FLOOD RISK MANAGEMENT OF THE AVANÇON RIVER

PHYSICAL MODEL BASED STUDY

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INTRODUCTION

The sediment transport capacity of the Avançon river through the city of Bex in Switzerland is limited. During the October 2000 flood event, water levels rose to danger limits. After the flood, the river channel was completely filled with sediments, with a uniform layer thickness comprised between 1.7 and 1.8m through the village. The return period of the flood event was estimated to be around 20 years, but the amount of transported sediments was extremely high for such an event.

RISK MANAGEMENT

Studies carried out by STUCKY Ltd between 2001 and 2005 showed a huge damage potential for the city of Bex. Consequently, it was proposed to increase the hydraulic capacity through Bex and to create a sediment retention basin upstream from the village. The purpose of the last measure is to laminate up to 50% the bedload transport downstream. The rest of the sediments will partially be deposited in the riverbed upstream of Bex and partially cross the village without excessive deposition. The hydraulic capacity of the river will so be kept high enough to convey the 100-year flood. The proposed system is based on an automatic sediment distribution between the retention basin and the river, presenting a hysteresis behavior during the increase and decrease phases of the flood hydrograph.

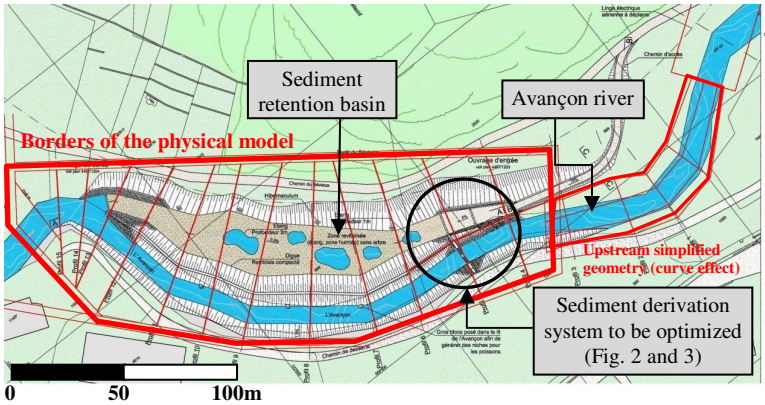

Fig. 1 Topographic plan view with borders of the 1/30 physical scaled model

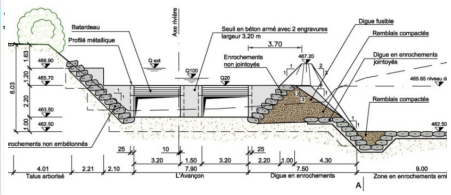

Fig. 2 **Sill with orifices**

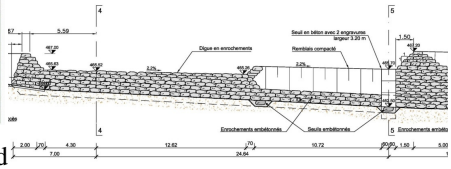

Fig. 3 **Lateral weir**

Because of the innovative concept of the derivation and retention hydraulic works on the Avançon river, the validation and optimization of the project was done by physical modeling. Experimental tests were carried out in the Laboratory of Hydraulic Constructions at the Ecole Polytechnique

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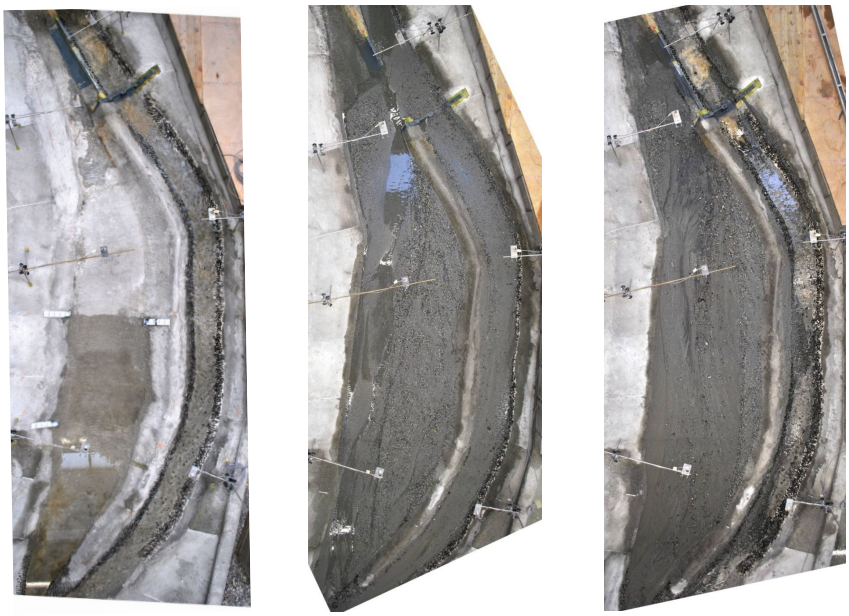
Fédérale de Lausanne (Switzerland). The model was built at geometrical scale 1/30 in the limits shown on Fig. 1 and operated with respect to Froude similarity.

PHYSICAL MODELLING AND EXPERIMENTAL RESULTS

The physical scaled model tests revealed as a powerful tool to investigate the efficiency of the proposed solution and to optimize the project. Several tests have been carried out for different configurations of the sediment derivation system, composed of a sill with two orifices across the riverbed (Fig. 2) to control the discharge and an upstream lateral weir (Fig. 3) to divert water and sediments in an adjacent reservoir.

During tests, hydrographs and sediment hydrographs where simulated to follow the sediment deposition process during the floods. First tests, for a 100 years return period event, showed an appropriate accumulation of sediments in the retention basin. However, at the end of the flood, all the water continued to flow through the retention basin, because of the obstacle created by the sediments deposited in the riverbed. Consequently, part of the retained sediments were remobilized and transported downstream, reducing the functionality of the retention basin. In order to remedy this flaw, different forms, lengths and heights of the lateral dyke were tested with the purpose to warrant the sediment retention in the basin and the auto-cleaning of the river at the end of the flood. Quantified objectives, related to different return periods, had to be taken into account.

Following an iterative experimental procedure, an optimized arrangement could be defined (**Fig. 4**a). The sediment deposition at the end of a 100 years flood and after the following auto-cleaning are shown on **Fig. 4**b and **Fig. 4**c for the final configuration.



a) b) c)

Fig. 4 a) Optimized configuration of the project; b) Sediment deposition at the end of the 100 years flood (peak flow of 79m^3/s); c) Sediment deposition after the auto-cleaning phase following the 100 years flood (base discharge of 19.7m^3/s)

The physical tests led to the following main adjustments of the initial configuration: (i) increase of the height of the upstream part of the lateral dyke, (ii) decrease of the height of the downstream part of the lateral dyke, (iii) creation of a compound channel in the upstream part of the retention basin in order to decrease the diverted discharge when the sediment deposition reaches a certain elevation in the basin, and (iv) geometrical modification of the sill with two orifices across the riverbed, allowing the sediments to be deviated in the reservoir.

Keywords: flood risk management, sediment transport, sediment retention, experimental modelling.