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An Analysis of the Performances of Various Buoys as the Floats of Wave Energy Converters

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Abstract : The power generated by eight point absorber type wave energy converters each having a different buoy are calculated in order to investigate the performances of buoys in this study. The calculations are carried out by modeling three different sea states observed in two different locations in the Black Sea. The floats analyzed in this study have two basic geometries and four different draft/radius (d/r) ratios. The buoys possess the shapes of a semi-ellipsoid and a semi-elliptic paraboloid. Additionally, the draft/radius ratios range from 0.25 to 1 by an increment of 0.25. The radiation forces acting on the buoys due to the oscillatory motions of these bodies are evaluated by employing a 3D panel method along with a distribution of 3D pulsating sources in frequency domain. On the other hand, the wave forces acting on the buoys which are taken as the sum of Froude-Krylov forces and diffraction forces are calculated by using linear wave theory. Furthermore, the wave energy converters are assumed to be taut-moored to the seabed so that the secondary body which houses a power take-off system oscillates with much smaller amplitudes compared to the buoy. As a result, it is assumed that there is not any significant contribution to the power generation from the motions of the housing body and the only contribution to power generation comes from the buoy. The power take-off systems of the wave energy converters are high pressure oil hydraulic systems which are identical in terms of their characteristic parameters. The results show that the power generated by wave energy converters which have semi-ellipsoid floats is higher than that of those which have semi elliptic paraboloid floats in both locations and in all sea states. It is also determined that the power generated by the wave energy converters follow an unsteady pattern such that they do not decrease or increase with changing draft/radius ratios of the floats. Although the highest power level is obtained with a semi-ellipsoid float which has a draft/radius ratio equal to 1, other floats of which the draft/radius ratio is 0.25 delivered higher power that the floats with a draft/radius ratio equal to 1 in some cases.

Keywords : Black Sea, buoys, hydraulic power take-off system, wave energy converters
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