ISEAWIND

Innovative Structural Engineering Approaches for the design of offshore WIND turbine support structures

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General description

Time frame:

September 2015 – September 2020

Motivation:

There is a need for increasing the body of knowledge regarding the design, planning and response of offshore wind turbine support structures in order to improve the performance and cost-effectiveness of this type of structures.

Aim:

The aim of the project is to study the dynamic effects of the complex loading situation of offshore wind turbine support structures and to develop the methods used for their design.

1. Study of the engineering aspects of offshore wind turbine support structures in Sweden (2015 - 2016)

Objectives:

• Identify the specific engineering challenges (e.g. environmental conditions, load and ground conditions, buildability, etc.) for offshore wind turbine support structures in Sweden (for the Baltic Sea and the large lakes) in order to assure a correct focus for the project

• Define the case to be studied in the project and set its boundaries

Future work:

• Survey the possible solutions for offshore wind turbine support structures in general and specifically in Sweden

• Review and study of the operating wind turbines in Sweden, as well as, possible locations for future projects

2. Study of load transfer from the tower to the ground and stress distribution in the support structure (2016 - 2017)

Objectives:

• Modelling of load transfer from the tower to the ground considering the dynamic behaviour of the whole wind turbine structure

• Determine the levels and points of the stresses in the support structure under cyclic loads and identify the most critical points

Future work:

• Numerical modelling of the support structure based on a holistic approach, i.e. considering the dynamic behaviour of the whole structure

• Modelling of the interactions tower-foundation and foundation-ground

• Identification of the most critical points in the support structure

3. Study of specific details prone to fatigue (2017 - 2018)

Objectives:

• Detailed modelling and analysis of the critical points identified in *Study 2*

• Deeper understanding of the failure mechanisms in the support structure under cyclic loads

Future work:

• Develop finite element analysis models for specific details

• Qualitative investigations of the failure mechanisms involved

• Fatigue assessment of the specific details under cyclic loads

4. Study of the potential of using continuous structural health monitoring (2018 - 2020)

Objectives:

• Show the potential of processing large quantities of measured data for assessing the structural health of wind turbine support structures and predicting the residual load-carrying capacity and lifetime of the structure

Future work:

• Explore methods to validate, calibrate and update numerical models (from *Study 2* and *Study 3*) using continuous measurement data in order to predict changes in the performance of the structure

• Identify the need for measurements on the wind turbine structure (for loads and/or load effects)

Expected outcome

• PhD with unique knowledge in the design and planning of offshore wind turbine support structures with focus on Swedish coastal conditions

• Answers to the current confusion about the structural design of foundations subjected to cyclic loading

• Improvement of methods used for the design and structural assessment of offshore wind turbine support structures

• Expertise in the choice of technical solution, material, design and performance for safe and cost-effective offshore wind turbine support structures

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