Wave Absorption Study of Artificial Beach with CFD

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ABSTRACT

We adopted Computational Fluid Dynamics (CFD) to study the wave reflection off an artificial beach. In an offshore basin with finite dimension, wave generated can be reflected by the basin walls. Wave absorption device is needed to minimize wave reflection to simulate the realistic wave impact on offshore structures in the ocean. We had built a computational model with both wave generator and wave absorbing absorption device is needed to minimize, if not eliminate, wave reflection. In general, passive wave absorption has been researched intensively, although passive wave absorption with artificial absorbing beach which is commonly used in many deep-water offshore basins worldwide such as basins in Shanghai Jiaotong University (Lu, Yang and Li, 2008) and Maritime Research Institute Netherlands (Buchner and de Wilde, 2008). Ouellet and Datta (1986) summarized the performance of different beach designs, including variations in beach profile, surface roughness and porosity. Among different designs of absorbing beach, parabolic profile was reported to be the most effective in wave absorption. They concluded that a parabolic beach with a slope ratio between 1/10 and 1/5 provided best performance in wave absorption. Surface roughness and porous materials such as sand, gravel and wire mesh structures could further dissipate wave energy but the improvement was small relative to the change in beach profile. In general, low reflection coefficient (smaller than 10%) is not achievable for beach shorter than one half of a wavelength (Ouellet and Datta, 1986). Although a longer beach can absorb wave energy more effectively, it requires larger space and may extend into the testing region in the basin, thereby reducing the effective measurement area of the basin. We need to seek the balance between beach performance and space requirement. Tiedeman, Allsop, Russo and Brown (2012) designed a demountable wave absorber that can be folded or removed within an hour to maximize the space usage for towing tests when the absorber is not needed. Both vertical screen and parabolic slope could meet the requirement of reflection coefficient (in terms of energy) lower than 10%, but the parabolic slope was preferable as the vertical screen was too heavy to be removed in a short duration.

Although passive wave absorption has been researched intensively, there is a lack of published data on parametric study of absorbing beach in offshore basins. In this paper, we attempted to develop a computational model to quantify the wave reflection off a parabolic beach under different wave parameters, and thereby deduce the optimum shape/geometry of the beach. The computational model is outlined in next section, followed by verification of wave generation