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Combined bed-load and driftwood retention at river Engelberger Aa

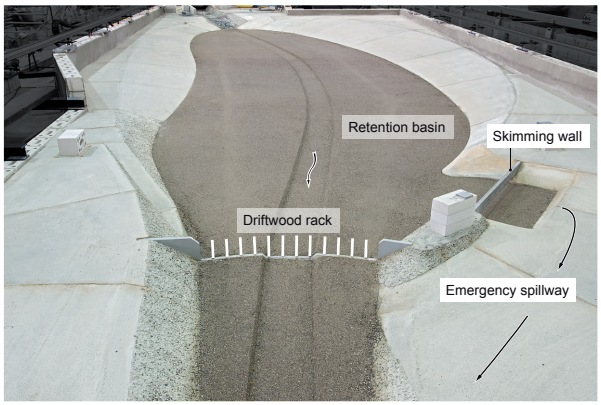

Fig. 1: Hydraulic model of the retention basin at a scale of 1:30 (view against the flow direction)

The 2005 flood event caused major damages all over Switzerland. In the valley of Engelberg several flood embankments were overtopped due to massive accumulations of both bed-load and driftwood in the river Engelberger Aa. The available cross-section of Engelberger Aa cannot manage the bed-load supply. Driftwood further led to blockage of bridges as the freeboards were insufficient. Therefore a comprehensive flood protection project was proposed for Engelberg village. Its main part consists of a sediment retention basin combined with a driftwood rack, located 3 km upstream of the village. Both bed-load and driftwood are consequently retained, thus preventing flooding of the village. The 300-year flood was selected as the design flood with a maximum discharge of 90 m3/s, a total bed-load of 60,000 m^3 and a total driftwood amount of 1,000 m^3.

Fig. 2: Bed load and driftwood deposition in the retention basin after a 300-year flood (view in flow direction)

The sediment retention basin consists of a local river widening over a length of 300 m with a maximum width of 145 m (Fig. 1). The driftwood rack is located at the downstream end of the retention basin. An emergency side spillway ensures a controlled water discharge under an extreme flood event or a total blockage of the driftwood rack. A skimming wall at the beginning of the spillway prevents the passage of driftwood. During a flood event, the bed-load deposits in the retention zone as the driftwood accumulates at the rack.

Fig. 3: Driftwood accumulation at the rack after a 300-year flood

Engelberg has assigned VAW to investigate the effect of the planned retention basin for several scenarios by means of a physical model investigation. A 1:30 scale movable bed model simulated both erosion and aggradation. Three different flood scenarios were tested: HQ_{100}, HQ_{300} and the extreme flood EHQ. For all test scenarios, at least 100% of the bed-load as well as 90% of the driftwood were retained with the proposed retention basin (Fig. 2). The spillway controlled the overload discharge whereas the skimming wall successfully prevented a driftwood passage. The feasibility of this retention basin was therefore validated using hydraulic model tests.

Keywords:	retention basin, bed load retention, driftwood retention, driftwood rack, skimming wall, emergency spillway
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