Eidgenössische Technische Hochschule Zürich
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Versuchsanstalt für Wasserbau,
Hydrologie und Glaziologie

Project Work or Master's Thesis
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Project Based Research Work

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High Energy Air-Water Flows on Spillways

Spillways are key safety structures of reservoir dams to convey extreme floods. Spillway failure may have catastrophic consequences for the downstream river reaches (Fig. 1). On the typically steeply inclined spillways, water is accelerated by gravity, resulting in large flow velocities, a significant cavitation risk and the onset of self-aeration. Current methods to describe such high energy air-water flows are mostly empirical and based on time-averaged flow properties obtained in scaled physical model tests and may be affected by scale effects. Recent advancements in air-water flow instrumentation and data analysis allow for reliable measurements of turbulent fluctuations and even shear stresses. The application of such advanced instrumentation in large-scale physical models will allow to complement existing data sets, improve existing empirical relations and hopefully to deepen the quantitative understanding of physical processes in high energy air-water flows.

Fig. 1: Catastrophic failure of the Oroville dam spillway in 2017, leading to the evacuation of 180'000 people. (Source: Kelly M. Grow, California Department of Water Resources)

Therefore, the goal of this thesis is to investigate spillway hydrodynamics with state-of-the-art instrumentation such as Laser Doppler Anemometry (LDA) and newly developed phase-detection probes in a large-scale spillway model in the VAW laboratory . By considering different roughness heights, spillway slopes and inflow conditions, a complete set of air-water flow properties will be collected, which will provide a basis for future model development and validation. In this thesis, you will get a better understanding of spillway hydraulics and gain insights into state-of-the-art instrumentation and data analysis techniques. Overall, this thesis contributes to a safer design of spillway structures.

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Remarks:

Experimental thesis, Individual project; "Project Based Research Work" also possible