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Deeply embedded ring anchor for floating offshore wind turbines and corresponding mooring systems

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ABSTRACT

The trend of envisioned sites for offshore wind energy is expected to shift from fixed towers in shallow water to floating platforms in deeper water due to factors such as wind resource consistency and local seafloor bathymetry. A novel deeply embedded ring anchor (DERA) is a cost-effective alternative to secure floating offshore wind turbines (FOWTs) to the seabed. Previous preliminary studies indicate that the DERA provides significant capital cost savings due to its installability in any soil, multiline potential, compact size, and applicability to various mooring systems. While they provide valuable insights into anchor performance, these studies sought optimal DERA designs for specific soil and loading conditions. However, the industry requires a cost-effective anchor suitable to a range mooring types, water depths, geological locations, and environmental conditions. This spurs the current study to optimize the anchor design for a number of complex conditions anticipated at envisioned wind farm sites. Firstly, this paper compares three mooring systems for different conditions of turbine spacing and water depth, and for single-line versus shared-anchor (multiple lines attached to a single anchor) systems. Secondly, the study carries out a comparative study on how soil heterogeneity and the depth of the sediment layer overlying the rock affect the anchor design to achieve load capacity demand, which is computed by using a physics-based engineering tool. Lastly, a scenario study is also conducted to evaluate the appropriate

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installation methods for the DERA under various site conditions. The findings from the study provide a platform to select a mooring system considering geometric constraints and estimate the required physical features of the DERA for achieving the needed load capacity. The results show that the DERA is a feasible and cost-effective alternative for heterogeneous soils, all water depth, and thin sediment layers.

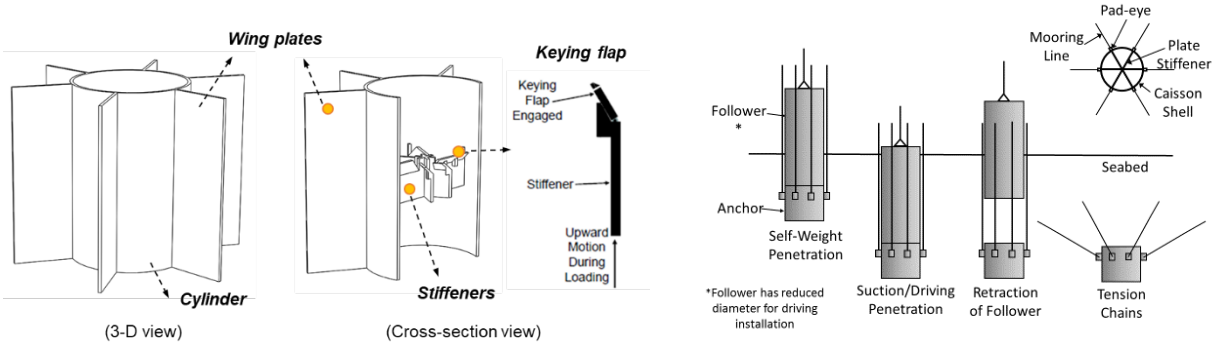

Fig. 1 Six-wings DERA and strategies for enhancing load capacity (left); the installation procedure of the DERA (right) (Lee et al. 2021; Lee and Aubeny 2020)

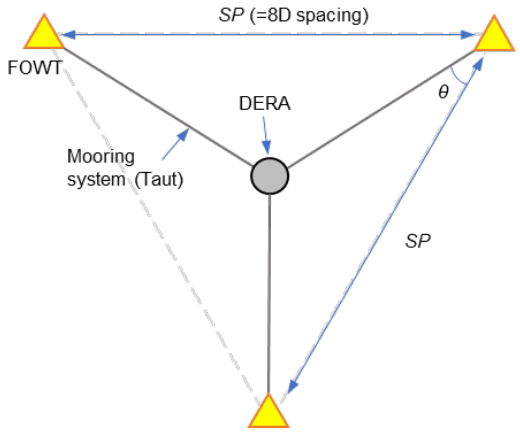

Fig. 2 Plan view of taut mooring system for the 3-lines shared anchor concept

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