Wave attenuation and focusing by a parabolic arc pontoon breakwater

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**Introduction**

In the multifunctional system consisting of a pontoon type floating breakwater and point absorber wave energy converters (WECs), the breakwater plays an essential role in attenuating waves on the lee side and amplifying waves for better energy harvesting on the stoss side. These two aspects, however, are rarely evaluated together and a simple method to enhance both wave attenuation and amplification performance is absent. Aiming at the two problems, a novel parabolic arc pontoon breakwater is proposed.

Based on the linear wave theory, the breakwater is simulated in frequency domain. As this is a 3D problem, normalized surface elevation (by the unit incident wave amplitude) and its average value in two selected areas closely in front of and behind the breakwater are used instead of the 2D reflection and transmission coefficients as the criterion to evaluate the focusing and attenuation performance. A comparative study in deep water on two 20m long, 1m wide, and 1m in draft breakwaters, a parabolic one with 10m focal distance and a straight one in a wide range of waves (0.5–4.5 rad/s) is taken. A parametric study on the parabolic breakwater is also taken.

**Results**

Taken the case of $\omega=3.0$ rad/s as an example, surface elevation in the protection zone of the parabolic breakwater appears a roughly stratified pattern. In the central part, wave motion is quite faint compared with that of the straight breakwater. In the deployment zone, the straight breakwater shows a wave field with a periodical strip pattern, revealing little obvious focusing. Whereas the parabolic arc breakwater is able to focus higher waves in some locations.

As the draft of the parabolic breakwater is increased to 3m, we find that averagely up to 62.4% of wave height can be attenuated and relatively large focusing area with an amplification factor (maximum surface elevation/incident wave amplitude) of 2.43 can be obtained for a 1.67 rad/s wave, which is commonly observed in real sea states.

**Conclusion**

A parabolic arc breakwater is better than a straight breakwater in attenuating waves on the lee side and focusing waves on the stoss side. With fine tune according to real sea states, the parabolic breakwater has potential to well protect infrastructures behind it and simultaneously provide a good operation environment for point absorber wave energy converters.