

# DYNAMICS OF MONOPOLES FOR OFFSHORE WIND TURBINES: INSTALLATION, ACOUSTICS AND MONITORING

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## ABSTRACT

This presentation is focused on the monopole that is the most widely used support structure of the offshore wind turbines. The monopole is “just” a cylindrical shell and it may seem surprising to devote a plenary lecture to such a simple structural element. However, nowadays, the monopoles are about 80 meters long and 8 meters in diameter and their size is likely to grow further. Nearly two thirds of the length of the monopole should be driven into the soil by huge hammers and after the installation the monopoles and the surrounding soil should withstand tremendous loads for many years. There are quite a few challenging aspects of the dynamics, vibroacoustics and monitoring of the monopole that are associated with its installation and operation and this presentation will focus on those.

Four specific topics will be addressed in the presentation. I will begin with a description of a recent experimental campaign, in which a new, so-called GDP pile driving technology, was tested and assessed. The GDP stands for Gentle Pile Driving. It uses a novel shaker that generates both vertical and torsional vibrations at distinctly different frequencies. The pile dynamics in the course of driving as well as penetration speed will be addressed along with the post-installation bearing capacity of the soil.

The next subject matter will be the underwater noise generated during installation of monopoles by means of impact and vibratory hammers. The role of the monopole-water-soil interaction in the noise generation and propagation will be focused upon.

The third focal point will be the ice-induced vibrations of wind turbines that can occur due to interaction of level ice with support structures of the offshore wind turbines. This is a very interesting synchronization phenomenon, which is potentially important for offshore wind turbines to be installed in the Baltic Sea and in ice-infested waters in general. Finally, a novel non-contact method for measuring the stress waves in the monopiles during the impact pile driving will be discussed.

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