



**RAMBOLL**

## MASTS AND TOWERS

**Masts and towers are used in different phases of wind energy projects – for wind measurements during development stage and to support the wind turbine generators.**

Design of masts and towers requires technical knowledge and experience. At Ramboll we strive to achieve a successful design through a fundamental understanding of client requirements and site conditions.

As one of the largest consultancies in northern Europe, Ramboll has a broad range of engineering disciplines including masts and towers. Since the founding of our company in 1945, Ramboll has been heavily involved in design of masts and towers for various applications.

We contribute to national and international standards in this area. Ramboll is heavily engaged in the wind industry, and our focus on masts and towers includes structures for meteorological measurements and development of innovative turbine tower concepts.

### **Our experience and competences**

Ramboll has broad international experience with more than 30,000 mast and tower structures world-wide (incl. telecommunication and wind energy purposes). Independent of climate and geography, Ramboll has the experience and expertise to create optimised designs through technical and economic considerations.

From our selected and certified manufacturing partners in Europe, Ramboll can offer supply and installation of met masts. From execution of EPC projects, Ramboll has gained valuable on-site feed-back to our designs, which have been used to develop our design concepts even further.

In relation to towers for wind turbine generators, Ramboll has been extensively involved in many projects for several years.

Alongside our clients, we have optimised conventional turbine towers and developed new concepts to the market, with the aim of reducing the cost of wind energy.

Challenged by our clients, we strive to meet the market demands, supporting our culture as an innovative consultant.

For further information, please visit [www.ramboll.com](http://www.ramboll.com) or contact us directly:

### **CONTACT**

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### Design of masts and towers

Reliable collection and analysis of meteorological data is crucial to form the business case for future wind farms and to evaluate performance of the existing ones.

During the past 70 years, Ramboll has gained invaluable knowledge within mast and tower design. Our designs entail:

- Innovative Concept designs
- Custom-made solutions based on well-proven concepts (references up to 300m)
- Preparation of technical specifications for masts and towers
- Development of structure maintenance programmes
- 3rd party reviews, insurance claims, expert testimonies
- Technical due diligence

Ramboll has developed our own software, which is well-proven and used for design of many complex structures worldwide. We use our well proven design concepts to provide customised designs to our clients.

### Design and built

We cooperate with our approved manufacturers, which enables us to supply and deliver masts on site. Ramboll has manufacturing partners in several countries, enabling us to provide our masts in several geographies.

In European countries, we offer met mast sites on full EPC contract terms:

- Supply of met masts including guy ropes
- Installation of met masts and civil works
- Supply and installation of met equipment, data compilation, storage and transmission
- Supply of booms for instrumentation
- Supply of power packs with wind, solar, fuel-cells and/or fossil generators

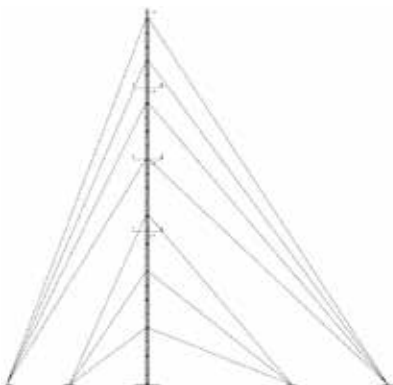
Involvement in design and built stage of the projects provides us with valuable learning that supports continuous development of our solutions.

### Wind turbine towers

Optimisation of conventional wind turbine towers and introduction of new concepts is vital to reducing the cost of energy.

Ramboll offers a wide range of services within onshore and off-shore wind turbine towers. These cover:

- Conceptual design and concept evaluations
- Detailed design
- Site specific tower designs for offshore wind farms as an integral process of foundation design
- 3rd party reviews, insurance claims, expert testimonies
- Design of damping devices and vortex shedding suppression
- Vortex shedding damage assessments
- Installation concept innovations
- Design of tower internals
- Integration of commercial telecommunications
- Structural monitoring



#### 3x160m GUYED MET MAST FOR INDIA

**CLIENT**  
Wind World India Ltd.  
**LOCATION**  
India

**PERIOD**  
2013-2015

**SERVICE PROVIDED**  
Full detailed design, detailed design of side mounted mast installation crane.

#### DESIGN AND BUILT OF 120 m MASTS

**CLIENT**  
E-ON Wind  
**LOCATION**  
Norway & Sweden

**PERIOD**  
2012-2015

**SERVICE PROVIDED**  
Design, manufacturing, civil work, installation and data logging.

#### BOLTED STEEL SHELL (BSS) TOWER DEVELOPMENT PROJECT

**CLIENT**  
Siemens Wind Power A/S  
**LOCATION**  
Denmark

**PERIOD**  
2008-2013

**SERVICE PROVIDED**  
Conceptual and detailed design of segmented tower concept for large hub heights, assistance in relation to 3rd party certification, design optimisations for product commercialisation.