Abstract of Doctoral Thesis

Title：Outflow Fluctuations due to Landslide Dam Deformation by Overtopping

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Heavy rainfall and earthquakes tend to cause large-scale landslides and create landslide dams. Large landslide dams retain considerable water and often burst causing floods and catastrophic damages downstream. Therefore, landslide dam deformation studies are essential to implement flood-risk management. This study focuses on landslide dam deformation by overtopping and aims to develop a numerical model to simulate outflow discharge caused by landslide dam deformation.

First, a numerical model that simulates outflow discharge because of landslide dam deformation was proposed. During landslide dam erosion by overtopping, flow causes formation of channel; channel widen by side-bank erosion and collapse. Additionally, dam materials are washed away by various types of sediment transport. Therefore, the inertial debris flow model, side-bank erosion model, and slope collapse model were incorporated in the model. For validation, simulation results were compared with the previous flume experimental results.

Second, flume experiments of landslide dam erosion by overtopping are described. Research on landslide dam erosion from partial channel width of the dam surface is insufficient. Therefore, some cases of flume experiments were conducted and factors affecting outflow discharge were determined. Consequently, the dam height, inflow discharge, and sand diameter affected outflow discharge; outflow discharge was little affected by the dam shape. Additionally, simulation results were compared with experiments, and the proposed model reproduced the outflow discharge and dam height erosion processes.

Third, field experiments of landslide dam by overtopping are described. Few landslide dam experiments are conducted in mountainous stream. Therefore, three field experiments were conducted. Simulation results were compared with experimental data, and the model largely reproduced the outflow discharge of experiments. However, the simulation and experimental results did not agree in one case: longitudinal slope failure was observed in the middle of the erosion process and caused high peak outflow. In the model, cross-sectional slope collapses, such as a side-bank collapse, are considered; however, such longitudinal slope failures were not considered in the proposed model. Therefore, outflow discharge was not accurately reproduced.

Herein, a numerical model of landslide dam deformation by overtopping were proposed, and the results were verified by comparing with experimental results. The proposed model successfully reproduced the outflow discharge and dam height erosion processes.