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PhD Thesis: Seabed Wind Farm Interaction. Aalborg University : Department of Civil Engineering, Aalborg, Unpublished

Abstract: Due to global warming the interest in renewable energy sources is increasing; among these is wind energy. In recent years, there has been an increased interest in offshore wind turbines compared to the onshore ones. This preference is among other factors due to less turbulent wind and higher wind intensity and thus a higher power output. Further the visual impact is not an issue for offshore wind.

The foundation of offshore wind turbines is complex and makes up to about one third of the overall investment. An often used foundation concept for offshore wind turbines is monopiles. A monopile is a single large-diameter pipe pile. The p-y curve method, which traditionally is employed when designing monopiles, is developed and validated for piles with diameters up to 2 m. However monopile foundations for offshore wind turbines have diameters around 4-6 m. A validation of the p-y curve method is therefore needed for large-diameter piles.

When installing a monopile in a seabed containing sand/silt a scour hole will form around the pile due to erosion. The protection against such scour is usually carried out by covering the seabed around the base of the foundation with rocks at a cost in the order of 1 mill DKK per foundation. Alternatively, a monopile foundation may be intentionally unprotected and designed to allow full development of the scour hole. In this design, a scour hole will both amplify the hydrodynamic loads and reduce the soil support. Therefore the embedded length of the monopile needs to be increased when designing the foundation without scour protection. However as scour protection is highly expensive, the most economic solution might be to design the monopile without scour protection. The depth of the scour hole will change over time dependent of the wave and current climate, as the scour depth will increase when currents are dominating, and backfilling of the scour hole will take place when waves are dominating. Currently there is no knowledge concerning the strength of the backfilled soil material. The objective is therefore to determine methods that can accurately predict the stiffness of the soil-pile interaction for a given wave and current climate.

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Employed: 01.08.2009 -30.07.2012