**REGISTRATION FORM**

Name _____

Address _____

_____

_____

Tel. _____

Email _____

☐ I wish to register for the course at a cost of £750 +VAT (UK only) including course material and workshop lunches.

☐ I enclose a cheque for £750+VAT

☐ Please invoice me at the above address

☐ Please send me information on local hotels

**Disclaimer**

All materials and information supplied during and associated with this course are intended purely for instructional purposes. Whilst every effort is taken to ensure that materials provided are accurate and suitable for training purposes, ASRANet Ltd accepts no responsibility for their accuracy or utility.

**I accept the above.**

Signature _____

Date _____

The completed form should be sent to:
*ASRANet Ltd*.
5 St Vincent Place, Glasgow, G1 2DH

**Cost**

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

**Payment**

ASRANet Ltd. accepts payments by cheque, cash and bank transfer. Please contact for further details.

**Venue**

Croydon Park Hotel
7 Altyre Road
Croydon, London
CR9 5AA

**Note**

Please do not make your travel arrangements until you receive an Invoice from us.

**Contact**

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5 St Vincent Place
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# Foundation Design of Offshore Wind Turbine Structures

## 27-28 June 2017

**ISO 9001:2008 certified company**

**(A maritime company for courses, conferences and research)**

## London, UK

**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.

**PROGRAMME**

**Tuesday 27th June 2017**

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|---|---|
| 09.00 - 10.30 | Lecture 1: Overview of the whole Wind Turbine structure<br>*Prof. Subhamoy Bhattacharya* |
| 10.30 - 11.00 | *Break* |
| 11.00 - 12.30 | Lecture 2: Loads on the offshore wind turbine structure<br>*Prof. Subhamoy Bhattacharya* |
| 12.30 -13.30 | *Lunch* |
| 13.30 – 15.00 | Lecture 3: Consideration for foundation design and the calculations necessary<br>*Dr. Domenico Lombardi* |
| 15.00 - 15.30 | *Break* |
| 15.30 - 17.00 | Lecture 4: Geotechnical Site Investigation and Soil behaviour under cyclic loading<br>*Dr. Domenico Lombardi* |

**Wednesday 28th June 2017**

| | |
|---|---|
| 09.00 - 10.30 | Lecture 5: Soil Structure Interaction (Cyclic and dynamic)<br>*Prof. Subhamoy Bhattacharya* |
| 10.30 - 11.00 | *Break* |
| 11.00 - 12.30 | Lecture 6: Simplified hand calculation of case studies<br>*Prof. Subhamoy Bhattacharya* |
| 12.30 - 13.30 | *Lunch* |
| 13.30 - 1630 | Lecture 7 and 8: ULS and FLS analysis. Practical Example with FAST<br>*Dr José Azcona Armendáriz (TBC)* |
| 16.30 | *End of Course* |

## CV'S OF LECTURERS:

### Professor Subhamoy Bhattacharya:

Professor Subhamoy Bhattacharya currently holds the Chair in Geomechanics at the University of Surrey where he leads the Geomechanics Research Group. He is also the Programme Director for the MSc course in "Advanced Ground Engineering/Advanced Geotechnical Engineering" and the Director of Undergraduate Studies in Civil Engineering. Previously, he held the post of Senior Lecturer at the University of Bristol, Departmental Lecturer at the University of Oxford and Academic fellowship at Tokyo Institute of Technology as well as industrial positions with Fugro Limited (UK) and Consulting Engineering Services (India) Ltd - now Jacobs. He obtained his PhD from the University of Cambridge, investigating failure mechanisms of pile-supported structures in liquefiable soils. He proposed a new theory on pile failure which received the 2005 T.K.Hseih award for the best paper in civil engineering dynamics from the Institution of Civil Engineers. His further work on piles includes design principles for the foundation design of new generation Floating Production Storage and Offloading platforms, built from his experience designing piles for more conventional offshore structures. His work on p-y curves for clay appears in the latest API/ANSI/ISO code of practice. His current research interest are foundations for offshore wind turbines, seismic behaviour of piles.

### Dr Domenico Lombardi:

Dr. Domenico Lombardi is currently a lecturer in Geotechnical engineering at The University of Manchester. After graduating with a first class honours (with distinction) in Civil Engineering from the University of Sannio (Italy), Domenico moved to the University of Bristol to finish his postgraduate studies, first with an MSc in Offshore Engineering and then with a PhD in Earthquake Engineering. His doctoral studies focused on the effects of soil liquefaction on the dynamic behaviour of pile-supported structures. Before joining The University of Manchester, he was appointed as a Foreign Researcher in the Department of Civil and Environmental Engineering at Yamaguchi University (Japan), where he investigated the cyclic behaviour of soils and conducted a series of field surveys in the area hit by the 2011 Tōhoku earthquake and subsequent tsunami. Domenico is author of over 20 publications focusing on different civil engineering problems, including long-term performance of offshore wind turbines and design of structures in liquefiable soils. His main research interests are in geotechnics and structural dynamics, related to problems of offshore engineering and behaviour of structures under repetitive loading

### Dr. José Azcona Armendáriz

Dr. José Azcona Armendáriz is responsible for the Offshore Wind Energy area at CENER (the Spanish Renewable Energy National Centre). He graduated in Industrial Engineering at the Universidad Pública de Navarra and obtained his PhD in Naval Engineering at the Universidad Politécnica de Madrid. He has experience in rotor design and loads calculation for wind turbines. He has taken part at the IEA annexes 23 and 30 on validation of integrated simulation codes and he has lead several tasks in European research projects. He has developed the OPASS code for the dynamic analysis of mooring lines that he has validated experimentally and coupled with tools for floating wind turbines. His main research topics are related with integrated simulation tools, mooring line dynamics and scale testing of floating wind turbines. He has published his work in many conferences and also in refereed journals as "Wind Energy" or "Ocean Engineering".

## 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 and 8: ULS and FLS analysis. Practical Example with FAST

This session will show the methodology for the calculation of the certification loads for an offshore wind turbine with monopile substructure using an integrated code. The load cases requested by the guidelines for fatigue and ultimate calculations will be presented. Afterwards, the FAST simulation code will be briefly described, presenting the theoretical background of the physical model and the main input and output files and parameters. The available codes for the generation of turbulent and steady wind files will be also presented.

FAST will be used for a practical exercise with an offshore wind turbine supported by a monopile. A reduced number of load cases will be simulated and the ultimate loads and equivalent fatigue loads will be calculated.

The objective of this exercise is to provide a general overview of the load calculation and the available simulation tools for fixed wind turbines that can serve as starting point for the integrated simulation of wind turbines.