

## Block ramp design for upstream fish passage

Block ramps are often built as a replacement for sills in rivers and are intended to facilitate fish movement. However, steep block ramps with slopes of more than 4 to 5 % still represent a considerable barrier for most fish species. An example of a block ramp that was built for fish passage is the block ramp in Zell (Canton of Lucerne, Switzerland) on the Luthern River. It was constructed in 2021 and destroyed only two years later during a flood event in May 2023 (Fig. 1). Since the peak flood discharge was below the design discharge of the block ramp, the ramp should not have failed. The reasons of the failure are not yet completely known and are currently being investigated by two laboratory studies at VAW. It is assumed that a combination of various unfavorable structural aspects of the block ramp led to the failure, among others the built-in zig-zaging fish passage that could have destabilized the ramp. This example shows that more research is necessary to develop designs for steep block ramps with built-in fish passage structures.



Fig. 1: Remnants of a block ramp in Zell (LU) after its failure (May 2023).

In this study, experiments will be performed in a flume in VAW's laboratory facilities. The objectives of the thesis are to conduct experiments with different ramp parameters and fish migration structures to check the stability of the ramp and potential failure mechanisms. The results of this thesis will contribute to a better understanding of the design of steep ramps with built-in fish passage structures.

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**Remarks:** Hydraulic laboratory experiments  
Project language: English or German  
1 student for Master's thesis or up to 2 students for Project Thesis