**ABOUT THE COURSE**

The costs of offshore wind are currently, significantly higher than onshore wind. A significant contributor to this higher cost is the cost of the foundations for the turbines. Hence a rational and optimized design of foundation for wind turbines is essential to reduce the overall cost.

This course gives a detailed knowledge about the design and analysis of mono pile, Suction piles, and jacket structure foundations. This course also includes the soil pile interaction and the dynamic responses.

The course will include both ultimate and fatigue limit state check for the design of these types of foundations. The uncertainties of various design variables will also be discussed in these lectures. Lastly a reliability based design of suction pile will be covered.

**Who Should Attend**

Engineers and researchers involved in the design of offshore wind farm foundation, Contracts engineers, Wind turbine Installation companies, Team leaders, Conversion Engineers, Project engineers and managers, offshore controls engineers, Safety inspectors will benefit from attending this course. The course is innovative in both content & structure with a careful balance of theory & practice.

**COST**

The registration fee of the workshop will be £750 + VAT (UK only) which includes course notes and lunches. You should make your own arrangements for accommodation.

**PAYMENT**

Payments can be made by cheque (made payable to ASRANet Ltd.), cash or bank transfer. Please enquire for details.

**CONTACT**

ASRANet Ltd.
St Georges Building
5 St Vincent Place
Glasgow, G1 2DH
Scotland, UK
**W** www.ASRANet.co.uk/courses
**E** info@asranet.co.uk
**T** +44 (0)141 248 3040
**F** +44 (0)141 275 4800

# Foundation Design of Offshore Wind Turbine Structures

ASRANet

PROGRAMME

| Day 1 | | Day 2 | |
|---|---|---|---|
| 09.00 - 10.30 | Lecture 1: Overview of the whole Wind Turbine structure | 09.00 - 10.30 | Lecture 5: Soil Structure Interaction (Cyclic and dynamic) |
| 10.30 - 11.00 | *Break* | 10.30 - 11.00 | *Break* |
| 11.00 - 12.30 | Lecture 2: Loads on the offshore wind turbine structure | 11.00 - 12.30 | Lecture 6: Simplified hand calculation of case studies |
| 12.30 -13.30 | *Lunch* | 12.30 - 13.30 | *Lunch* |
| 13.30 – 15.00 | Lecture 3: Consideration for foundation design and the calculations necessary | 13:30-15:00 | Lecture 7: Introduction to Bladed for offshore wind turbine and foundation modelling |
| 15.00 - 15.30 | *Break* | 15.00 - 15.30 | *Break* |
| 15.30 - 17.00 | Lecture 4: Geotechnical Site Investigation and Soil behaviour under cyclic loading | 15:30-17:00 | Lecture 8: Demonstration of offshore foundation load calculations in Bladed (ULS and FLS analysis) |

Content of the lectures:

### Lecture 1: Overview of the whole Wind Turbine structure

General overview of the overall wind turbine structure/wind farm keeping in mind the concepts necessary for foundation design: [Wind Turbine Structure - Dynamic sensitive nature, brief review of the turbine types, general considerations on the selection of site (wind speed, water depth, wave and current, ground type), cut-in and cut-out speed, natural frequency of wind turbine system]. Types of foundations either in use or proposed. Dynamics of these structures on different types of foundations.

### Lecture 2: Loads on the offshore wind turbine structure

This lecture will focus on the main loads on the structure from wind, wave, 1P and 3P with the aim to obtain the mudline bending moment for foundation design. Also this lecture will describe a simple frequency domain methodology to obtain the critical loads (overturning mudline moment, lateral and vertical loads) in the foundation due to the 4 types of loads. An EXCEL example will be taken to show the methodology.

### Lecture 3: Consideration for foundation design and the calculations necessary

The design consideration includes the following Limit States: ULS (Ultimate Limit State), SLS (Serviceability Limit State) and FLS (Fatigue Limit State). Issues related to installation will also be discussed. This section will also discuss the calculations that needs to be carried out the designers: (a) ultimate capacity of the foundation; (b) natural frequency of the whole system; (c) deflection and rotation of the foundation; (d) long term tilting of the foundation and change in natural frequency.

### Lecture 4: Geotechnical Site Investigation and Soil behaviour under cyclic loading

This lecture will discuss the site investigation necessary and the soil testing required for obtaining the design parameters for carrying out the design. The lecture will also discuss the advanced soil testing apparatus that may be used to obtain the parameters.

### Lecture 5: Soil Structure Interaction (Cyclic and dynamic)

Explain the various Soil-Structure-Interaction and simplified methods that can be to carry out soil-structure analysis will be described. The analysis are: (a) Natural frequency of wind turbine structure considering the foundation flexibility based on a mathematical model; (b) Minimum requirement of foundation stiffness (Translational, Rotational and Cross-Coupling) from SLS; (c) Prediction of rotational and tilting of the wind turbine; (c) Long term rotation prediction.

### Lecture 6: Simplified hand calculation of case studies

This lecture will take an example of a wind turbine along with wind, wave and geotechnical data to carry out step by step calculations.

### Lecture 7: Introduction to Bladed offshore wind turbine and foundation modelling

This lecture will provide a general overview of the aero-servo-hydro-elastic software Bladed and the different engineering models behind the code in order to represent the coupled dynamics of offshore wind systems. Special focus will be given to the offshore aspects of it, covering both the metocean environmental conditions and offshore foundation modelling. An overview of the different links with other
engineering codes for offshore design will also be provided such as Sesam, Ansys Asas and Sacs.

### Lecture 8: Demonstration of offshore foundation load calculations in Bladed (ULS and FLS analysis)

A practical demonstration will be shown for the typical load calculations workflow in Bladed in order to compute both ultimate and fatigue loads for offshore foundations, from turbine/foundation/soil inputs up to postprocessing the loads results.