Eidgenössische Technische Hochschule Zürich
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Laboratory of Hydraulics,
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Project Work
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Impulse wave run-up on converging slopes

Very rapid mass movements such as rockfalls, landslides, or avalanches can cause large water waves in oceans, bays, natural lakes and engineered reservoirs. The initial amplitudes of these so-called impulse waves and their close-range run-up heights may be an order of magnitude larger than those of earthquake induced tsunamis. Impulse wave events like in Lituya Bay, Alaska, in 1958 are therefore also referred to as mega-tsunamis.

Impulse wave events involve a process chain including the stages of wave generation, wave propagation, and wave-structure/shore interaction. After an impulse wave event, only traces of the last stage may generally be observed and measured in the field (Fig. 1a). For preventive hazard assessments, the impact at the shore line may be estimated with equations derived from hydraulic laboratory tests. However, the equations describing wave run-up were derived from experimental setups featuring non-converging slopes (Fig. 1b, c). In gullies and small valleys, i.e. in landforms converging in flow direction as shown in Fig. 1(a), the water masses running-up the shore are getting concentrated. Existing equations may therefore underestimate actual run-up heights.

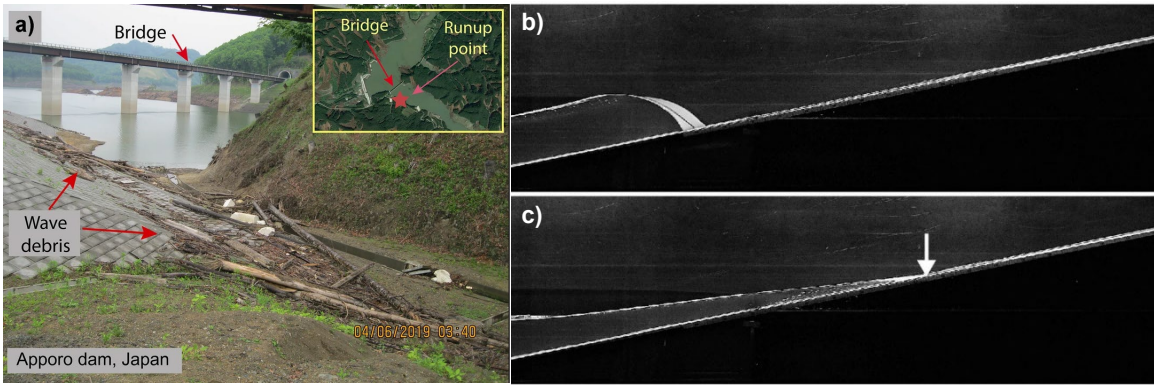

Fig. 1: (a) Debris traces after impulse wave run-up in Apporo reservoir, Japan (Heidarzadeh et al. 2022); (b, c) solitary wave run-up on a slope with constant width (Fuchs 2013)

Within this project work, the hydraulic features of solitary impulse wave run-up on converging slopes is to be investigated with model experiments. A pneumatic piston-type wave generator will be used to generate solitary waves in an 11 m long wave channel. Model parameters such as wave height, still water depth, slope inclination, and convergence angle will be systematically varied to cover a broad range of run-up scenarios. The objective is to extend the understanding of the relevant hydraulic processes and to derive equations for the quantification of potential events at prototype scale. The results of the work thus contribute to an improved handling of natural hazards, in particular in the context of dam safety.

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