

## Nature oriented stream bed stabilization: Dala Leukerbad (VS)



Flow condition at low and high stage in the laboratory flume. The discharge at high stage was the design discharge (42 m<sup>3</sup>/s).

step-pool morphology with an averaged slope of 8%. The existent bed material ( $d_{90} = 0.4$  m) was additionally stabilized with several heavy blocks (block diameter = 1-1.4 m and block placement density = 0.35 blocks/m<sup>2</sup>) in different arrangements. The so prepared stream bed was then impinged gradually on to the design discharge of 42 m<sup>3</sup>/s.

The river bed of the Dala at Leukerbad (VS) was in a state of heavy degradation. The erosion in the late nineties reached a critical extent regarding embankment stability, so landslides with debris flows and inundation consequences could not be excluded any more. Due to this danger, the canton Valais commissioned a restoration project. The fluvial engineering office Hunziker & Zarn in Aarau suggested two variants with a series of check dams or long block ramps, respectively. Designed in an appropriate way, these variants represent stream bed stabilization measures, which are closer to a natural mountain stream than other custom solutions.

Flume experiments were carried out at the VAW in order to test the design of two sections with a typical



Flow condition at low and high stage in nature. The photo at high stage was taken during the flood event in October 2000 with a discharge between 25 and 30 m<sup>3</sup>/s.

Five runs with different arrangement of the blocks were carried out. A strong restructuring of the blocks and the subjacent bed material was observed between discharges of 36 and 42 m<sup>3</sup>/s, depending on the arrangement. This global restructuring of the stream bed led to a rougher and more stable bed structure, which corresponds to the aspired natural mountain stream morphology. The block placement density of this new structure was more than 0.4 blocks/m<sup>2</sup>. The restructuring, however, was accompanied by a considerable mass loss in the upper flume section. For safety reasons this mass loss had to be avoided because in nature the accompanying depth erosion could endanger the stability of the embankments. Additionally blocks washed away by floods could lead to clogging of bridges downstream and so trigger inundations.

Therefore, in nature the resulted step and pool morphology had to be approximated already during the construction. Thus, most blocks were arranged in steps oriented transverse to flow direction with a distance of 7-9 m between each other. Additionally, a block placement density of about 0.4 blocks/m<sup>2</sup> was aspired between the steps. This new bed stabilization withstood the flood event in October 2000 without any problems.

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