Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Versuchsanstalt für Wasserbau,
Hydrologie und Glaziologie

Head: Prof. Dr. Robert Boes

Supervision: Stephan Kammerer, Julian Meister

Master's Thesis
FS 2019

Numerical investigation of fish guidance structures

The extensive expansion of run-of-river power plants in the past decades has impaired natural river systems and aquatic habitats. As a result, fish populations are prone to decline. The revised Swiss Waters Protection Act (WPA) demands the revitalization of water bodies compromised by manmade structures by the year 2030, which includes the unharmed passage of migrating fish. Horizontal bar rack bypass systems (HBR-BSs) are an effective fish passage technology, successfully applied at multiple prototype hydropower plants (HPPs). Previous physical and numerical studies investigated the two main criteria for fish guidance structures (1) the fish guidance efficiency and (2) the turbine admission flow. Whereas the bar rack itself has only a minor effect on the flow field, the general HPP setup and the layout of top and bottom overlays proved essential for a homogenous turbine admission (Fig. 1).

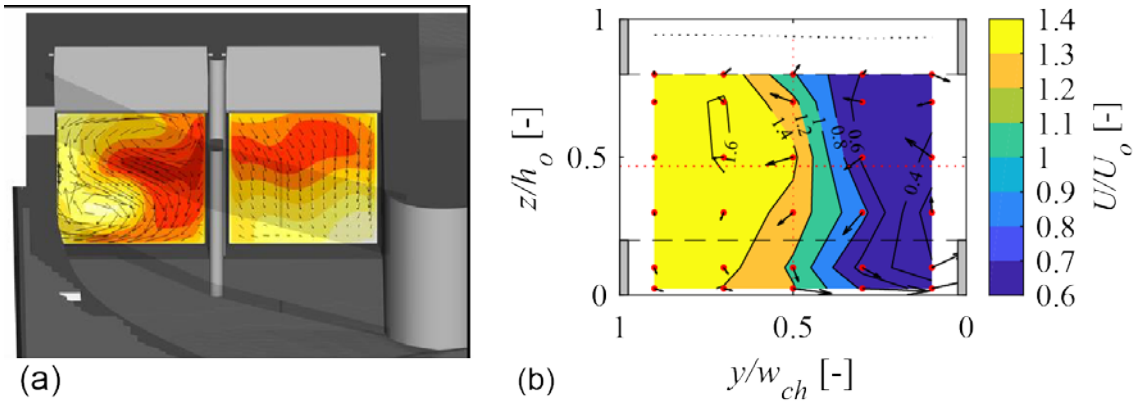

Fig. 1: Turbine admission flow (a) at a bay type unit HPP derived from numerical simulations and (b) at a diversion HPP derived from physical model investigation

Using the software OpenFoam, different HPP setups (diversion type, block type unit, bay type unit, side intake) are to be numerically investigated in laboratory scale without implementing the actual bar rack. The effect of additional features such as weir flow and a guidance wall to improve the approach flow conditions are to be implemented and analysed. The findings will be applied in a numerical case study to an existing HPP to evaluate both the fish guidance efficiency and the turbine admission flow.

Contact:

Stephan Kammerer
HIA D 57
044/632 66 00, meister@vaw.baug.ethz.ch

Julian Meister
HIA B 13
044/632 41 31, meister@vaw.baug.ethz.ch

Remarks:

Numerical model investigation,
Report can be written in EN or DE