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Numerical analysis of a hybrid substructure for offshore wind turbines

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Abstract. For the reliable design of substructure supporting offshore wind turbines it is very important to reduce the effects of wave forces. Since the substructure is strongly influenced by the effects of wave forces as the size of substructure increases. In the present study, the hybrid substructure with multi-cylinder is newly suggested to reduce the effects of wave forces. Using diffraction theory the scattering waves in a fluid region are expressed by an Eigenfunction expansion method with three dimensional potential theory to calculate the wave force acting on the hybrid substructure. The wave force and wave run-up acting on the hybrid substructure is presented to examine the water wave interaction according to the variation of cylindrical size and the distance among cylinders. It is found that the suggested hybrid substructure with multi-cylinder is very useful to reduce the effects of wave forces acting on the substructure for offshore wind turbines.

Keywords: hybrid substructure; offshore wind turbine; Eigenfunction expansion method; wave force; wave run-up

1. Introduction

To tackle climate change and to find alternative and reliable energy sources, the offshore wind energy has gained attention from many countries. It is recognized that the offshore wind energy one of the most promising and fastest growing alternative energy sources in the world. Therefore, many offshore wind farms are in the planning phase. South Korea will also invest $9 billion in building a 2.5GW offshore wind farm in the southwest sea of Korea by 2019 (South Korea offshore wind project plan 2011). However, the size of a substructure supporting offshore wind turbines is gradually increased because the size of a tower and a rotor-nacelle becomes larger with increment of wind turbine's gross generation. In other words, the substructure for offshore wind turbines is strongly influenced by the effect of wave forces as the size of substructure increases.

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