B24

Seepage and Slope Stability Analysis of Landslide Dam

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1. Introduction

The water impounded by a landslide dam may create a dam reservoir (lake) that may last from short times to several thousand years. Due to their rather loose nature and absence of controlled spillway, landslide dams frequently fail catastrophically and lead to downstream flooding, often with high casualties. A common failure scenario of a landslide dam is overflowing with subsequent dam breach and erosion by the overflow stream.

Water flow in unsaturated porous media is two phase (water and air) flow problem. Previous researchers have been considered only water phase flow in the analysis of seepage flow in their studies. In this study seepage flow numerical simulation model is developed considering both the phases to get the more accurate result. Simulation results of two-phase seepage flow and slope stability analysis is compared with the two-dimensional and three-dimensional experimental measurements carried out by Awal (2008) in his study as well as the simulation results of single-phase (water phase) seepage flow and slope stability analysis.

2. Numerical Models and Experiments

A seepage flow model is developed using line successive over relaxation (LSOR) scheme to solve the water phase and air phase nonlinear parabolic partial differential equations by an implicit iterative finite difference scheme. The seepage flow model is combined with a slope stability model for the slope stability analysis.

In case of two-dimensional experiments a rectangular flume of length 5m, width 20cm and depth 21cm was used. The slope of the flume was set at 17^{o}. A rectangular flume of 5m long, 30cm wide and 50cm deep was used in case of three-dimensional experiments. The slope of the flume was set at 20^{o}. The rectangular shape of the flume was modified to make cross slope of 20^{o} so that the height of the dam is 30cm in one side and decreased uniformly towards other side to 19.08cm. Mixed silica sand (Mix 1-7) was used to prepare the dam body in the both two and three-dimensional experiments. Water content reflectometers were used to measure the temporal variation of moisture content during seepage process.

3. Results and Conclusions

Fig.1 shows the two-dimensional simulated and experimental slip surface for constant head provided in the upstream reservoir.

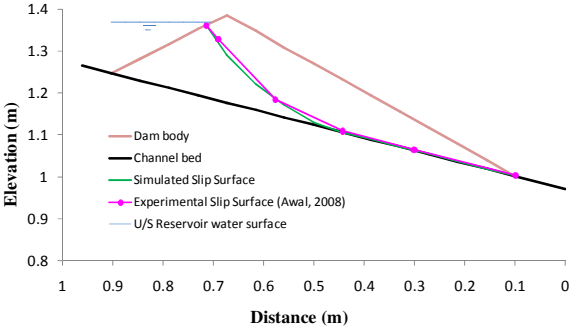

Fig.1 Two-dimensional simulated and experimental slip surface for constant head in upstream reservoir

The simulated results of movement of moistures in dam body and time of failure of dam body, considering both water and air phase flow, are in good agreement with the experimental results in comparison with that of considering only water phase flow. The simulated result of critical slip surface agrees with the experimental result.