Experimental Study on Landslide Dam-Break Due To Internal Erosion and Piping Using Monitoring Sensors

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Introduction

Internal erosion and piping are common phenomena associated with natural dams (landslide dams, moraine dams, and levees). This has been referred to be due to unconsolidated nature of natural dam materials.

A critical study and understanding of the initial complex process of internal erosion and piping in natural dams is important in the evaluation of natural dam longevity and stability.

Research Objectives

- To contribute to the knowledge and understanding of the effect of internal erosion and piping to landslide dam stability and longevity.

- By building laboratory-scale landslide dam models with materials of selected natural dams, this research tries to understand the effects of different hydrological conditions to longevity of natural dams.

- To understand the relationship between erodibility with regards to internal erosion and material composition of natural dams.

Equipment, Materials and Methods

Pore water sensor
Model: BPR-A-50KPS
Rated Capacity: 50 KPa

Horizontal Displacement Transducer:
Model no: DTP-D-1KS
Measuring range: 0 – 1000 mm
Calibration coefficient: 0.0001
Pulleys
Clamps and very thin metallic thread

Laser Displacement sensor:
CMOS Multi-function Analog laser sensor (IL series)
Sample Preparation:

Akatani landslide dam model

Geotechnical properties of the materials

Grain size distribution of the landslide dam materials and silica sand #8

Predominantly coarse-grained material

Laboratory Simulation and Result:

A. Silica sand #8 dam model

Plot of Upstream lake against Subsidence

Laboratory Simulation and Result:

A. Silica sand #8 dam model

Plot of Upstream lake against Lateral displacement

Laboratory Simulation and Result:

B. Kuridaira Landslide dam model

The result obtained indicates that landslide dam material of Kuridaira shows high resistance to mass transport and failure which could be due to geotechnical strength properties of the material.

Plot of Upstream lake against Lateral displacement

Laboratory Simulation and Result:

B. Kuridaira Landslide dam model

The result shows that the critical erodibility value which could cause failure of the dam has not been attained. This is shown by small change in geometry of the model even at increased upstream discharge rate.

Plot of Upstream lake against Subsidence
Laboratory Simulation and Result:

B. Kuridaira Landslide dam model

\[ t = 0 \text{ seconds} \]
\[ t = 1800 \text{ seconds} \]
\[ t = 3600 \text{ seconds} \]
\[ t = 5400 \text{ seconds} \]

Laboratory Simulation and Results:

C. Akatani Landslide dam model

Plot of Upstream lake against Lateral displacement

Plot of Upstream lake against Subsidence

Laboratory Simulation and Result:

C. Akatani Landslide dam model

\[ t = 0 \text{ seconds} \]
\[ t = 1800 \text{ seconds} \]
\[ t = 3600 \text{ seconds} \]
\[ t = 5400 \text{ seconds} \]

Present conclusions:

Erodibility, internal erosion and piping simulation carried out on selected landslide dam materials were compared with silica sand #8. Result obtained shows that erodibility was high in silica sand #8 and low in landslide dam materials obtained from the field.

Result obtained shows that internal erosion and piping in natural dams depends on erodibility of the dam material.

More research will be carried out to validate the result obtained in these experiments.