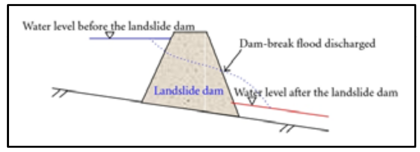
Experimental Study on Landslide Dam-Break Due To Internal Erosion and Piping Using Monitoring Sensors

Austin Chukwueloka Okeke,
Yasuhiro Mitani,
Fawu Wang,
Yohei Kuwada

Department of Geoscience,
Shimane University, Japan

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.

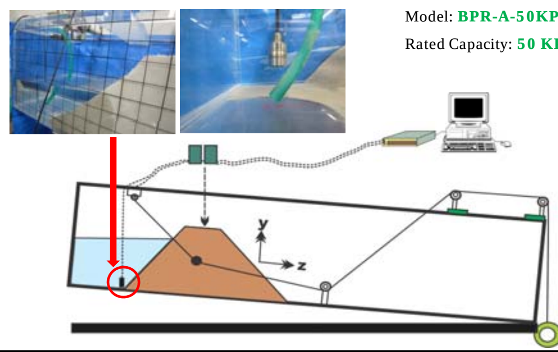
Research Objectives

- 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

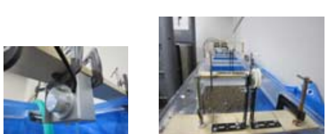
Model: **BPR-A-50KPS**
Rated Capacity: **50 KPa**

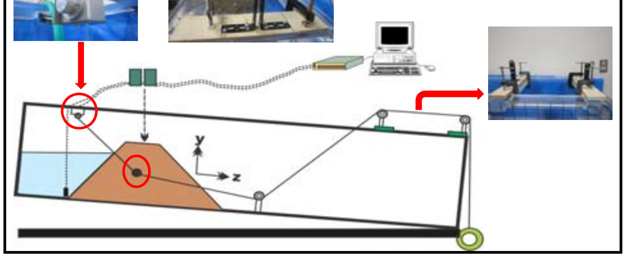


Equipment, Materials and Methods

Horizontal Displacement Transducer:

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

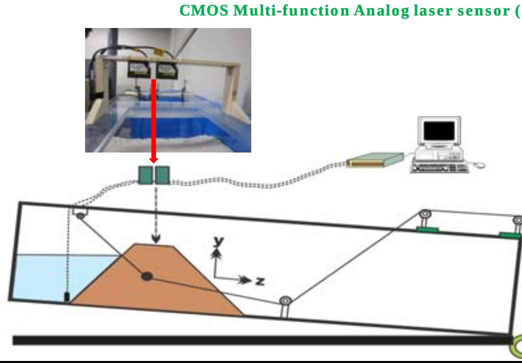




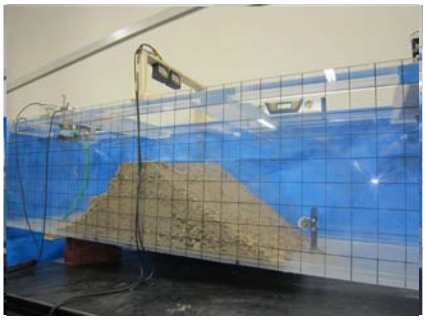
Equipment, Materials and Methods

Laser Displacement sensor:

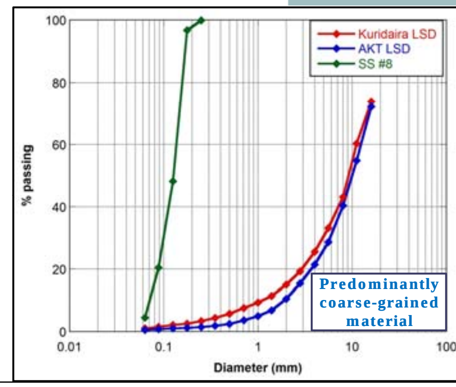
CMOS Multi-function Analog laser sensor (IL series)



Sample Preparation:



