



RAMBOLL

OFFSHORE WIND TURBINE FOUNDATIONS

Wind turbine foundations are the basis for a reliable and successful offshore project. Ramboll provides world-leading design of all interfaces with a clear focus on reduction of energy costs.

Ramboll is world leading in offshore foundation design for wind turbines. We have performed more than 2,500 individual designs for more than 40 offshore wind farms around the world, totalling more than 65% of all installations. The designs are carried out using Ramboll's own state-of-the-art software program. The software has been developed over the past 25 years and is continuously being updated and supplied with new features and models.

Our unique foundation design

Our detailed foundation designs are based on the actual site conditions and water depth at each turbine's location. This results in unique and individualised foundation designs ranging from gravity-base foundation to monopile, jacket or an entirely different type of foundation. Compared to a design philosophy using grouping of foundations, Ramboll's approach can provide clients with substantial material savings due to the optimised design.

At Ramboll, we believe that a professional foundation design requires that all phases in the life-cycle of the wind turbine - from fabrication, transportation and installation to operation, maintenance and decommissioning - are taken into account. Furthermore, the interaction between the primary and secondary structures must also be considered, as it forms an integral part of our design services.

Foundation types

When it comes to choosing a foundation type, there are many possibilities. The turbine foundation can be a steel monopile, a concrete gravity-base structure, a suction bucket, a steel jacket or another concept altogether.

Based on factors such as choice of turbine and site conditions, Ramboll will carry out the necessary analyses to select the best-suited foundation type for your project and assist in all phases of the project development.

Project-specific design

Ramboll is an independent consultant and we are not connected with any design solution.

This means that we have full flexibility to design the best sub-structure for our client and the given project.

For further information, please visit www.ramboll.com or contact us directly:

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Load exchange with wind turbine manufacturer

At Ramboll we are experienced in collaborating with all key wind turbine manufacturers. With a detailed design strategy, we perform load exchange with wind turbine manufacturers to optimise the structural design of both the substructure and the wind turbine tower.

Detailed design of foundations

Our design of foundation structures includes:

- Primary structures
- Secondary structures
- Geotechnical design
- Electrical outfitting
- Corrosion protection
- Review of fabrication drawings
- Transport and Installation specifications and designs
- Operations and maintenance manuals and plans
- Monitoring solutions
- Procedures for lifetime extension and/or decommissioning

Ramboll carries out the design in accordance with any acknowledged standard requirements for certification with an authority, such as DNVGL, SGS, ABS, TÜV, applied standards may be IEC61400-3, Eurocode and/or other international codes. Our services also include liaison with the certifying authority.

Geotechnology as an integral part

Ramboll's specialists in the fields of geology, geophysics, and geotechnics work in close collaboration to innovate and illustrate the best design for our clients. We believe that with our knowledge of high quality geotechnical models, we can ensure an optimised foundation design and the identification of ground-based hazards for offshore wind projects.

We integrate our 3D site models to include geological descriptions and geotechnical design parameters and we incorporate statistical site data in our geodatabases.

Innovative solutions

In addition to our traditional and well-established foundation design, Ramboll actively participates in R&D initiatives (internally and externally) to reduce the cost of energy for coming projects.

A focus area is to improve tested solutions, such as monopiles and jackets, by applying integrated design, more advanced modelling features and by bringing the design closer to fabrication.

Novel concepts are likewise a focal point at Ramboll, such as new hybrid solutions (i.e. steel-concrete structures) or suction buckets. Here Ramboll has gained substantial experience through dedicated R&D projects and prototype projects, as shown in below reference.

A final innovation focus area is to improve designs and subsequently operations through measurements and monitoring. Such input can be used to further optimise design tools, but also to apply smart solutions to reduce operating expenses and/or extend the life expectancy of the structure.



SANDBANK

CLIENT

Vattenfall

LOCATION

Germany

PERIOD

2014 - 2016

SERVICE PROVIDED

Detailed design of monopile foundations for the WTG.

BORKUM RIFFGRUND

CLIENT

DONG Energy

LOCATION

Germany

PERIOD

2013 - 2016

SERVICE PROVIDED

Detailed design of first offshore wind jacket with suction bucket foundations.

BINHAI NORTH PHASE II 400 MW SUBSTATION

CLIENT

Powerchina Huadong Engineering Corporation Limited

LOCATION

China

PERIOD

2016

SERVICE PROVIDED

Detailed design of monopile foundations for the WTG.