MANAGEMENT OF THE BEDLOAD TRANSPORT OF THE MILIBACH TORRENT FOR FLOOD PROTECTION PURPOSE

PHYSICAL MODEL BASED STUDY

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INTRODUCTION

The *Milibach* River between Hasliberg-*Reuti* and *Meiringen* agglomerations in Switzerland has a limited hydraulic capacity leading to frequent flooding. During the 2005 flood event, large populated areas were inundated and damages exceeding many millions of Swiss francs occurred (Fig. 1). The deficit of the river flow capacity is essentially caused by a reduction of river cross sections due to local sediment deposits which lead to the overtopping of the lateral embankments.

RISK MANAGEMENT

Aiming to manage the flood risk, a protection concept in the *Reuti* region has been proposed by *Herzog Ingenieure*. It consists in adjusting the layout, the cross-section and the longitudinal profile of the river and fitting out the neighboring lands inside an area of about 40 hectares. The main purpose is to create sediment deposition terraces, able to laminate, up to 75%, the bed load transport towards the downstream part of the river. Therefore, the flood peak can cross *Meiringen* without excessive sediment deposition, keeping the hydraulic capacity high enough to transit 100 years return period floods.

Considering its high sensitivity level, the optimization of the project was done by physical modeling. The experimental tests were carried out on a physical set-up built in the Laboratory of Hydraulic Constructions at scale 1/30, according to Froude similarity. A plan view of the project with the physical model borders are shown on Fig. 2.

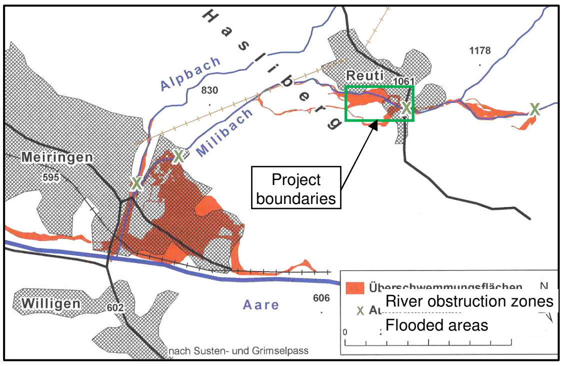

Fig. 1 Project location and flooded zones during the 2005 event.

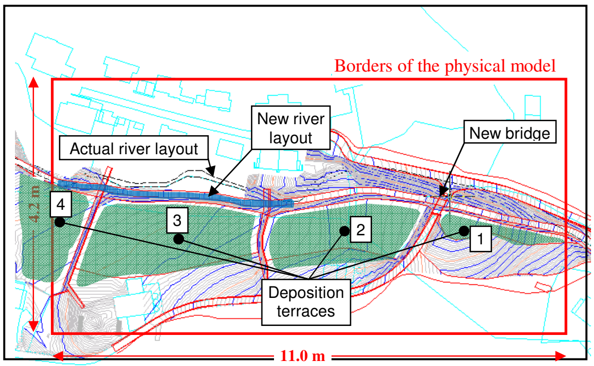

Fig. 2 Topographic plan view and borders of the physical 1/30 scaled model.

PHYSICAL MODEL AND TEST RESULTS

The physical scaled model tests revealed to be a powerful tool to optimize the project and to analyze the efficiency of the proposed solution. Several tests have been carried out on different configurations built by adding weirs across the river bed, by changing locally the layout and/or the longitudinal slope

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of the river and by smoothing the transversal slopes of the deposition terraces. Two hydro- and solidographs with a return period of 100 years and with two different durations have been used for optimization puposes. They are characterized by prototype peak water flows of 7 and 15 m^3/s and solid flows of 1.0 and 1.5 m^3/s, respectively. An extreme flood with a peak water flow of 25 m^3/s (peak solid flow of 2.7 m^3/s) was also tested to evaluate the robustness of the optimized solution. A picture of the final configuration is given in Fig. 3.a. The sediment depositions at the end of the two 100 years floods and the extreme event are shown on Figs.3.b, c and d, respectively.

(a) (b) (c) (d)

Fig. 3 a) Optimized configuration of the project, b) sediment deposition at the end of the 100 years flood (peak flow of 15m^3/s), c) sediment deposition at the end of the 100 years flood (peak flow of 7m^3/s), and d) sediment deposition at the end of the extreme flood event (peak flow of 25m^3/s)

The physical tests have led to the following adjustments of the initial configuration proposed by *Herzog Ingenieure*: (i) reduction of the longitudinal river slope near terraces 3 and 4, (ii) implantation of four weirs across the main river bed, (iii) reduction of the transversal slope of terrace 3 from 5 to 1%, and (iv) construction of three small rock dams of 1.5 m height to close the three terraces and lead the flow towards the main river.

IN-SITU WORKS

The execution of the project has started during summer 2010. Fig. 3.a shows the construction site downstream from the new bridge including terraces 2 and 3 and two weirs inside the river bed. The new bridge and the upper river bed section are shown in Fig. 3.b. As the flood events are expected to occur only every 20 years, the area remains in private property and agricultural use.

(a) (b)

Fig. 4 Pictures of the construction site, a) from the bridge towards downstream, b) towards upstream

Keywords: flood risk management, sediment transport, sediment retention, river training works.