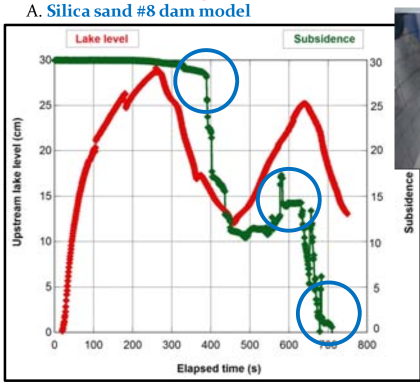
Akatani landslide dam model

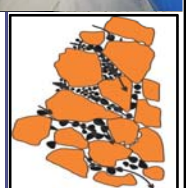


Grain size distribution of the landslide dam materials and silica sand #8

Laboratory Simulation and Result:

A. Silica sand #8 dam model

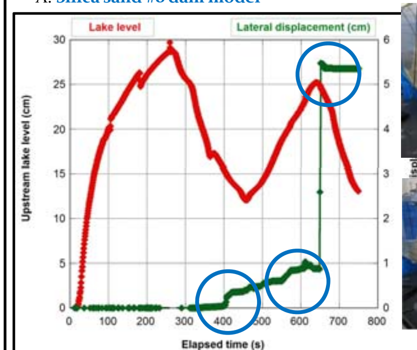




Plot of **Upstream lake** against **Subsidence**

Laboratory Simulation and Result

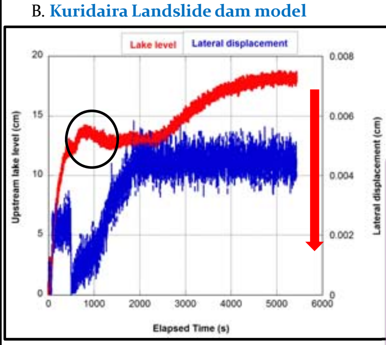
A. Silica sand #8 dam model



Plot of **Upstream lake** against **Lateral displacement**

Laboratory Simulation and Result

B. Kuridaira Landslide dam model

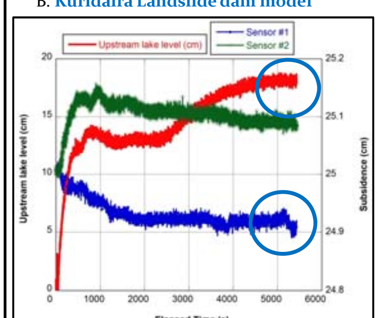


Plot of **Upstream lake** against **Lateral displacement**

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.

Laboratory Simulation and Result:

B. Kuridaira Landslide dam model

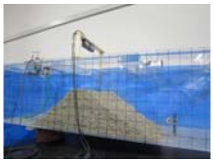


Plot of **Upstream lake** against **Subsidence**

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.

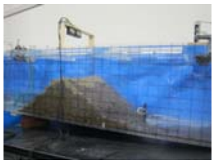
Laboratory Simulation and Result:

B. Kuridaira Landslide dam model



t = 0 seconds

t = 1800 seconds

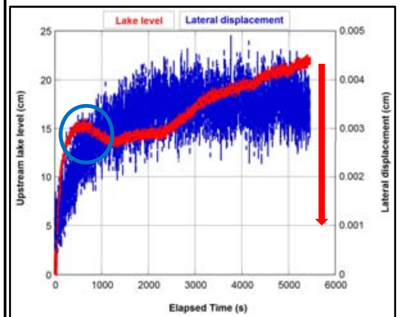


t = 3600 seconds

t = 5400 seconds

Laboratory Simulation and Results:

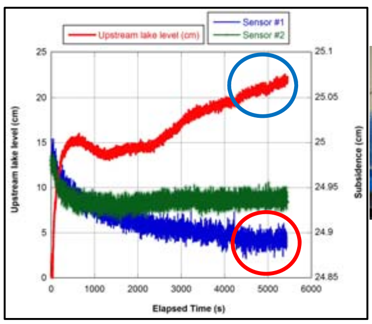
C. Akatani Landslide dam model



Plot of Upstream lake against Lateral displacement

Laboratory Simulation and Results:

C. Akatani Landslide dam model



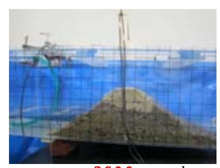
Plot of Upstream lake against Subsidence

Laboratory Simulation and Result:

C. Akatani Landslide dam model

t = 0 seconds

t = 1800 seconds



t = 3600 seconds

t = 5400 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.