CHARACTERISTICS OF BORES GENERATED BY DIFFERENT MECHANISIMS IN THE LABORATORY

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The present work focuses on investigating characteristics of tsunami-like bores generated by different generation systems in the laboratory. These characteristics include the bore strength, bore height and bore length.

The dam-break system has been the most commonly used generation mechanism (e.g. Yeh et al. 1998). Barranco and Liu (2021) studied the inundation produced by bores of different strength and length generated by a dam-break system with various reservoir lengths. Based on numerical results and experimental data, empirical formulas for the maximum inundation depth, runup height and flooding duration as a function of bore strength and bore length of the bore reaching at beach toe were presented. They highlighted the importance of the bore length on the duration of the inundation events and provided relations to calculate the minimum bore length necessary to produce a quiescent flooding plateau during the inundation phase.

Bores have also been generated in laboratory by using a piston-type wavemaker (e.g., Miller 1968). Using a long stroke wavemaker, Barranco and Liu (2022) studied the surf and swash flows produced by bores of different strength and length. They also produced and analyzed decaying bores, which are short bores with decaying strength. Their results point out that the swash flows only depend on the characteristics of the bore reaching the toe of the slope, and that, therefore, are independent of the bore generation mechanism. They found that the swash produced by decaying bores can be approximated as the swash produced by bores of length equal to zero. Moreover, they measured flow velocity and turbulence fields for undulating and breaking bores on the constant water depth and swash region. Their results provide evidence on the flow velocities during the quiescent flooding phase produced by very long bores.

Tsunami-like bores are non-uniform with stronger front and trailing secondary waves. Barranco (2021) demonstrated that by combining the dam-break and wavemaker systems non-uniform bores can be generated in the laboratory. In Barranco (2021) two cases were considered. In the first scenario, both systems were activated simultaneously. This produced a leading long bore, generated by the dam-break system, and a trailing bore, generated by the wavemaker, riding on the first bore's plateau. In the second scenario the dam-break gate was lifted at the time when the front of the wavemaker generated bore reached the dam-break location, producing instantaneously a combined bore. A comparison of both scenarios and a uniform bores are plotted in Figure 1. The inundation depth and runup height measurements from both scenarios were compared with those of uniform bores.

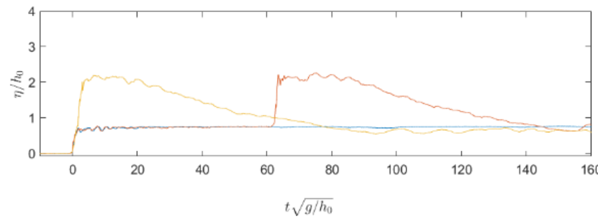

Figure 1 - Combination of breaking bores. Dam-break generated uniform bore in blue, riding bore in red and combined bore in yellow.

Pneumatic Long-Wave Generator (PLWG) systems have been employed to generate long tsunami-like waves in laboratories (Rossetto et al., 2011, McGovern et al., 2018, Chandler et al., 2021). This type of system allows the generation of long waves by controlling the flow in and out the pneumatic tank, as shown in Figure 2. One of the advantages of this system in the generation of tsunami-like waves is that the PLWG is capable of generating long trough leading N-waves, which mimic tsunami scenarios in which the water retreats from the shoreline before the tsunami wave crest reaches the coast. In this work we have employed the PLWG at HR Wallingford to produce a new data-set of bores propagating in a 100 m long flume.

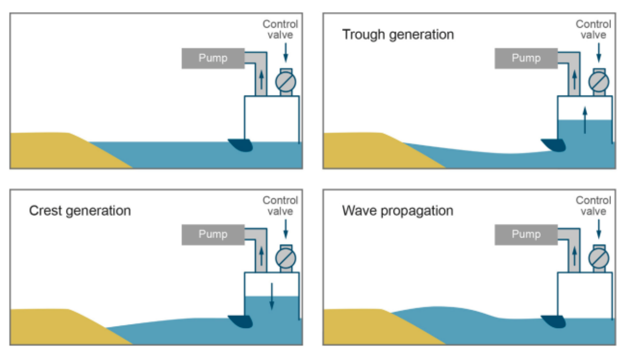

Figure 2 - Schematic diagram of pneumatic long-wave generation.

In this presentation we shall compare the bores generated employing the different generation mechanisms and provide analytical relations to aid in laboratory experimental design aiming to generate bores or inundations of specific characteristics. We shall also present an extended dataset of non-uniform bores generated employing the combination of dam-break, wavemaker and PLWG systems, including inundation and run-up measurements. In addition, the generation of N-bores is explored. N-bores are generated in the combined dam-break and wavemaker system by setting lower water depths in the upstream region of the dam-break gate, which is lifted at the same time the wavemaker starts to move. This causes the water to retreat in the slope region before it is later flooded by the wavemaker generated bore. On the other hand, N-bores are generated with a procedure similar to the generation of N-waves employing the PLWG system.

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