Impact of a dam break wave against a rigid wall: experiments and simulations

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Abstract:

Dam break and tsunami waves impact considerably the physical environment, by causing huge damages and human fatalities. In this context, a crucial issue is the evaluation of forces that these waves induce on structures they interact with.

Scaled laboratory experiments of dam-break waves impacting on obstacles are fundamental for understanding the hydrodynamics of the phenomenon and for validating numerical models.

The present work focuses on experimental and numerical investigation of the impact of a dam-break wave against a vertical wall. The experimental setup is composed by a Perspex channel 3.0 m long, 0.4 m wide, and 0.5 m high, divided into two parts by a movable lift gate, which can be suddenly opened through a pneumatic system. Two high- speed CCD cameras were used to obtain the instantaneous free surface profiles by image analysis. A vertical rigid wall is placed at the end of the channel and equipped with six pressure transducers. Different tests have been performed on both fixed bed and mobile bed conditions and considering different values of the water depth upstream the gate.

In the realized experiments the wave impacts the fixed wall, and it is reflected many times until the water reaches the hydrostatic condition. The temporal evolution of the force during the reflections is analysed. The experimental data are compared with the numerical simulations performed with two different theoretical models: a shallow water

- Exner model and the Deltares-Delft3D hydrodynamic and morphological model.

The analysis of the experimental data provides new insights about the characteristics of the phenomenon, highlighting the effects of the bottom mobility. Moreover, the comparison with the numerical simulations indicates capabilities and limits of the models.

Keywords: Dam break, Rigid wall, Impact force, Experiments, Numerical Simulation

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