Estimation of flood discharge caused by landslide dam overflow erosion and the applications of countermeasures

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ABSTRACT

When landslide dams are formed, it is essential to quickly estimate the flood discharge caused by overflow erosion, the most-frequent type of dam outbursts, and take urgent measures for its reduction, together with giving warning and evacuation system for inhabitants located downstream. The results of our previous studies[1), 2),3)], it has been found that flood discharge by overflow erosion and the resulting outburst can be generally estimated using the "two-layer simulation model" proposed by Takahama et al.[4)]

In September 2005, a landslide dam was formed in the Mimi River, Miyazaki Prefecture due to heavy rainfall caused by a typhoon, and the dam collapsed shortly later because of overflow erosion. Chiba et al.[5)] estimated the flood discharge from this outburst based on the outflow and inflow data at two hydroelectric dams of the Kyushu Electric Power Co., Inc. located upstream and downstream of the landslide dam. Referring to those data, we also estimated the flood discharge from this landslide dam by applying the above-mentioned two-layer simulation model and evaluated the applicability of the estimation method. The following is an overview of our investigation results.

(1) We attempted to verify the flood discharge caused by the overflow erosion of the Nonoo landslide dam which was formed in the Mimi River, Miyazaki Prefecture in 2005, using the record of water inflow at the Kyushu Electric Power Company's Yamasubaru Hydroelectric Dam located downstream of the landslide dam. From this verification, it was found that the two-layer simulation model can generally predict the flood level.

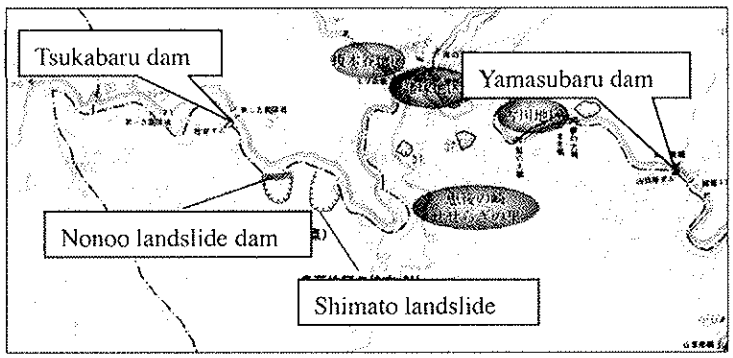

Fig.1 Nonoo landslide dam-site and Hydroelectric dams in Mimi river

(2) In terms of how estimation of flood discharge changes with grain size, it was found that the effect of grain size becomes smaller as the distance from the landslide dam becomes greater. This suggests that if the target protection area is far away from the landslide dam, it is not necessary to consider the grain size so seriously.

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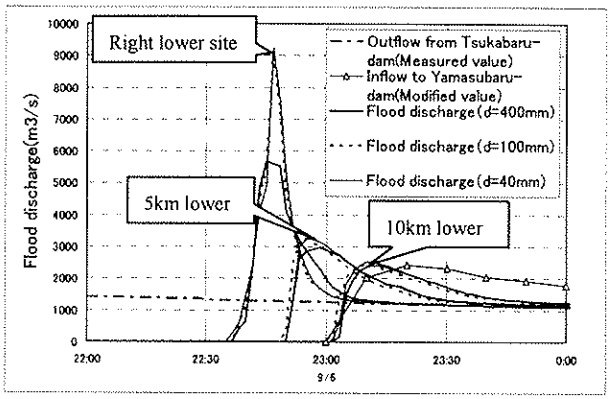

Fig.2 Estimated flood discharge relative to average grain size

(3) We evaluated the flood discharge that changes with the height and longitudinal profile of a landslide dam using the model. From this evaluation, it was found that if the longitudinal length of a landslide dam, or accumulated sediment, is long compared with its height, then a dam outburst will not occur even if an overflow occurs. In contrast, if the longitudinal length of the dam's top area is small compared with its height, there is a high possibility of an extreme flood, and caution is required. From our investigation, it can be said that it is possible to conduct swift flood discharge analysis and apply the results to risk-analysis if this two-layer simulation model is used, even when multiple landslide dams are formed.

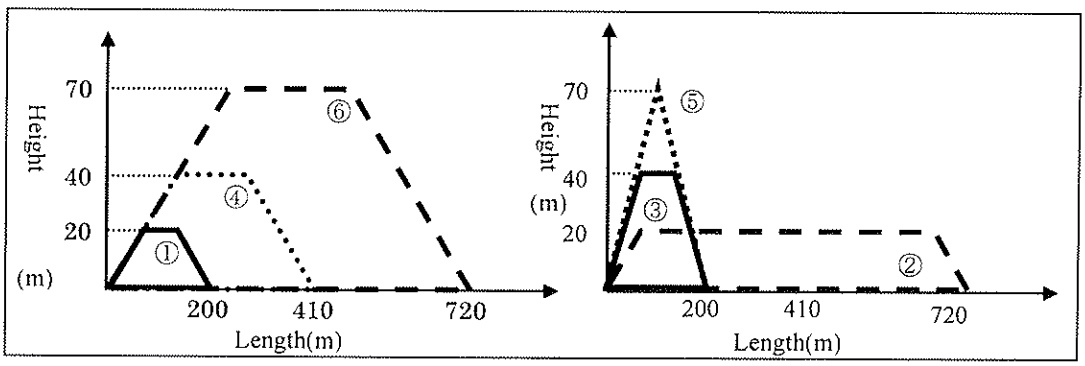

Fig.3 Longitudinal profiles used for calculation

KEYWORDS: landslide dam, outburst, flood discharge, two-layer model, risk-analysis

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