Geophysical Research Abstracts
Vol. 15, EGU2013-9743-1, 2013
EGU General Assembly 2013

Geotechnical simulation of tertiary creep behavior of landslides induced by extreme rainfall

Atitkagna Dok (1) and Hiroshi Fukuoka (2)

(1) Graduate School of Global Environmental Studies, Kyoto University, Kyoto, Japan (dok@landslide.dpri.kyoto-u.ac.jp), (2) Disaster Prevention Research Institute, Kyoto University, Uji, Japan (fukuoka@scl.kyoto-u.ac.jp)

Rainstorm indirectly provokes landslides because of its ability to level up the groundwater table after certain hours dropping. This process causes excess pore water pressure generation and soil liquefaction at the sliding surface and determines the behavior of landslides triggered by extreme rainfall. Creep deformations are commonly observed in a slope before sliding down. Creep behavior, in particular tertiary creep behavior, is therefore the main focus in predicting the final failure time of a slope. Progressive failure/tertiary creep deformation is the stage when strain rate exponentially increases just before final collapse. This study aims at simulating geotechnical model of tertiary creep behavior in soils, which was empirically discovered by Saito (1965) and Fukuzono (1985) to help issue warning of rainfall–induced landslides in developing countries where there is no implemented methodology for issuing effective warming of landslides yet.

Tertiary creep to failure is reproduced by pore-pressure-controlled test in ring shear apparatus, through which obvious relationship of A and α (alpha) values was obtained, following consistent range with those found in previous studies under slightly deviated trend due to different test condition: pore-pressure-controlled and shear stress development tests. Constant shear speed test under shear speed of v=1cm/s was conducted in the ring shear apparatus to obtain the relation curve of shear resistance and shear displacement, from which exponential expression of creep behavior is originated. The model formula is governed by two constants: m and γ (gamma) whose relation with constants A and alpha was examined. Geotechnical simulation of creep behavior is then constructed by assuming that shear strength of soil increases and remains constant after reaching its maximum value in residual condition. This is to quantify normally consolidated condition of soils in natural slope. Shear resistance diminishes, while pore pressure is gradually generated through time until shear resistance is smaller than initial shear stress, and failure encounters. The large shear displacement took place after failure is used to calculate velocity and acceleration of virtual surface displacement. A and alpha values are measured through the plot of velocity and acceleration in log scale and compared with those of laboratory tests. In similar way, additional formulation of shear stress development condition to failure was also investigated.

Consequently, model simulation of creep behavior to develop a most appropriate method for landslide early warning is successfully developed through very good correlation with experimental results. The constant m and γ are corresponded to A and α respectively. A value gets smaller when m is higher, whereas alpha and gamma increase accordingly. The m value best fitted with experimental result is 0.1. Deviated trends were also observed in pore pressure control and shear stress increase simulations. The result shows that higher alpha value, higher landslide susceptibility is expected.