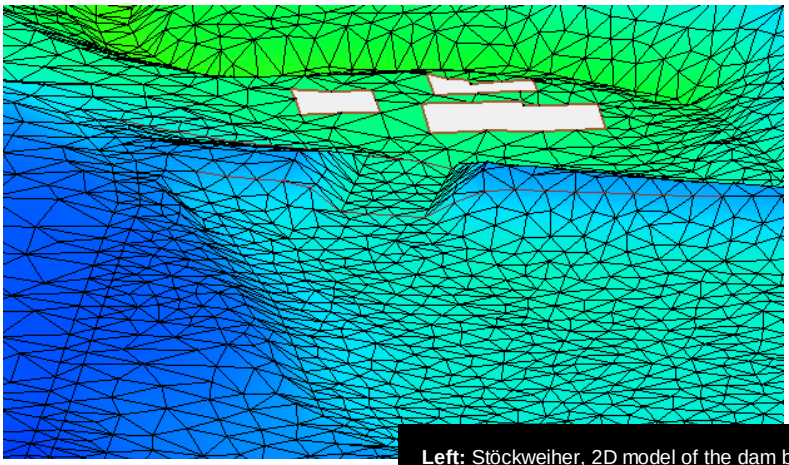

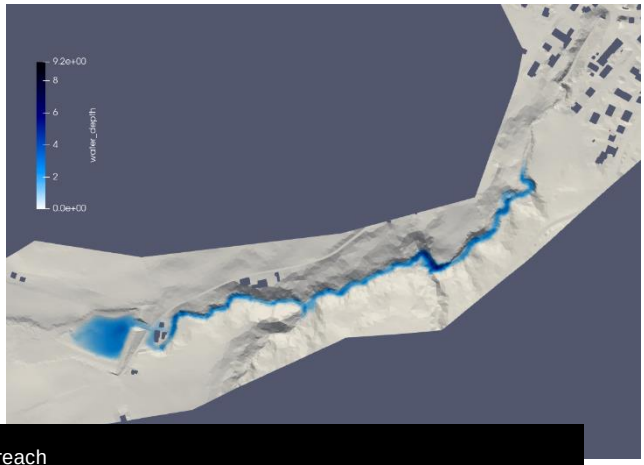

Left: Stöckweiher, 2D model of the dam breach
Right: Stöckweiher, flood wave propagation in 2D model

2D-Modelling of Dam Breaches

BASEMENT User Meeting 2023

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Introduction

The Water Retaining Facilities Act (WRFA) and Water Retaining Facilities Ordinance (WRFO) regulate the safety of water retaining structures from the construction phase to the operating phase. Dams are subjected to the WRFA and WRFO depending on their size and risk potential. In the Canton of Zurich, there are many small dams, which do not check the size criterion but have to be assessed regarding their risk potential. In previous studies, these dams were analysed using empirical formula and visual inspections.

Method

With the use of 2D hydraulic models, the impact of dam breaches can be investigated more thoroughly. An FME-tool, developed by B&H, combined with BASEmesh and QGIS enables an almost automatic generation of large 3D meshes. The standard dam breach is either implemented as a geometric adjustment in the mesh or, alternatively, the breach hydrograph is implemented as an external source. The tool BASEbreach is used to determine these hydrographs. With the described tools, a 2D hydraulic model can be set up and run with minimal expense, using the significant speed-up made available with the GPU-support of BASEMENT v3.2. The method is applied for the Brauiweiher and Stöckweiher in the canton of Zurich.

Results

The hydrographs produced by the different mathematical models in BASEbreach (Macchione, AWEL and Peter) show that the Peter model leads to a more progressive dam breach with a smaller peak discharge. While for the Brauiweiher, the resulting maximum water depths are very similar for all hydrographs, there is a larger difference for the Stöckweiher, where smaller maximum water depths result with the Peter hydrograph. All models lead to a maximum intensity of more than 2 m^2/s at the buildings first reached by the flood wave for both reservoirs, indicating a high risk potential and subjection to the WRFO. The construction of a new spillway at the Brauiweiher leads to a reduced intensity to 1.5 m^2/s and the dam is not subjected to the WRFA and WRFO. Due to the proximity of the buildings below the dam of the Stöckweiher, the intensity cannot be reduced sufficiently. Instead, monitoring and emergency regulations in accordance with the WRFO are developed.

Outlook

With the use of open-source data and software and an efficient mesh generation due to automatisation, valuable and reliable information regarding flood wave propagation and risk potential can be gained for the planning of mitigation measures regarding the subjection of small dams to WRFO.