

A Numerical Study of Effects of Perforation Layouts on Wave Energy Dissipation Caused by a Submerged Perforated Breakwater in Front of a Vertical Seawall

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Perforated structures are a promising alternative to standard sea walls and breakwaters for dissipating wave energy and protecting coastlines. Perforated marine structures can effectively remove wave energy from ocean waves by the energy loss associated with the flow through the perforations in the structure. Understanding the factors that may affect the hydrodynamic characteristics of flow through a perforated plate is important for designing perforated marine structures. The purpose of this research was to determine the wave energy dissipation performance of thin-walled plates with various perforation configurations using OpenFOAM-based CFD simulations. Ten different plate configurations were designed and tested with a constant 9.8% porosity while varying the distribution, shape, and size, of the perforations to determine the impacts to energy dissipation performance. The energy dissipation of each plate was quantified by measuring the incident and reflected wave amplitude of numerically generated Second-Order Stokes waves in a rectangular wave flume with a vertical back wall ("seawall"). Physical wave flume experiments were also conducted to verify and validate the numerical models. The results showed that the perforation distribution, shape, and size plays a minimal role in the energy dissipation performance when porosity is held constant. The minimal performance deviation between the perforation configurations was consistent across a range of wave periods and amplitudes.

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