ETH zürich

Impulse waves – effects of hill slope angle and granulometry

Impulse waves in reservoirs, lakes and estuaries generated by landslides, shore instabilities, avalanches, ice and rock falls are considered. For Alpine lakes impulse waves are particularly significant, due to steep shores, narrow reservoir geometries, large slide masses and high impact velocities. The resulting impulse waves can overtop dams and cause disaster in the tailwater as in Vajont, Italy (1963), where nearly 2500 people were killed.

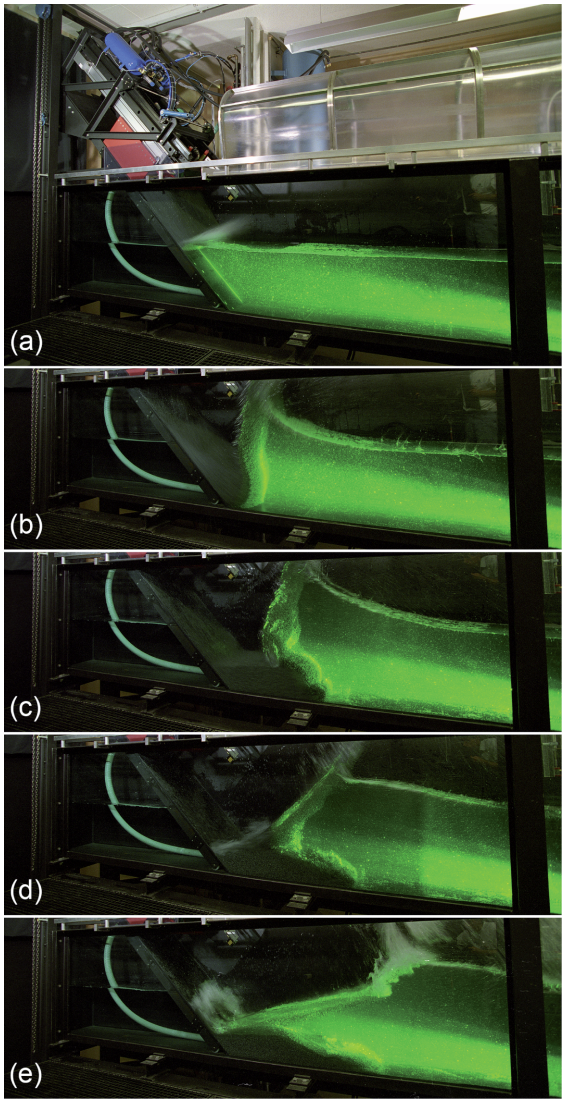

Fig. 1: Sequence of impulse wave generation in hydraulic model

Experiments are conducted in a rectangular prismatic channel (L x W x H: 11 m, 0.5 m, 1 m) with water depths from 0.15 m to 0.675 m and hill slope angles from 30° to 90°. The slide is modelled with artificial granular material of different densities and grain sizes. To vary independently every parameter describing impulse wave generation, a sophisticated pneumatic acceleration mechanism accelerates the slide up to impact velocities of 8 m/s. Fig. 1 shows a sequence of impulse wave generation in the hydraulic model. The pneumatic acceleration mechanism accelerates the red box containing granulate, the flap opens, the granulate impacts the water body and produces an impulse wave.

The 2D measurement system consists of two laser distance sensors (LDS) to scan the slide profile before impact into water, a Particle Image Velocimetry (PIV) system to establish the instantaneous velocity fields in the slide impact area and seven capacitance wave gauges (CWG) to measure the resulting wave profiles along the channel.

In two previous PhD studies the influence of the slide velocity, its volume, height, density and the water depth were investigated. The influence of hill slope angle and granulometry of the slide for impulse waves generation are considered in the present project.

Main goals

- Understanding the mechanism of wave generation
- Investigating the effects of hill slope and granulometry on impulse waves
- Quantifying the velocity distribution inside the three-phases transition zone of the primary wave generation
- Specifying the governing wave features propagating over the water body

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