on the component model theory and unsaturated soil mechanics. This creep model was validated with laboratory creep data. The results show that this creep model can effectively and accurately describe the nonlinear creep behaviors of the unsaturated sliding zone soils. In order to apply this creep model to predict the long-term deformation process of landslides, a numerical model for simulating the coupled seepage and creep deformation of unsaturated sliding zone soils was developed based on this creep model through the finite element method (FEM). By using this numerical model, we simulated the deformation process of the Shuping landslide located in the Three Gorges reservoir area, under the cycling reservoir water level fluctuation during one year. The simulation results of creep displacement were then compared with the field deformation monitoring data, showing a good agreement in trend. The results show that the creeping deformations of landslides have strong connections with the changes of reservoir water level. The creep model of unsaturated sliding zone soils and the findings obtained by numerical simulations in this study are conducive to reveal the mechanisms of the dynamic process of landslide deformation, and serve as an important basis for the prediction and evaluation of landslides.