

Master's Thesis HS 2023 (Project Based Research Work)



Head:

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Effects of tunnel geometry on high-speed air-water flows in low-level outlets

Reservoir dams play a key role in modern society and economy, especially for hydropower energy production, flood control, and climate change mitigation. Low-level outlets (LLOs) are important safety structures aiming at regulating the water level in the reservoir, and at allowing a fast drawdown in case of maintenance or emergency situations. In LLOs, the flow regime is characterized by the transition from pressurized to supercritical free-surface flow downstream of the gate. In the free-surface tunnel, flow is characterized by high turbulence and velocities, i.e., up to 30 - 60 m/s, depending on the available head. This leads to significant air entrainment and transport resulting in sub-atmospheric pressures which may induce significant problems such as gate vibration and cavitation. Sufficient flow aeration is crucial to mitigate these issues and to achieve a safe and reliable operation of LLOs.



Fig. 1: View of the LLO tunnel in the physical model. Flow direction from left to right.

Recent studies at VAW dealt with the effects of hydraulic parameters, tunnel geometry, wall roughness, and air vent design on LLO performance. However, the influence of tunnel profile transitions downstream of the gate - as they typically occur in most prototypes - is still unclear. To fill this gap, you will carry out experiments in the low-level outlet physical model currently available at VAW (Fig. 1), and investigate the influence of two different profile transitions, i.e., abrupt and smooth transition, on LLO performance. In this thesis, you will get a better understanding of the hydraulics of high-velocity air-water flows and you will have the opportunity to gain experience with advanced laboratory instrumentation and data analysis techniques. In conclusion, the thesis contributes towards a safer design of LLOs tunnels.

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Individual project Experimental thesis (English) Possible "Project Based Research Work"

Remarks: