

Free-Surface Dynamics and Chamber Coupling in a Dual-Chamber OWC with Vertical Breakwater

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ABSTRACT: This study presents a numerical investigation of a dual-chamber Oscillating Water Column (OWC) integrated into a vertical breakwater, using a two-dimensional RANS–VOF model. The objective is to characterize the fundamental hydrodynamic behavior of the coupled chambers and to assess how wave period and geometry influence multiresonant response. The computational domain consists of a wave tank, a vertical breakwater, and two internal OWC chambers connected through a horizontal duct. Regular waves are generated using a moving-wall wavemaker.

The study focuses on three aspects: (1) the temporal evolution of the free surface inside each chamber, (2) the interaction and phase relationship between Chamber 1 and Chamber 2, and (3) the velocity field within the connecting duct and the breakwater opening. Results show that the dual-chamber configuration exhibits distinct resonant peaks, confirming the multiresonant nature of the system. Chamber 1 responds more strongly near the primary natural period, while Chamber 2 amplifies motion at a secondary frequency. Flow visualization reveals strong jets and recirculation zones that influence energy transfer between chambers. These findings provide a foundation for future optimization studies and for extending the model to include turbine dynamics.

Keywords: dual-chamber OWC, multiresonant, RANS–VOF model,

[Link simulations](#)

