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Procedia Engineering 79 (2014) 606 – 611

Procedia Engineering

www.elsevier.com/locate/procedia

37th National Conference on Theoretical and Applied Mechanics (37th NCTAM 2013) & The 1st International Conference on Mechanics (1st ICM)

A Particle Floating Model for the Initiation of Debris Flows

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Abstract

Riverbeds in Taiwan are full of granular materials such as boulder, cobble, gravel, sand, and silt. Under the action of floods, particles with their sizes from little to large will be floating upward and then flowing with floods gradually. Mechanical models for critical conditions of debris flows taken by some other researchers in Taiwan are mainly based on slope stability criteria. However real debris flows are generally observed to be initiated when granular soils start floating upward. Under such circumstances, a more proper mechanical model was proposed by the authors. It was proved that such a model can provide proper solutions as compared with those produced from tests.

Selection and peer-review under responsibility of the National Tsing Hua University, Department of Power Mechanical Engineering

Keywords: critical conditions; debris flow; bottom velocity; riverbed; riverbank

Nomenclature

v	a superficial velocity (m/sec)
v_{sc}	actual seepage velocity under critical conditions (m/sec)
v_{bc}	bottom velocity under critical conditions (m/sec)

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Selection and peer-review under responsibility of the National Tsing Hua University, Department of Power Mechanical Engineering
doi:10.1016/j.proeng.2014.06.386

1. Introduction

Fig.1 shows that very severe debris flows happened at Shirnmu Village, Nantou, Taiwan. It is generally observed that granular soils are floating upward at first and then flowing with floods when a debris flow is to be initiated. Since particles of smaller size are easier to flow under lower bottom velocity, void volume and bottom velocity for granular soils are then subject to increasing. Thereafter larger particles have the potential to flow. Based on the above-mentioned observation, a mechanical model was proposed by the authors at first. Then a theoretical governing equation was formulated. Some theoretical solutions of bottom velocities were calculated and presented with different values of void ratios, inclination angles of riverbed and particle sizes.

(a)

(b)

Fig. 1. Very severe debris flows happened at Shen-mu Village, Nantou, Taiwan.