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Numerical Investigation Of The Performance Of Catamaran Floating Breakwaters

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Abstract

This paper gives details of the refinement of a two-dimensional numerical model for the computation of the wave-induced currents and floating breakwater (FB) response. The numerical model results are validated and verified against laboratory tests. The model is based on the hypotheses of inviscid fluid and irrotational flow; linearized boundary conditions are applied at the free surface and at the object boundaries. The equations are solved using the Finite Element Method, allowing detailed description of complicated shapes of the object and bottom boundary. The resulting model is computationally efficient and economic. Validation is carried out using the results of a small scale experiments on a Catamaran Floating Breakwater. Despite of the simplifications of the model equations, the numerical results satisfactorily agree with the experimental ones. The model appears suitable to be used for the preliminary design of Floating Breakwater and also to optimize the configuration of FB.

Introduction

In the last decades, there has been a worldwide trend to use floating breakwaters as an environmental friendly substitute for costly fixed breakwaters in small harbors [1]. As a result, several types of FBs have been proposed by scholars for specific conditions based on experimental and/or numerical studies. In most of these researches analytical description have been proposed to relate the effective factors on the FBs performance. A number of of scientist have classified floating breakwaters into different categories with similar characteristics from material and shape to design limits and wave attenuation functions [2]. Some of them compared different types of FBs and mentioned their advantages and disadvantages [3]. Aside from advantages of floating breakwaters; they have some restrictions which reduce their performance. Generally, FBs are almost used to attenuate short waves in shallow waters with period and wave height up to 4 sec and 1.5 meter respectively [4] [5]. Figure 1 shows an example of floating breakwater installment in Italy to attenuate wind waves. The efficiency of FBs can be shown by transmission coefficient (K_t), which is the portion of transmitted to incident wave heights. Although the most important factor regarding to the performance of FBs is transmission coefficient, reflection (K_r=reflected to incident wave heights) and energy loss (K_e) coefficients are another important parameters related to the hydrodynamic performance of floating breakwaters. However, the majority of researches were done to evaluate just