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On the Rainfall-induced Landsliding Behavior of Sandy Materials with Different Fine Particle Contents in Flume Tests

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Introduction

Landslides affect the flanks of mountainous and volcanic edifices on earth and other planets, which locally constitute an important natural hazard on earth. Non-plastic fines exit in the landslide in abundance including original slope rich in fine granitic soil, loess landslide, debris avalanche deposits, tailings dam landslides and coseismic landslide dams generating secondary sliding phenomenon. Most understanding of non-plastic fines effect has relied almost entirely on element testing of small specimens under idealized conditions, lack of landslide physical modeling experiments verification and physical mechanism research. Hence, this study aims at examining the effect of non-plastic fines on the initiation and movement of rainfall-induced landslides in flume tests.

Material and Method

A serials of small flume tests were performed by using mixtures of silica sand No. 7 with different contents (0%, 10%, 20%, 30%, 40% and 50%) of silica powder by weight and different relative density. Mixtures were prepared to have an initial water content 10%. A flume with landslide physical model as descripted in Fig. 1 was employed, which has transparent sides and is 180 cm long, 24 cm wide, and 20 cm high. During test, the flume was sloped to 25°. Pore-water pressure and tilting transducers were installed to monitor the water pressure and soil rotation. Laser sensor and liner transducer were used to capture inner displacement of soil mass. Cameras were used to monitor test process from one side of the flume and also from the toe part.

Results and Conclusion

The results demonstrated that the varying non-plastic fines content has a remarkable effect on the initiation and movement of rainfall-induced landslides with similar relative densities. The relative density has effects on landslide behavior with the same fines content. Transformation from retrogressive landslide type to fluidized landslide type could be illustrated by tilt sensor and displacement sensor. Equivalent void ratio could be used to better explain the behavior of mixtures with fines, the addition of fine particles into coarser grains alters the internal contact microstructure of matrix. In the mixtures with fine content less than threshold, the mechanical behavior is dominated by the coarser particles contact, fine grains have a secondary role in the transfer of inter-grain forces. Once fines content increases beyond the threshold, the behavior of mixtures is primarily affected by fine-grains contacts, and the role of coarser particles becomes less important. This study could provide insights into behavior of fluidized landslides rich in fine particles under climate change and then enhance the understanding for catastrophic geohazards, which could provide the whole progress hazard chain information for landslides and landslide dams.

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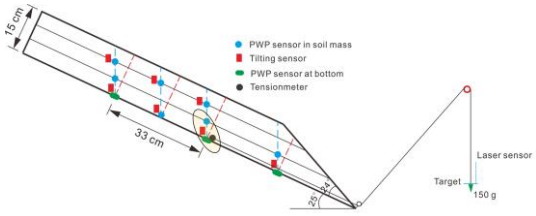

Fig.1 Arrangement of landslide modeling in the flume