

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, and jacket structure foundations. This course also includes the soil pile interaction and the dynamic responses.

This course 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

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 £595.

PAYMENT

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

COURSE MATERIAL:

The lecture notes will be sent in advance

CONTACT

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ON-LINE COURSE (via ZOOM) on Foundation Design of Offshore Wind Turbine Structures

9th - 10th
March
2022



PROGRAMME (All timings are in GMT)

Wednesday 9th March 2022

07.00 - 08.30 Lecture 1: Overview of the whole Wind Turbine structure
Prof. Subhamoy Bhattacharya

08.30 - 09.00 *Break*

09.00 - 10.30 Lecture 2: Loads on the offshore wind turbine structure
Prof. Subhamoy Bhattacharya

10.30 -11.30 *Break*

11.30 – 13.00 Lecture 3: Consideration for foundation design and the calculations necessary
Prof. Subhamoy Bhattacharya

13.00 - 13.30 *Break*

13.30 - 15.00 Lecture 4: Geotechnical Site Investigation and Soil behaviour under cyclic loading
Prof. Subhamoy Bhattacharya

Thursday 10th March 2022

07.00 - 08.30 Lecture 5: Soil Structure Interaction (Cyclic and dynamic)
Prof. Subhamoy Bhattacharya

08.30 - 09.00 *Break*

09.00 - 10.30 Lecture 6: Simplified hand calculation of case studies
Prof. Subhamoy Bhattacharya

10.30 - 11.30 *Break*

11:30-13:00 Lecture 7: Introduction to OpenFAST for offshore wind turbine modeling and its pre-processing
Dr Yang Yang

13.00 - 13.30 *Break*

13:30-15:00 Lecture 8: Demonstration of offshore wind turbine foundation modeling and load calculation under different conditions
Dr Yang Yang

CV'S OF LECTURERS:

Prof Subhamoy Bhattacharya, Chair in Geomechanics, University of Surrey



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.Hsieh 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.

Some of his publications are:

Text Books

1. S.Bhattacharya (2019): Design of foundation for offshore Wind Turbines, Wiley. ISBN: 978-1-119-12812-0.
2. S.Bhattacharya, R.Orense and Lombardi (2018). Seismic design of foundations: Concepts and Applications, ICE Publishing; ISBN: 9780727761668
3. S.Bhattacharya, N.Alexander, D.Lombardi and S.Ghosh (2015): Fundamentals of Engineering Mathematics, ICE (Thomas Telford Publication). ISBN: 9780727758415

Dr Yang Yang, Associate professor at the Ningbo University, China.

Dr Yang Yang obtained his PhD degree from University of Shanghai for Science & Technology (USST). His doctoral thesis is on ' Seismic analysis of offshore wind turbines'. He is an outstanding student in his undergraduate class of USST where he did his bachelor's degree in Power Machinery and Engineering. He was a visiting scholar at the Liverpool John Moores University (LJMU), UK where he was responsible for various projects namely (i) Development of a fully coupled tool for a multi-body floating offshore wind turbines (FOWT),(ii) Development of FOWT controller considering the platform motion feedback;(iii) Identification of damage hotspots of the FOWT and (iv) Development of a damage diagnosis approach for the FOWT. He is now an associate professor at the Ningbo University, China.

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.

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 (c) Prediction of rotational and tilting of the wind turbine; (d) 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 OpenFAST for offshore wind turbine modeling and its pre-processing.

This lecture will provide a general overview of an open source tool, OpenFAST, that was developed for aero-hydro-servo-elastic coupled simulations of wind turbines. The basic theories behind the software will be introduced. In addition, the lecture will show how to generate a turbulent wind field using TurbSim and to model a tower mounted on a new foundation using BModes.

Lecture 8: Demonstration of offshore wind turbine foundation modeling and load calculation under different conditions.

This lecture includes a demonstration of modelling a fixed-bottom foundation in OpenFAST through SubDyn. The hydrodynamic modeling in HydroDyn corresponding to the foundation will be introduced. In addition, the lecture will introduce how to define the operating scenarios (running, parked, emergency) through ServoDyn. The loads of a specific member of the substructure will also be explained.

PAST PARTICIPANTS

- Atkins, UK
- Bureau Veritas, UK
- Bladt Industries A/S, Denmark
- DEME Group, Belgium
- DEWI, Belgium
- DNV, UK
- Empire Engineering, UK
- ESBI, Ireland
- Ferrovial, Spain
- Harland-Wolff, UK
- Jan De Nul N.V
- LICenergy UK Limited, UK
- Mott Macdonald, UK
- Parkwind, Netherlands
- RWE International
- Siemens, Germany
- SSE, UK
- Van oord offshore wind, Netherlands
- Volker InfraDesign, Netherlands
- Xodus Group, UK