Study on Acceleration Features of Long Waves over Sloping Beaches - A comparison between Solitary Wave and Undular Bore

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One of the burning issues in civil engineering is the evolution of free-surface flows near shoreline when the incident oscillations of considerable water masses caused by long waves, like tsunami, bores and storm surf, can eventually result in tremendous destructions and casualties. Most of such damages are related to run-up and run-down motions of long waves around the shoreline. Therefore, understanding the features of related hydrodynamics during the whole process is very important for the evaluation of any kind of mitigation effort.

Solitary wave and dam-break generated bore experiments were conducted in a 14.0 m long glass-walled wave flume. A piston-type wave generator driven by a precision servo-motor was used to generate the solitary waves with the incident wave-height to water-depth ratio varying from 0.01 to 0.04. Furthermore, undular bores were generated right downstream of a suddenly lifted gate (over which its supporting frame-structure was mounted upon the wave flume). The generated bores travel first over a horizontal bottom and then propagate over a 1:20 sloping beach. The ratio of the upstream water depth to the downstream one ranges from 1.5 to 1.8 to allow the generation of undular bores. Flow visualization technique and high-speed PIV were employed to observe the flow patterns and velocity fields of both solitary waves and undular bores.

Based on visualized images captured and velocity fields measured near the still-water shoreline, the following flow features at different stages of solitary wave and undular bores will be explored: (1) The temporal and spatial variations in the velocity fields during run-up and run-down stages; (2) Flow reversal zone and evolution of vortex structure close to the sloping-beach surface; (3) Variation characteristics of acceleration and pressure gradient; (4) Comparison of acceleration and deceleration features for solitary wave and undular bore for addressing prominent distinction in between. Furthermore, the effect of breaking leading waves on the velocity fields of undular bore will be also discussed.