

Assessment of Pier Foundations for Onshore Wind Turbines in Non-cohesive Soil

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Abstract : In non-cohesive soil, onshore wind turbines are often found on shallow foundations with a circular or octagonal shape. For the current generation of wind turbines, shallow foundations with very large breadths are required. The foundation support costs thus represent a considerable portion of the total construction costs. Therefore, an economic optimization of the type of foundation is highly desirable. A conceivable alternative foundation type would be a pier foundation, which combines the load transfer over the foundation area at the pier base with the transfer of horizontal loads over the shaft surface of the pier. The present study aims to evaluate the load-bearing behavior of a pier foundation based on comprehensive parametric studies. Thereby, three-dimensional numerical simulations of both pier and shallow foundations are developed. The evaluation of the results focuses on the rotational stiffnesses of the proposed soil-foundation systems. In the design, the initial rotational stiffness is decisive for consideration of natural frequencies, whereas the rotational secant stiffness for a maximum load is decisive for serviceability considerations. A systematic analysis of the results at different load levels shows that the application of the typical pier foundation is presumably limited to relatively small onshore wind turbines.

Keywords : onshore wind foundation, pier foundation, rotational stiffness of soil-foundation system, shallow foundation

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