SUBMERGED POROUS PLATE WAVE ABSORBER

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The wave absorbing breakwater for the sheltered region is one of the current engineering advancements in port design, in order to provide a further calm basin to insure safer and more efficient port operation, ship berthing and navigation inside of inner harbors (Yip and Chwang, 2000). In view of this, many researchers have been particularly interested in the interaction between the water waves and porous structures. Based on the linear water wave theory, a series of study can be traced back to the analysis of wave motion over a submerged porous plate by using boundary element method (Yu and Chwang, 1994) and found that a plate with proper porosity can suppress significantly the wave reflection. The water wave reflection by a vertical wall with a horizontal submerged porous plate was investigated by Wu et al. (1998) using the eigenfunction expansion method, and found that the larger plate with proper porosity behaves similarly to a wave absorber which can suppress the wave amplitude on the vertical wall surface and reflected waves. The combination of a perforated wall and a submerged horizontal plate has been investigated by Yip and Chwang (2000), and found that the size of a wave chamber can be reduced thanks to the presence of the internal horizontal plate over that generate the shorter wavelength. Cho and Hong (2004) investigated the performance of a wave absorbing system using an inclined porous plate using multi-domain boundary element method, and checked its validation through the comparison with experimental results. It was found that an inclined porous plate have a better wave absorbing efficiency, for the inclined angle range between 10° and 20°, compare to a horizontal one.

Such a series of previous research motivates us to investigate the phenomenon of the wave energy dissipation over the inclined porous plates in front of the vertical wall, and to find out the optimal system which has better performance especially in the long wave region. Two-dimensional multi-domain formulation was carried out in the context of linear wave-body interaction theory and Darcy's law on order to assess the efficiency of triple horizontal porous plates. It is assumed that the ratio of thickness of the plates to the wavelength is small enough to neglect its effects. Based on the wave motion of local standing wave, one inclined porous plate and two reversely inclined plates have been chosen as an optimal design to obtain further wave energy dissipations by the trapped waves in front of the vertical wall (Park et al., 2005).

In the present paper, we extended the previous work to the practical caisson breakwater which is modified with one internal horizontal or slightly inclined porous plate. The hydrodynamic interaction of incident waves with the rigid porous bodies was solved by the distribution of the simple sources along the all boundaries, which satisfies the Laplace governing equation in each fluid domain. The accuracy and convergence of the developed

2-domains boundary element program were checked based on the energy-conservation formula for a limiting case. The numerical results were further verified by checking and through comparison with the experiment result in a two-dimensional wave tank. The numerical predications for the test model were generally in good agreement with experimental results.

It is found that the internal porous plate can, if it is properly tuned for wave trapping to the coming waves, have high performances in reducing the reflected wave amplitudes against the incident waves over a wide range of wave frequency, especially in high frequency region.

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