



Secondary Steel Design Solutions

The purpose of secondary components on the primary steel of the offshore wind turbine foundations is to fulfill the interface requirements for operation & maintenance, installation, QHSE etc. Having the possibility to choose between a variety of solutions for secondary components and materials, makes it easier to design fit for purpose components for specific foundation concepts. We have strong experience with detailed design of secondary components consisting of steel, aluminum and concrete to fulfill employer's requirement for the foundation use. During the design and drafting work of secondary components we mainly use ANSYS®, Excel, Mathcad, MATLAB and Inventor®

External Platforms Solutions

External platforms have to meet different sets of requirements. These can be to the material it's to be fabricated in i.e. concrete or steel. Furthermore the size of the laydown area and the elevation of the platform are key factors for design and layout of the external access platform. We have in this matter designed external access platforms in concrete and steel. We have also designed platforms at the waterline without having a laydown area, allowing for multiple access points to the foundations.

In the tender design for Hornsrev 3, for our client Vattenfall, the external platform was designed in concrete. This platform including the reinforcement system was designed analytically in Excel and was exposed to run-up waves and 20 metric tonnes on the laydown areas.

LICEngineering has furthermore detailed designed the full foundations of Rampion OWF for E.ON. the external platform on Rampion was designed in steel. The platform and its supporting system was designed in ANSYS®.

Design of an external platform without a laydown area has been performed in the tender design of Smålandsfarvandet for European Energy. The design was basically based on a concrete platform with multiple access directions by the service vessel.



Scroby Sands Offshore Windfarm - Installation



Platform for Northwind Offshore Wind farm

Boatlanding & Access Systems

Boatlanding systems can be designed in many ways to allow for easy access to the wind turbines. We have designed different systems over the years allowing for multiple access points to the foundations: We have designed the traditional two-fender system allowing the service vessel to land directly up to the shaft of the foundation. Furthermore, we have experience with systems allowing for landing to components installed at the waterline, whether it is an external access platform or an ice cone. The foundations of Horns Rev 3 was tender designed by LICEngineering to Vattenfall. The boatlanding solution for this project was based on a two-fender solution.

Another landing solution was presented at the tender design performed for Danish nearshore projects for European Energy at Smålandsfarvandet OWF. The accessing system there was based on a direct landing by the service vessel to the lowered external concrete platform.

Ice cones are designed and analyzed by LICEngineering. The ice-cone for LEEDCo OWF located in Lake Erie is located in a zone with heavy and frequent ice-sheet impact and build up of ice ridges and keels reaching the seabed.

LIC has furthermore detailed designed the monopile foundations of Scroby Sands Offshore Wind Farm. The foundations were designed as monopiles with no transition piece to the towers. The access system was designed as a cage including the boatlanding, external ladder and external J-Tubes, and to be installed offshore after the pile driving in a single lift.

At Rampion and Northwind Offshore Wind Farms, detailed design of monopile foundations including transition pieces to the towers was done by LIC: A traditional boatlanding solution attached directly to the TP wall

Electrical and Cable Installation Interface

Electrical outfitting's such as davit crane, foghorns, illumination, cable trays, hang-off 's etc. has been included in many of our previous designs. The electrical interface has been managed at LIC to govern the best design for the foundations. Furthermore; cable installation scenarios has been analyzed to optimize design of J-tubes, and prepare the internal platforms for a simple cable pull-in strategy. cable protection systems and preparation of the internal platforms to simplify the cable pull in for the cable installation team

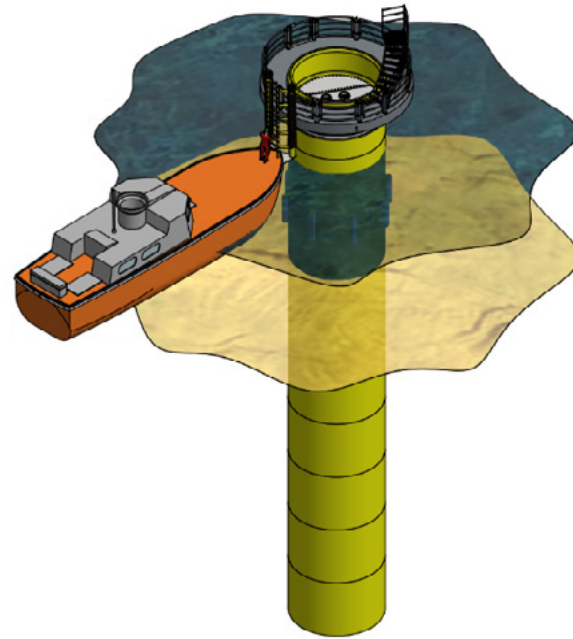


Illustration of boatlanding



Scroby Sands Offshore Windfarm



Monopiles ready for commissioning

Internal Platforms

Internal platforms serve different purposes which could be: working platforms for bolt tensioning, cable hang-off support, air-tightening, components support etc.. Some of the purposes are; bolt tensioning, cable installation, airtightening, components support as switch gear etc. Typically three internal platforms are used internally: Upper internal platform, airtight platform and lower internal platform. However, this is very much depending on the foundation type and request by the owner and operator. We have designed different internal platforms in different materials i.e. steel, fibreglass or aluminium.

Other Components

LICEngineering is working closely together with suppliers to ensure the best possible solutions of secondary items are implemented. This eases the choice between different solutions for cable protection systems, temporary tent for the transition piece top, handrails, corrosion systems etc. Furthermore; we provide solutions for handrails, which might be produced in steel, aluminium or fibreglass. Some of the suppliers used could be: ALUwind, Corrosion Control, TWI, fibrestruct, Tekmar, Seaproof etc.

Project References- Secondary Steel Design Solutions

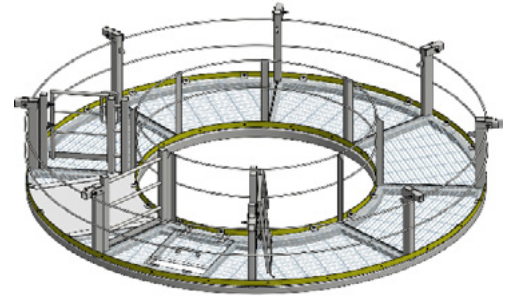
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Internal Platform



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