Gampel-Bratsch flood protection and sediment retention basin Tschingelbach 2010

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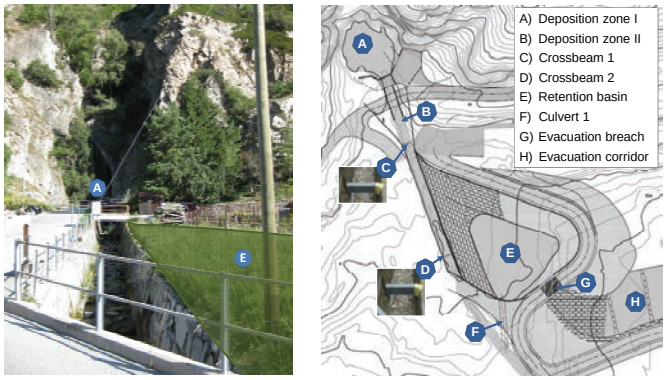
Client: Municipality of Gampel-Bratsch

Introduction and objectives

During a flood on October, 2000, the two villages of Bratsch and Gampel were affected by severe inundation. Neither maintenance works nor land use can provide sufficient mitigation, so that constructive protection measures are required. These include a sediment retention basin upstream of the village of Niedergampel to retain bed load and eventually driftwood during floods, including three retention zones (deposition zones I & II and retention basin, Figure 1).



a) **b)**

Figure 1: a) Photo and b) sketch and terminology of the Tschingelbach sediment retention system

As the retention basin is located in a residential area, the reliability and safety of the structure must be guaranteed. Therefore, the proposed concept was tested on a hydraulic model with the following objectives:

- Analysis of the retention performance and the flood evacuation system
- Optimization of the retention measures
- Optimization the required breach and culvert

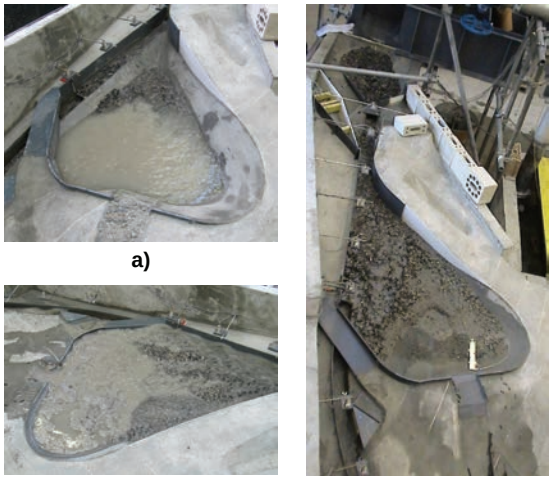
Physical Model

The hydraulic model was built with a scale factor of 1:25 involving Froude similitude. It reproduces 100 m of the Tschingelbach creek to measure discharges, water levels and sediment volumes during and after individual test runs. In a first phase, the optimal operating mode of the retention concept was determined. Then, flood events with return periods from 30 to 1000 years (PMF) were simulated systematically with bed load and driftwood.

Results

The results of the model tests led to the following conclusions:

Operating mode: The sediment retention always follows the same trend. If deposition zone I once is filled, the two crossbeams are activated at HQ_{100} which lead to the aggradation of the creek bed and the filling up of deposition zone II and the retention basin (Figure 2a). In the model, the culvert never chokes due to sediment and the evacuation breach operates as planned (Figure 2b).



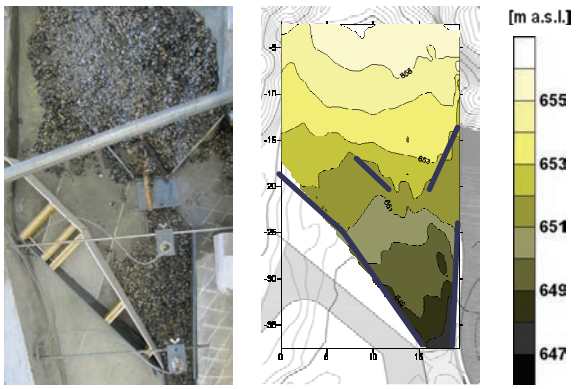
a) **b)** **c)**

Figure 2: Sediment retention in the hydraulic model (PMF); a) filling of retention basin, b) activated breach, c) final deposits

Retention capacity: Deposition zone I can be exploited as planned and is filled completely during PMF events. Downstream aggradation regulates its retention volume by blocking the outlet to a certain degree. The capacity of deposition zone II depends on the height of the transversal structure at its downstream end, consisting of the crossbeam and a horizontal trash rack. The main retention basin of the flood protection concept starts operating at HQ_{100} and is filled in its upstream part for floods up to HQ_{300}. During a PMF, sediments are transported further downstream in the basin filling up the entire storage volume (Figure 2c).

Driftwood: The appearance of driftwood can affect the operation and safety of the sediment retention scheme. The outlet section of deposition zone I, the left abutment of the bridge downstream of the retention basin and the culvert are sensitive for choking. It is recommended to chamfer the abutment and the inlet section of the culvert in order to improve the hydraulic behavior. An upstream wood trap should be considered to reduce the damage potential due to driftwood.

Optimized geometry of the retention system: A more pronounced deflection wall in retention zone II (Figure 3) and a reduced height of the transversal structure at the downstream end of deposition zone II allow for a better integration of the flood protection project into town- and landscape. The culvert was optimized to avoid increased water levels due to turbulent flow and the related overflow at the confluence spilling back into the creek bed.



a) **b)**

Figure 3: Sedimentation in deposition zones I & II (HQ_{100}); a) model photo; b) measured topography