



Mechanism and numerical simulation of a rapid deep-seated landslide in Van Hoi reservoir, Vietnam

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ABSTRACT

At approximately 5:00 AM on December 16, 2016, a rapid and deep-seated landslide was triggered by intense rainfall in the Van Hoi irrigation reservoir in Binh Dinh province, Vietnam. The landslide generated an impulsive wave with a height of approximately 20 m, resulting in severe damage to the reservoir operation station. This study investigated the mechanisms behind the landslide's initiation and simulated its initiation and motion processes through site surveys, ring shear tests, and the LS-RAPID simulation model. The physical tests were conducted on two soil samples from the sliding zone to examine the landslide mechanism. The results indicated that only sample 2 (a sand sample of completely weathered gneiss rock) showed a high level of landslide mobility due to its liquefaction phenomena resulting in a rapid pore water pressure development and a significant strength loss.

In contrast, sample 1 (a silty sand sample of residual soils) did not exhibit this behavior due to its high shear resistance value at a steady state. The findings suggest that the sliding plane of the Van Hoi landslide formed in the completely weathered gneiss layer, and the high mobility level of sample 2 is primarily responsible for its rapid movement. Notably, the LS-RAPID model successfully reproduced the landslide process using the geotechnical properties obtained in the ring shear experiments. The simulation showed that the Van Hoi deep-seated landslide was initiated from the lower middle slope at a critical value of 0.55 for the pore water pressure ratio and traveled at a high velocity of approximately 37.0 m/s. The consistency between the computer simulation results and the on-site evidence and recorded data highlights the reliability of the LS-RAPID model as a tool for assessing landslide hazards.

Keywords: Deep-seated landslide, rainfall, pore water pressure, mobility, numerical simulation, Van Hoi reservoir, Vietnam.

1. Introduction

Vietnam has one of the world's largest dam and reservoir systems, with about 750

classified as medium or large dam reservoirs among over 7,000 dams (W.B., 2022). One notable reservoir in this system is the Van Hoi dam reservoir in An Tin commune, Hoai An district, Binh Dinh province. Since its establishment in 2003, the Van Hoi Reservoir

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