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Wave Attenuation Performance of Floating Breakwater Needs to be Evaluated by Using Irregular Waves

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Floating breakwaters have been used to protect shorelines, marinas, very large floating structures, dockyards, fish farms, harbours and ports from harsh wave environments. A floating breakwater outperforms its bottom-founded counterpart with respect to its environmental friendliness, cost-effectiveness in relatively deep waters or soft seabed conditions, flexibility for expansion and downsizing and its mobility to be towed away. The effectiveness of a floating breakwater design is assessed by its wave attenuation performance that is measured by the wave transmission coefficient (i.e., the ratio of the transmitted wave height to the incident wave height or the ratio of the transmitted wave energy to the incident wave energy). In some current design guidelines for floating breakwaters, the transmission coefficient is estimated based on the assumption that the realistic ocean waves may be represented by regular waves that are characterized by the significant wave period and wave height of the wave spectrum. There is no doubt that the use of regular waves is simple for practicing engineers designing floating breakwaters. However, the validity and accuracy of using regular waves in the evaluation of wave attenuation performance of floating breakwaters have not been thoroughly discussed in the open literature. This study examines the wave transmission coefficients of floating breakwaters by performing hydrodynamic analysis of some large floating breakwaters in ocean waves modelled as regular waves as well as irregular waves described by a wave spectrum such as the Bretschneider spectrum. The formulation of the governing fluid motion and boundary conditions are based on classical linear hydrodynamic theory. The floating breakwater is assumed to take the shape of a long rectangular box modelled by the Mindlin thick plate theory. The finite element – boundary element method was employed to solve the fluid-structure interaction problem. By considering heave-only floating box-type breakwaters of 200m and 500m in length, it is found that the transmission coefficients obtained by using the regular wave model may be smaller (or larger) than that obtained by using the irregular wave model by up to 55% (or 40%). These significant differences in the transmission coefficient estimated by using regular and irregular waves indicate that simplifying assumption of realistic ocean waves as regular waves leads to significant over/underprediction of wave attenuation performance of floating breakwaters. Thus, when designing floating breakwaters, the ocean waves have to be treated as irregular waves modelled by a wave spectrum that best describes the wave condition at the site. This conclusion is expected to motivate a revision of design guidelines for floating breakwaters for better prediction of wave attenuation performance.

Also, it is expected to affect how one carries out experiments on floating breakwaters in a wave basin to measure the wave transmission coefficients.