ABSTRACT

The efficiency of pontoon-type breakwaters can be expressed by the transmission coefficient, $K_T$. Physical modeling of pontoon-type breakwaters was conducted using a 2D wave flume at the Ocean Wave Research Laboratory (FCEE ITB) in Bandung Indonesia. To identify the coefficient $K_T$, two designs of floating breakwaters with different dimensions were investigated. Environmental conditions and dimensions of pontoons were scaled considering Froude Similarity. Wave heights ($H$) and periods ($T$) of data were observed both manually and digitally using wave probes. The relationship between $K_T$ and non-dimensional variables obtained are apparently valid for limited conditions within the experimental data range.

KEY WORDS: Long waves; non-dimensional quantity relationship; pontoon-type breakwaters; short waves; transmission coefficient.

INTRODUCTION

LNG exploration site at Bintuni Bay, Indonesia has a combo dock facility which allows ship berthing and LNG loading from the refinery site. Berthing operation needs calm wave conditions that can be achieved by installing breakwater in front of the facilities, where the water depths vary from 6 m to 9 m. Two designs of pontoon-type floating breakwaters (FB) have been investigated; namely Eastern Traveller and Eastern Galaxy. Each of them corresponds to different dimensions.

However, the experimental studies are rather limited, performed in small-scale facilities, and are only used for regular wave forcing. Sutko and Haden (1974) presented a series of small-scale experiments. Fugazza and Natale (1988) studied the phenomenon numerically and experimentally. They investigated the influence of the stiffness of the horizontal part of the mooring system. Murali and Mani in 1997 investigated the performance of cage floating breakwater using the experiments in laboratories. Koutados et al. (2005) examined experimentally hydrodynamic interaction of regular and irregular waves with FBs in shallow and intermediate waters in a large-scale facility.

In this study, the efficiency of a pontoon-type breakwater which is expressed by transmission coefficient ($K_T$), is discussed using a physical modeling of pontoons. The pontoon models were selected and investigated in 2-D wave flume at Ocean Wave Research Laboratory FCEE, ITB of Bandung. The wave flume has dimensions of 40 m in length, 1.2 m in width and 1.5 m in height. The waves were generated by a piston-type wavemaker that is able to generate regular waves up to 30 cm of wave height. The flume was equipped with 5 resistance-type wave probes and 8-channels DAS (Data Acquisition System).

Wave heights ($H$) and periods ($T$) of data were observed, manually from visual observation and digital observation from wave probes (processed further using zero mean up-crossing technique). Incident wave heights ($H_i$) were measured in front of pontoon-type breakwaters and transmitted wave heights ($H_t$) were measured behind floating breakwaters. Transmission coefficients ($K_T$) is equal to the ratio of transmitted to incident waves. Variables affecting transmission coefficient ($K_T$) were identified and presented using non-dimensional variables, i.e. non-dimensional: draft ($S/(gT^2$)), water depth ($h/(gT^2$)), incident wave heights ($Hi/(gT^2)$), and breadth of pontoons ($B/(gT^2)$) coefficients.

The objective of this study is to obtain a relationship between the ratio of pontoon draft to incident wave height ($S/H_i$) and transmission coefficient ($K_T$), in order to estimate the efficiency of pontoon-type breakwaters (Eastern Traveller and Eastern Galaxy pontoon).