Numerical study on wave field around an offshore pile-net enclosure structure

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The pile-net enclosures are progressively employed in offshore engineering. Nonetheless, modeling their interactions with waves is a considerable problem. This work introduces a numerical model that integrates a porous media model with a direct-forcing immersed boundary method to simulate the interaction between a pile-net enclosure structure and waves. The damping effect of the netting was modeled using porous media, whereas the pile was modeled by the direct-forcing immersed boundary method. The numerical model was validated against experimental data obtained from the physical model. Then the influence of wave period, net solidity, pile spacing, and incidence wave angles on the hydrodynamics of the pile-net enclosure construction are examined, including wave field and pile group coefficients. The results indicate that the pile-net enclosure construction exhibits a dampening effect on wave propagation, especially for high-frequency waves. An augmentation in net solidity substantially influences the wave forces exerted on downstream piles. Furthermore, varying angles of wave incidence result in differing internal wave heights within the structure, which facilitates the arrangement of the structure according to the predominant wave direction to mitigate internal wave heights.