Sediment trapping efficiency of modular steel check dam in laboratory experiment and field observation

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INTRODUCTION

Check dams constructed in the river at the mountain mainly aim at trapping debris flow and driftwood. A modular steel check dam improving the existing hard-to-change disadvantages of check dam, through assembly of longitudinal beams and transverse beams, and free adjustment of several independent dams, and then parallel configuration, can form a flexibly adjustable modular steel check dam. By dismantling of transverse and longitudinal beams, it also can adapt sediment transport, disaster prevention, and ecology for rivers environment in different basin condition. This concept is also known as the "breathing check dam".

EXPERIMENT DESIGN

1. Experimental flume

This study measured the actual size of field channels and modular steel check dam, and used a 1/25 scaled model to prepare four kinds of grain sizes. In addition, a steel rectangular with adjustable discharge was chosen for the experimental flume; and the gradient of the flume and the field was same as 9°.

2. Modular steel check dam design

To analyze the influence of sediments trapping efficiency between modular steel check dam with and without transverse beams, in the case of a dam with transvers beams, a dam module installed four transverse beams with interval in 2.00 cm (i.e. d_{50}), and the gap between the lower transverse beam and flume bed in 2.80 cm (i.e. d_{95}). In the case of a dame without transvers beams, the dam module design and configuration were same as that of the experiment with transverse beams.

DISCUSSION AND ANALYSIS OF EXPERIMENTAL RESULTS

1. Without transverse beams

The experimental process shows that there are delays from leading edges touching upstream side of dam to trapped completely. All of six experiment cases which without transverse beams, the time for debris flow's leading edges being completely trapped were within 5 to 6 seconds, with significant longer trapping process, in comparison to 3 to 4 seconds of the same for the dam with transverse beams.

Although the completely trapped time was same in all of six experiment cases with different discharges, however, considering the purpose of this experiment was to simulate the debris flow outbreak with a same sediment concentration in the beginning, and the

leading edges impacting duration was very short. It led to a similar completed trapped time between six different discharge cases.

2. **With transverse beams**

By analyzing the sediment trapping process and comparing the cases without transverse beams, it could be found that the debris flow's leading edges completely trapped time was reduced to about 3 to 4 seconds while the dam modular was installed transverse beams, and the hydraulic jump migrating speed which located the upstream end of retrogressive deposition became faster towards upstream.

COMPARISON OF LABORATORY EXPERIMENT AND FIELD SITUATION

This study used the debris flow impact brought by typhoon Soulik occurred on July 13, 2013 on modular steel check dam (as Fig. 1) to compare to the laboratory experiment (as Fig. 2). After calculating by a 1/25 scaled model, it shows that both d_{95} of accumulated sediments at the dam's upstream side was very close. However, as for the sediments accumulated in the dam structure, the grain size remained in flume experiment after being converted by a scaled model was 6.75cm, with about 10% errors in comparison to the d_{95} (0.60 m) of sediment remained in the field dam; namely, the grain size of sediments remained in the dam of laboratory experiment was significantly larger than the grain size in the field dam.

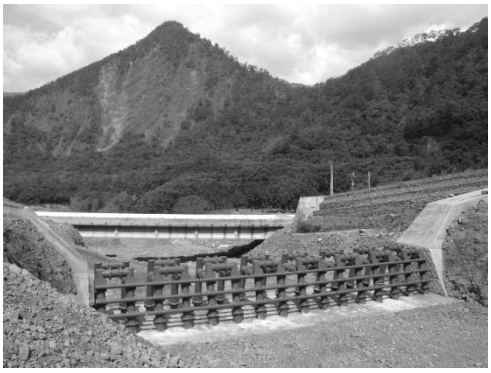

Fig.1 Field Steel check Dam

Fig.2 Steel check Dam Model

CONCLUSION

A modular steel check dam improves the existing hard-to-change disadvantages of check dam. Furthermore, this study analyzed the mechanism while the debris flow's leading edges trapped by the dam completely. We also compared with the experiment and field survey result to verify the sediment trapped capability of the modular steel check dam. The contrast researches of the modular steel check dam both on field observation and in laboratory experiment showed it had excellent efficiency of trapping debris flow.

Key words: modular steel check dam, adjustable transverse beam, debris flow