

Structured block ramps – River Emme case study



Fig. 1: Structure of ramp type called „Millipede“ (slope 6 %, 1.5 m drop height).

As a consequence of the river training works in the late 19th century the river Emme, one of Switzerland's major pre-alpine rivers still erodes today. Since the 1950s, about 80 sills have been built to stabilize the longitudinal profile. Fish and aquatic fauna are unable to pass the sills due to their large drop height. Structured block ramps were chosen to replace 13 of those ecological barriers in the section between Emmenmatt and Burgdorf.

To date no design guidelines are available for structured block ramps thus, model laboratory experiments were performed. Three different slopes (3 %, 6 %, 9 %) and two typical drop heights (1.5 m, 2.5 m) were tested (Fig.1). In addition the influence of sediment transport rate and flow depth downstream the sills were qualified.

Two different conditions were distinguished for a gradual increase in discharge: First, a threshold value (marked with a star) for which single blocks could be moved and second, the discharge for which the ramp was destroyed completely by a collapse of the ring-structure. In Fig. 2 the results for model tests with additional sediment transport are shown for different drop heights.

Despite of the stability criteria, ecological requirements concerning maximum values of flow velocity, turbulence, drop height and a minimum value for pool depth exist to guarantee the fish migration (Fig.3). These criteria were verified by handmade water level measurements for discharges between Q_{330} to Q_{30} .

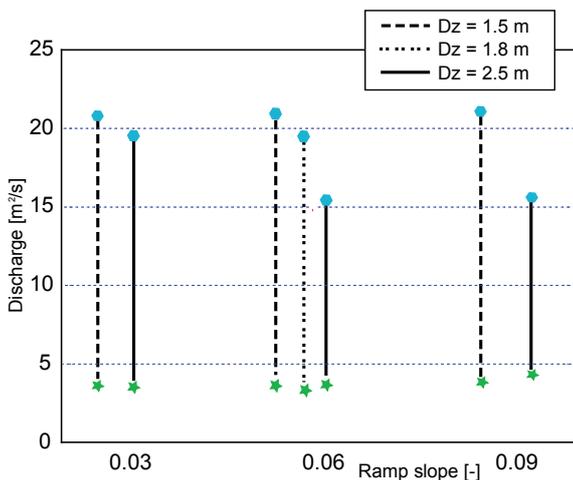


Fig. 2: Threshold flows in dependence of ramp slope for different drop heights.

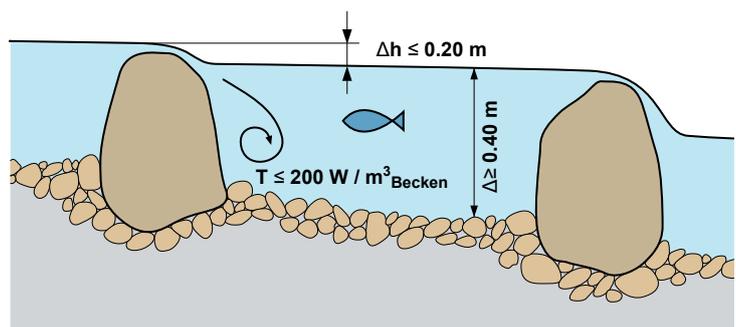


Fig. 3: Ecological criteria [DVWK 1996].

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