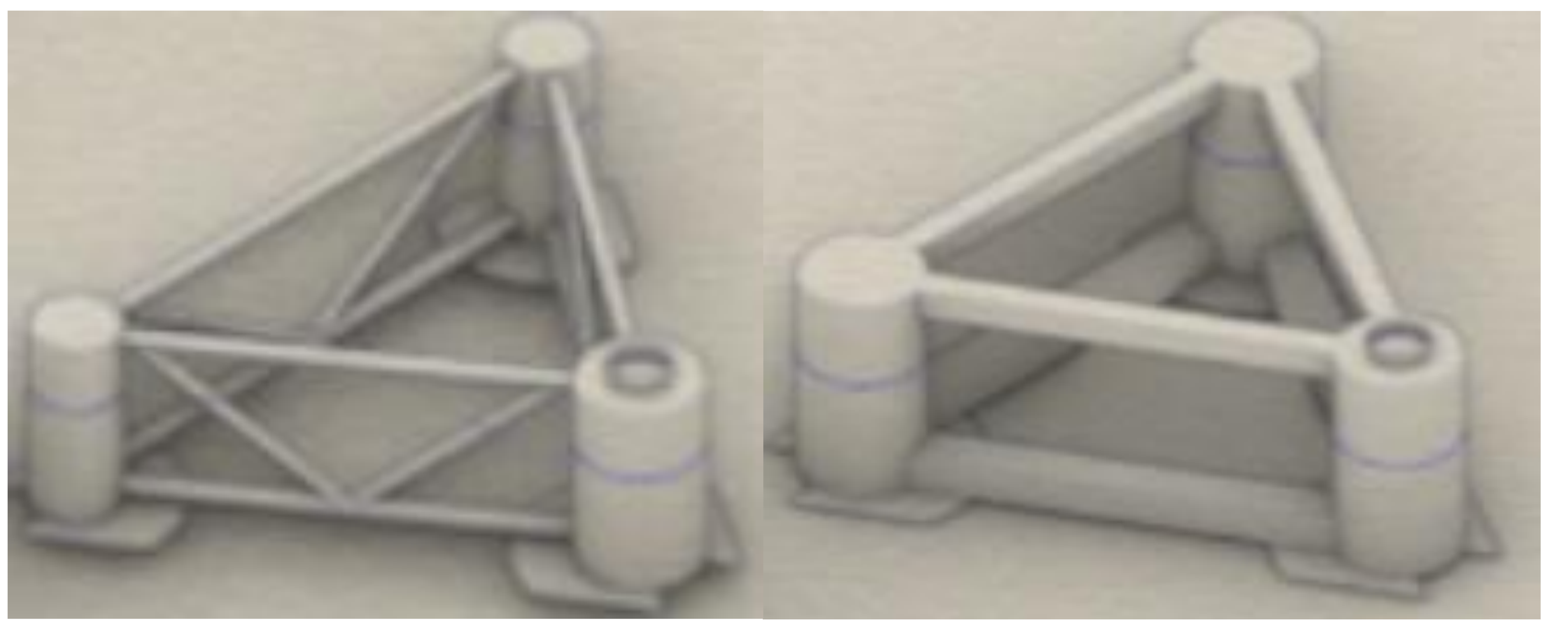
ReaLCoE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 791875.

Developing the Next Generation 12+ MW Offshore Wind Turbine for Clean and Competitive Electricity

Floating Hull Structural Design Derisking



Baseline Hull (left) and Alternative Hull (right) structural designs

Introduction - RealCoE

In locations were fitting fixed wind turbine foundation is not possible, floating foundations are a promising alternative. However, combining a wind turbine generator (WTG) onto a floating –and moving- foundation brings additional design challenges for both elements.
As part of ReaLCoE, one semi-submersible floating foundation with tubular connections and its alternative version with boxed pontoons and braces were studied up to basic design stage, including minimum scantling design. Further structural derisking activities, described after, would be needed for validation and iterative refinement of the basic assumptions used for the floater sizing, now that WTG capacities surpass 15 MW.

Strength analysis of key connections

The trend for larger capacity of WTG leads to heavier WTG, as well as significantly higher loads at the connection with the floater. Semi-submersible substructures consequently tend to increase their footprint and therefore larger deflections are observed on the pontoons and upper main beams. As a result, the structural connections between slender elements and columns requires more detailed local strength analyses.
Similarly, the mechanical connection of tower base with floater becomes a critical local strength design for derisking the structural design of the hull and tower.

Fatigue analyses

When designing a WTG and a floating foundation to be compatible with offshore environment and design lives above 25 years, two main sources of cyclic loads are to be accounted for: wave-induced and wind-induced ones. The fatigue loads account for the specificities of the WTG controller, which is to be adapted to floating conditions, and the environmental conditions (wind turbulence, wave conditions).
For the structural design of the floater and of the tower, fatigue analyses must be carried out for derisking against fatigue failure, as early as possible in the design process and through integrated load analyses.

Modal response of the coupled floater-turbine system

Modal response of the coupled elastic floater-turbine system is a key driver of the platform structural design and of the compatibility of a WTG with a certain floating foundation concept. It also has implications on the WTG structural design and operative performance.
Requirements on modal tuning are to be communicated between turbine manufacturer and substructure designer in an early stage and shall continue being updated along with both WTG and floater iterative design progress.

Secondary structures and outfitting design strategy

In parallel to the hull primary structure design process, the secondary structures and outfitting strategy must be defined at an early stage. This covers layout, position and functionality of the secondary structures fitted on the hull to serve both the floater and WTG functional requirements. This strategy affects the design of the floater in various aspects such as global compartmentation, access philosophy and corrosion protection philosophy or can locally bring additional loads due to wave slamming on outfitting on decks.

ReaLCoE's vision is to unleash the full potential of offshore wind energy

€35/MWh LCoE Goal, +12MW WEC Capacity, ~32 mio € Total Budget, 42 month project duration

SCAN ME

GE VERNOVA · JBO · 8.2 · EnBW · Fraunhofer IWES · DTU · Principle Power · DNV·GL · JAN DE NUL · wood. · Ingeteam · TNO · BIBA

Join the ReaLCoE community!

Further information about the ReaLCoE Programme can be found on our website: ReaLCoE.eu

ReaLCoE