HYDRODYNAMIC CHARACTERISTICS OF CURTAIN-WALL-PILE BREAKWATERS

KYUNG-DUCK SUH [1], SUNGWON SHIN [2], and DANIEL T. COX [3]

[1] Professor, School of Civil, Urban, and Geosystem Engineering, Seoul National University, San 56-1, Shillim-Dong, Gwanak-Gu, Seoul 151-742, Korea (Tel: +82-2-880-8760, Fax: +82-2-887-0349, e-mail: kdsuh@snu.ac.kr)

[2] Graduate Student, Department of Civil, Construction, and Environmental Engineering, Oregon State University, 202 Apperson Hall, Corvallis, OR 97331-2302, USA (e-mail: shinsu@engr.orst.edu)

[3] Associate Professor, Department of Civil, Construction, and Environmental Engineering, Oregon State University, 202 Apperson Hall, Corvallis, OR 97331-2302, USA (e-mail: Dan.Cox@oregonstate.edu)

In general, the width of gravity-type breakwaters increases with water depth, leaving a large footprint and requiring a great amount of construction material especially when built in deeper water. Often they block littoral drift and cause severe erosion or accretion in neighboring beaches. In addition, they prevent the circulation of water and so deteriorate the water quality within the harbor. In some places, they obstruct the passage of fishes and bottom dwelling organisms. A solid soil foundation is also needed to support such heavy structures.

In order to resolve the above-mentioned problems, porous (permeable) structures have been introduced especially in small craft harbors. The simplest porous structures may be a curtain wall breakwater, which consists of a vertical wall extending from the water surface to some distance above the seabed, or a pile breakwater, which consists of an array of vertical piles. In this paper, we deal with a CWP (curtain-wall-pile) breakwater as shown in Fig. 1, the upper part of which is a curtain wall and the lower part consists of an array of vertical piles. For short waves in which the wave motion is minimal in the lower part of the water column, this breakwater would behave like a conventional curtain wall breakwater, while for longer waves additional energy dissipation would occur due to flow separation around the piles, giving less wave transmission than the conventional curtain wall breakwater. In comparison with a pile breakwater, we expect somewhat smaller transmission for long waves and much smaller transmission for short waves, because the upper part of the breakwater is blocked with a vertical wall. In this study, we develop a mathematical model to compute various hydrodynamic characteristics of a CWP breakwater, describe the large-scale laboratory experiment performed to assess the mathematical model, and finally compare the predictions of the model with the experimental results.

Comparisons between measurement and prediction showed that the mathematical model was able to adequately reproduce most of the important features of the experimental results for both regular and irregular waves. It was also shown that the CWP breakwater always gives smaller transmission and larger reflection than a curtain wall breakwater or a pile breakwater and its capability of energy dissipation is superior to that of the curtain wall or pile breakwater for longer waves.

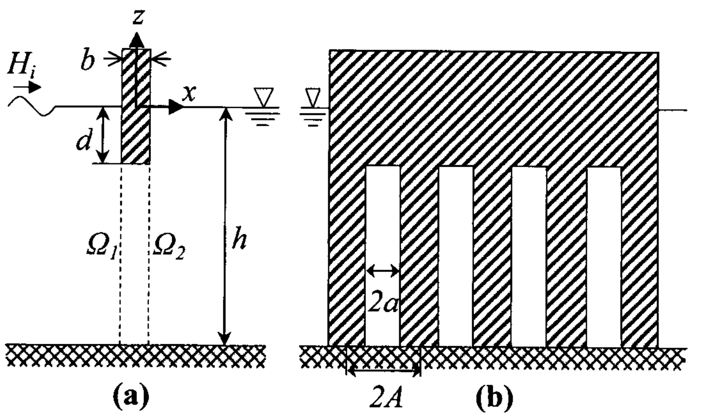

Fig. 1 Definition sketch of a curtain-wall-pile breakwater: (a) side view; (b) front view