Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Versuchsanstalt für Wasserbau,
Hydrologie und Glaziologie

Head: Prof. Dr. Robert Boes
Supervision: Matthew Halso
Dr. David Vetsch

Master's thesis
FS 2023

Overtopping Dam Breach: Computational Modeling and Laboratory Experiments

Extreme flood events are increasing in both frequency and intensity in many parts of the world. Climate change and other anthropogenic factors (deforestation, urban sprawl, stormwater routing, etc.) are largely to blame. With the increased number and strength of extreme floods, the frequency of embankment dam and dike overtoppings increases. If overtopped, an embankment dam may fail, and the resulting flood can be devastating. Forecasting the impacts of a potential dam breach flood requires estimation of the breach outflow. Reliable estimation of the outflow requires detailed understanding of the hydrodynamic and morphodynamic processes that cause the breaching. These processes comprise a field of scientific research, and are typically investigated by laboratory experiments and computational modeling.

Computational modeling of dam breaching is often performed with a parametric model (Fig. 1, left). A framework for parametric modeling of dam breaching has been developed at VAW, and was recently released as a freeware called BASEbreach. The goal of this Master's project is to use BASEbreach to deterministically calibrate a parametric model to laboratory-scale dams. The analysis may be extended by performing a probabilistic calibration of the model.

Laboratory experiments of dam breaching (Fig. 1, right) are performed at VAW as part of an ongoing doctoral research project.

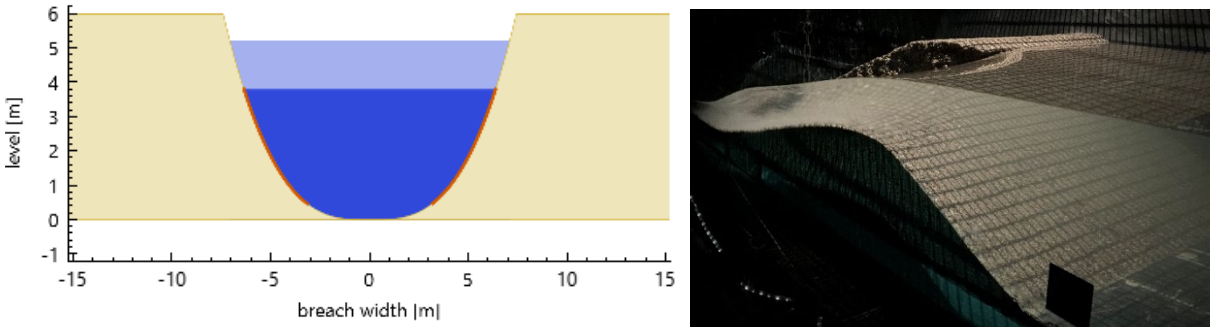

Fig. 1: Parametric modeling (left) and laboratory experimentation (right) of dam breaching

Within this thesis, you will work with the doctoral student to perform experiments at the VAW laboratory, to generate results for calibration of the parametric model.

This project combines computational modeling with laboratory experiments, in an effort to shift dam breach experimental research towards computational options. This reflects the efforts of the broader hydraulic research community, where the potentials of computational methods, combined with the proven reliability of laboratory experiments, are utilized to efficiently investigate complex hydraulic research questions. We seek a student who is interested in both computational hydraulics and laboratory experiments. Prior expertise on dam breaching and computational modeling is not necessary.

Contact:

Matthew Halso
Computational Fluid- and Morphodynamic Modeling Group, VAW, HIA D51
halso@vaw.baug.ethz.ch

Remarks:

Individual thesis, conducted in English; no prior expertise on computational modeling required