River Publishers

River Publishers Series in open

Improved Design Basis for Laterally Loaded Large Diameter Pile: Experimental Based Approach

Author: Caspar Thrane Leth

e-ISBN: 9788793102590
Available From: December 2013
Price: € 0.00

Description:

The development of offshore wind turbines has been in rapid growth since the construction of the first offshore wind farm in 1991 at Vindeby, Denmark. Developing from 11 turbines at a water depth of 2-6 m each with a capacity of 450 kW to the latest farms with up to 175 turbines each with a capacity of 3.6 MW and placed at water depths beyond 25 m. Different foundation solutions have over the years been applied for offshore turbines, but monopiles are currently the most applied foundation type and are typically with a pile diameter of 4-6 m and applied up to a water depth of 25 m. The expected development of offshore wind farms is towards larger farms, larger turbines and larger water depths. Monopiles have been applied widely and it is of interest to investigate the possibilities to further optimize the design and in particular the modelling of the soil-structure interaction. The target is to improve the use of monopiles as preferred support structure beyond the current limit at a water depth of 30 m.

Design of foundations for wind turbines has a large focus on the stiffness of the combined structure, turbine-tower-foundation, which has an influence on the environmental loads on the structure and the productivity of the turbine. Current design practice for monopiles are based on p-y curves developed for slender piles with a diameter of 0.6 m. The focus on the structure stiffness has entailed a significant research on the soil-structure interaction for large diameter monopiles. Comparison of the different approaches shows some discrepancy and conflicting statements, but the main findings can be summarized as:

- The standard p-y curves are inadequate to describe the behaviour of lateral loaded large diameter rigid piles.
- [illegible] with standard p-y curves. [illegible] interaction problem depending on the pile stiffness and the non-linear soil behaviour. The stress dependent and non-linear soil behaviour gives ground for application of physical models to understand the general behaviour of the pile, and the main objective for the present research is:

The present research is based on use of the centrifuge facilities at Danish Technical University (DTU), the sole geotechnical centrifuge in Scandinavia. It became evident in the initial phase of the research that the available centrifuge facilities at DTU was outdated and the focus was changed to establish up-to-date centrifuge facilities for medium to large diameter piles, and to initiate the research on the behaviour of large diameter piles in sand under static and cyclic loading. Key elements in the establishment of up-to-date facilities has been: Equipment for controlling centrifuge tests, data acquisition, preparation of test samples and equipment for and making of lateral load tests.

The present research has been narrowed to investigate the static and cyclic behaviour of stiff piles with a diameter of 1-3 m in dry sand by use of centrifuge modelling and to compare the findings with the standard p-y curves. It has been chosen to apply piles with an embedment length of 6 to 10 times the diameter of the applied piles.

The general static behaviour of monopiles in dry sand has based on centrifuge tests been investigated. The main focus has in the static tests been on initial stiffness and ultimate capacity, and for the cyclic tests accumulation of deformations and change in stiffness.

The main conclusion is that the static behaviour is poorly described by use of standard p-y curves, where the tests show a softer initial response and a higher ultimate capacity. The initial stiffness of the soil-structure interaction measured in the centrifuge tests, equivalent to initial stiffness of p-y curves, shows a dependency of depth and diameter. Control issues in relation to cyclic tests have resulted in tests with an apparent too high cyclic loading. The cyclic tests with a high utilization of the applied load vs. the static capacity shows a tendency of improvement in stiffness and ultimate capacity following the cyclic load series along with an increasing displacement with increasing number of cycles.

Keywords: Offshore Wind Turbines, Monopiles, Large Diameter, Physical Modelling, P-Y Curves, Stiff Piles, Cyclic Behaviour, Sand
Offshore Wind Turbines, Monopiles, Large Diameter, Physical Modelling, P-Y Curves, Stiff Piles, Cyclic Behaviour, Sand

Denmark Head Office
Alsbjergvej 10
9260 Gistrup
Denmark
www.riverpublishers.com
Email: info@riverpublishers.com

USA Office
Indianapolis, IN
USA
Tel.: +1-3176899634
Email: rajeev.prasad@riverpublishers.com

UK Office
River Publishers
Email: philippa.jefferies@riverpublishers.com