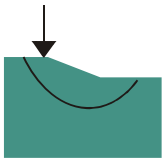
Foundation Solutions for Offshore Wind Energy Converters - Site Conditions, Planning & Design -

University of Duisburg - Essen
Campus Essen
Institute of Soil Mechanics and Foundation Engineering



by PD Dr.-Ing. Kerstin Lesny

Lecture Abstract

The utilization of offshore wind energy in Europe is well in progress, especially in countries such as; Denmark, Sweden, Great Britain, The Netherlands and Ireland. So far a total capacity of about 1000 MW has been installed. Eight wind farms with about 1300 MW are also under construction while many more are still in planning. The German government also plans to increase the percentage of renewable energies from today's 3.5 % to 20 % by 2020. This increase will only be possible by a vast expansion of offshore wind energy. As a result of a guaranteed market, many wind farms in the German North Sea and the Baltic Sea are currently in planning with several hundred wind turbines of up to 5 MW rated power each.

While most of the existing wind farms in Europe are located relatively close to the shore in water depths of up to 20 m, the site conditions in German waters are much more demanding. With water depths of 25-30 m and 30-50 km offshore, extreme wave heights of up to 22 m in the North Sea, and ice loading in the Baltic Sea the large number of windmills per farm will require economically and technically optimal solutions for foundation design, construction, transport and installation.

In the first part of this lecture the current status of offshore wind energy in Europe with a special emphasis on recent developments in Germany will be illustrated. Typical site conditions at various wind farm locations as well as the requirements due to the construction process and the resulting consequences for foundation design and installation will be discussed.

In the second part of the lecture different foundation concepts will be introduced. Most of them have been adopted from conventional offshore engineering such as gravity foundations or monopiles which are especially suitable for moderate water depths. However, with the demand to go further offshore jacket structures and even floating structures may become more suitable. Different aspects of foundation design will be discussed on the basis of a monopile foundation, the most commonly used foundation structure for offshore wind turbines. The design for extreme storm events reviewing the application of state-of-the-art offshore design guidelines as well as the foundation behaviour under cyclic loading will be addressed.

Short Biography

Kerstin graduated 1996 as Dipl.-Ing. at the University of Essen, Germany. After that she worked as a research assistant at the Institute of Soil Mechanics and Foundation Engineering, Dept. of Civil Engineering, University of Essen where she received a Dr.-Ing. in 2001. Since 2002 Kerstin works as a senior lecturer at the same institute where she obtained her Venia Legendi for her Habilitation in early 2008 (this is a German prerequisite to become a full professor at universities). Kerstin's main research interests are in the behaviour of shallow foundations under complex loading including probabilistic safety analyses and in foundation design for offshore wind energy turbines. The latter research has been conducted within three research projects funded by the German Federal Ministries of Environment and Technology from 2000 to date. This research includes the analysis of different foundation concepts as well as the design for extreme load events and the analysis of foundation behaviour due to the effects of cyclic loading. Kerstin teaches different undergraduate and graduate classes in soil mechanics and foundation engineering and is head of the soil mechanics laboratory. She is a member of the German Societies of Geotechnics and Harbour Structures as well as the International Society of Soil Mechanics and Geotechnical Engineering. She is also a member of TC 23 (Limit State Design in Geotechnical Engineering) of the ISSMGE and the Foundations of Bridges and Other Structures Committee of the TRB.