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# Experimental Study of the Wave Energy Dissipation Due to the Porous-Piled Structure

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## ABSTRACT

To investigate the reflection, transmission characteristics and energy dissipation of porous-piled structures, a series of physical experiments were conducted in this research. The results indicated that the reflection coefficient of double-row structure while *2S/L* (*S* is the structure gap spacing, *L* is an incident wave length) = 1 or 2 has a peak, also the peak value is larger when porous coefficient is smaller. This phenomenon is quite similar to the Bragg effect. Besides, the reflection coefficient and energy dissipation decreasing (transmission coefficient increasing) while porous coefficient of the structure increasing.

KEY WORDS: Porous-piled structure, reflection, transmission, energy dissipation.

## INTRODUCTION

All structures in the coastal zone have one thing in common: they must be able to withstand the forces caused by wave attack. Generally, breakwater can be divided into many types, in which the rubble-mound breakwaters and the monolithic breakwaters are the most important twos. Next to that, there are a few special types for some special purposes because of the complex coast bathymetry or environmental protection consideration.
Recently, a severe damage to a coastal structure due to a storm surge happened in Hua-Lien coast, where is a steep slope foreshore in Taiwan east coast. Although the investigation into the damage is still go on and many protection approaches are concerned. However, the most important of this problem is that the steepness of sea bottom in front of the sea defence makes the engineering very difficult. In order to overcome this kind of difficulty, the special types of breakwaters would be concerned. In the following, we will concern some special type of breakwaters:
Firstly, submerged breakwaters are mainly built of rubble stones. They reduce the wave energy passing to the onshore zone while causing breaking of large waves only. Early research considered the dynamic interaction between the wave and the breakwater [Losada, Sliva and Losada, 1996; Chiranjeevi Rambabu A, and Mani, JS, 2005]. Based on the horizontal bottom assumption, results of the most literatures can deal with a gentle slope coast only in practice [Requejo, S, Vidal, C, and Losada, IJ, 2002; Abul-Azm, AG, and Williams, AN, 1997; Kobayashi, N, Meigs, LE, Ota, T, and Melby, Jeffrey A, 2007]. Owing to bathymetry of Hua-Lien coast is steep, the submerged breakwater is not a suitable solution.
Secondly, porous structures are used effectively to dissipate ocean wave energy for the protection of coastal areas [Requejo, S, Vidal, C, and Losada, IJ, 2002; Kobayashi, N, Meigs, LE, Ota, T, and Melby, Jeffrey A, 2007]. The water flows inside the porous structure cause flushing, and the wave energy is damped out by turbulence dissipation. In recent years, there have been many studies concerning wave interaction with porous structures. Williams and Li (2000) presented a semi-analytical solution for a monochromatic wave interaction with an array of bottom mounted, surface piercing, porous cylinders. And these results show excellent efficiency in wave dissipation.
Finally, in the view of shore protection a very simple way that let most of wave energy dissipated in offshore zone is proposed. According to the mention above, a series of physical experiments will be conducted to investigate the hydrodynamic behavior of fixed and porous breakwaters in front of a steep slope bathymetry.

## EXPERIMENTAL ARRANGEMENT

### Experimental set-up

This experiment carried out in a 0.8m wide wave flume with a length of 28m at the Department of Harbor and River Engineering of National Taiwan Ocean University. Most of the construction was made of cement concrete with an observation glass included on the model side. One end of the wave flume is equipped with a piston type wave generator the motion of which is controlled by a computer. Behind the wave generator a wave absorber made by PVC pipes is provided to absorb the incident wave energy efficiently.
The model based on Froude number similarity theory is on the scale of 1/64, and the variation of flume width, porous coefficient, submerged depth, different arrays and numbers are taken account of. The model test in this paper can be divided into two parts, first one is single porous-piled structure and the other is double connected porous-piled structure. Both of them are made of hollow aluminum arrays (section with 2.54cm in height and 3.81cm in width), which are sealed with plastic foam and tape on both sides. The hollow aluminum arrays were screw to attach each other and sealed with silicone. A schematic sketch of the layout in the wave flume and the location of wave gauges are