DEPOSITIONAL PATTERN OF DEBRIS FLOW CAUSED BY COLLAPSE OF NATURAL DAM UPSTREAM OF THE SABO DAM

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Rivers, which flow through mountain gorges of steep and weak valley and landslide-prone formation, are likely to be blockaded by natural dams. It is a prevalent situation in Nepal every year usually during rainy season.

Present paper discusses on sediment deposition pattern of the debris flow emanated from the collapse of natural dam upstream of the sabo dam and makes an effort to simulate the sediment deposition pattern. In this study, sabo dam contains a fixed volume of debris produced by collapse of natural dam. Natural dams, trapezoidal in shape and downstream frontal slope nearly equal to the angle of repose of dam forming materials, were formed by using a non-uniform mixture of sediments having mean diameter 5.43 mm in the experimental channel. The bed slope of the experimental channel was 10.2 degree. At the downstream end of the experimental flume a sabo dam, 20 cm high, was set to check the debris flow and make it deposited upstream of the dam. One-dimensional momentum and continuity equations applicable to the unsteady flow in open channel were employed to verify the experimental results. Total flow (sediment plus water discharge) graphs and deposition profiles of the sediments were calculated and compared with observed results.

Debris flow can be considered a fluid mass moving continuously until just before it stops. Consequently, a system of momentum and mass conservation equations of fluid flow which take into account variation in discharge as well as the quality of fluid owing to erosion and deposition is also applicable to debris flow analysis The basic equation used to calculate the development and deposition of a debris flow and its flooding are the depth averaged one dimensional continuity and momentum equations.

At the initial stage of the deposition, the frontal part (deposition near the sabo dam) of the sediment deposition was dominated by coarser particles and rear part of the profile was dominated by fine ones. This fact was observed during the experiment. As water supply was kept on until all the sediments dislodged or transported from the original position of the natural dam, in the later stage of deposition, relatively clear water which passed over the deposition entrained fine particles from rear and body parts and deposited over the head of the deposition. This processes left the rear and body part of deposition armored. In Fig. 1, grain size curves follow this trend for discharge 61.00, 87.36 and 97.36 cm^2/sec. The size distribution curves of the body part of the deposition generally follow the pattern of original sample.

Fig. 2 shows a comparison between the actual total flows and the calculated ones using aforementioned model at 130cm upstream of the sabo dam. As the graph depict, it is evident that the trend of the actual total flows are in good agreement with the prediction. However, at the early stage, the rate of actual total flows differs considerably with calculated ones. In the case of observed data, deposition profiles are reported in a certain time interval unless there is no noticeable difference in consecutive flow profiles. The sediment volume that deposited during specified time interval is divided by the time interval and the obtained result is considered as discharge of the flow. This hypothetical calculation leads discharges to be same for the time interval, ignoring the flow fluctuation. This assumption may have contributed disappearance of the peaks at the early stage of experimental data.

Fig. 3 shows the relationship between observed and calculated longitudinal profiles of deposition just upstream of the sabo dam. In Fig. 3, the numerals in legends indicate the time in seconds measured when the first collapse appears at the frontal part of the natural dam. It is evident from Fig. 3 that around the frontal part of the deposition observed and calculated results are in good agreement, however, one can notice the quantitative difference at the middle and the tail parts the longitudinal profiles of the deposition. Nonetheless, trends of depositional patterns are similar at every part of the profile.

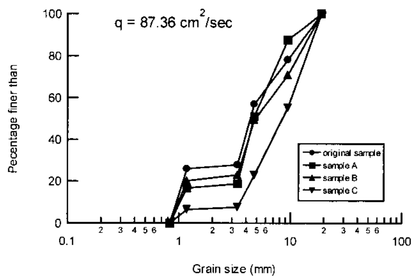

Fig. 1 Grain size distribution curves at various locations of deposition

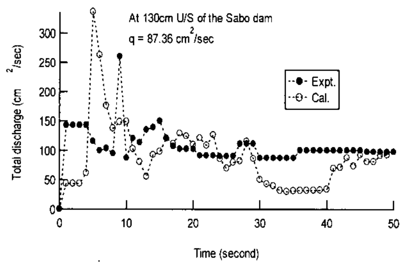

Fig. 2 Comparison of actual total flow with the model predictions at 130cm upstream of the sabo dam

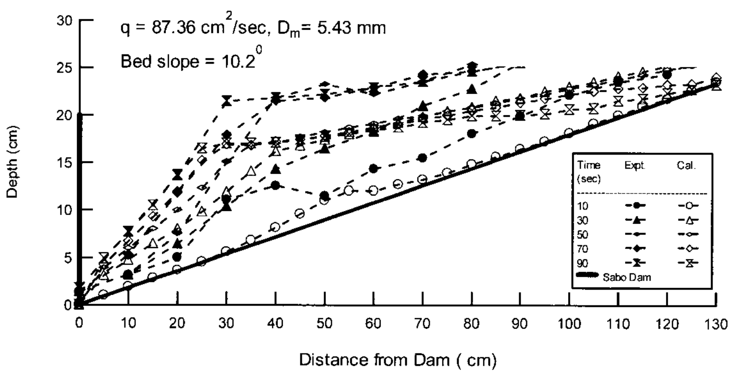

Fig. 3 Comparison of observed and calculated longitudinal profiles of sediment deposition upstream of the sabo dam