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1 **Numerical Simulations and Experimental Visualizations of the**
2 **Vortex Characteristics for a Solitary wave interacting with a**
3 **bottom-mounted vertical plate**

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11 **Abstract**

12 This study is aimed to investigate numerically and experimentally the interaction of a solitary
13 wave with a bottom-mounted vertical thin plate with focuses on the wave induced fluid kinematics
14 and vortex flow patterns. A streamfunction-vorticity free-surface (SVFS) based fully nonlinear
15 viscous wave model solved in a transient boundary-fitted coordinate system with locally overlaid
16 grids is applied to study this wave-plate interaction problem. Qualitative comparisons between
17 numerically generated flow patterns around the plate and the experimental observations, including
18 images from both the particle-tracking and the laser-dye visualization methods, are presented. The
19 shear-layer velocity profiles are compared quantitatively with the experimental measurements. The
20 detailed flow characteristics and formed vortices including the effect of the shape of the plate top on
21 the vortex formation and development are numerically investigated. For a thin vertical plate, the
22 flow characteristics that are affected by the dimensionless parameters of incident-wave height and
23 plate height are also investigated. The numerical visualizations illustrated by the virtual transport of
24 particle-tracing, streamlines, and equi-vorticity lines are useful to understand the kinematic
25 behaviors of the induced vortical motions. Furthermore, the pressure gradient, shear stress, and
26 maximum wave force are examined to detail the hydrodynamic impacts on the submerged plate.

27
28 **Keywords:** solitary wave, vertical plate, vortical flow, flow visualization, streamfunction, vorticity.

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