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GUYED WIND TURBINE TOWERS

INNOVATIVE TOWER CONCEPT FOR LARGE HUB HEIGHTS

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Ramboll has developed an innovative wind turbine tower concept to meet demand for large hub heights. The concept is based on more than 70 years of experience with the analysis, design and construction of towers and masts globally.

Large hub heights

In today's wind market some projects require wind turbines with large hub heights to yield a viable return on the investment. The introduction of new +4 MW onshore turbines also requires larger hub heights.

Ramboll has applied its +70 years of experience within mast and tower design, along with its +30 years of involvement in the wind industry to develop a game-changer within towers for the construction of tall wind turbines.

Guyed wind turbine towers

Initially conceived in 2003, the Ramboll-developed tower concept strengthens the traditional steel tubular tower by introducing guy ropes (stays), attached to the tower just below the rotor of the turbine. This means that taller towers can be constructed with a smaller cross-section than for the traditional tower concepts.

Advantages include:

- Tower sections well within onshore

transport restrictions

- Lower consumption of steel for the structure
- Simple and small foundations
- Same supply-chain as for the traditional steel towers

Supporting the tubular tower

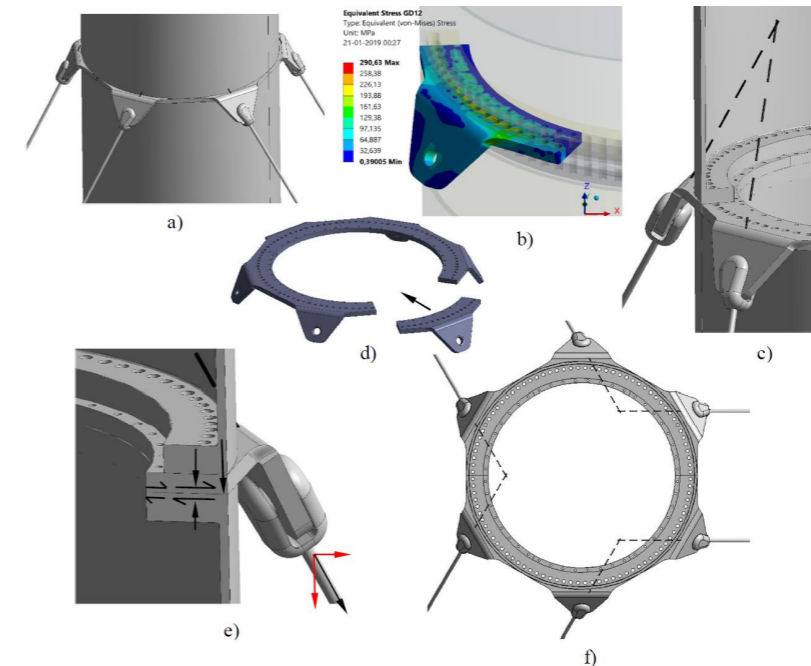
As the single added component to the standard tubular tower the attachment of the guy ropes to the tower has been engineered for optimised production and logistics. Comprising six identical plate elements, which are inserted between flanges of the standard tubular tower sections, the attachment is both lean and simple to manufacture and with excellent fatigue behaviour. The plate insert is provided with a bend and holes to attach cast socket terminations of the guy rope. The choice of having two guys in each of the three directions is partly to have a redundancy should a guy rupture occur, partly to have the guys in more manageable sizes.

Optimal foundations

Apart from optimisations of the tower itself, the concept also significantly reduces the costs of foundations, which are generally smaller than for a self-supporting tower. The smaller foundations and their general nature also facilitates the use of prefabricated concrete elements as an alternative to in-situ cast foundations. At sites with bedrock, the concept benefits from direct anchoring of the guy ropes to the rock.

Independent due diligence

As an independent engineering, design and management consultancy, Ramboll can ensure the best complete balance of plant, without any conflict of interest. Ramboll performs cost benchmarks and technical due diligence including risk profile against other tower technologies, such as traditional tubular steel, concrete/steel hybrid or lattice steel towers, without conflict of interest.



THE RAMBOLL PLATE INSERT ATTACHMENT TO TOWER

a) Final assembly, b) Von Mises stresses in Ultimate Limit State, c) Sideview with coincidence of guy ropes lines, d) Segmentation for fabrication and transport, e) Shear transfer in flange contact surfaces and internal bolt, f) Top view of layout and guy rope coincidence.



RAMBOLL IS THE GLOBAL LEADER WITHIN DESIGN AND CONSTRUCTION OF GUYED MASTS

Ramboll has +70 years of experience with the design of foundations for gusted masts for broadcast and telecommunications. This experience has been transferred to our Guyed Wind Turbine Tower concept. More than 30% cost saving has been determined for project scenarios compared to alternative tower concepts.

The higher the better - Ramboll's Guyed Wind Turbine Tower concept can be extended to very high hub heights and still be cost effective. Combined with the the installation concepts used for telecommunications masts, hub heights of more than 200 metres are not a problem.

NEW SITES MAY BE OF INTEREST FOR POWER GENERATION AND REPOWERING

With the Guyed Wind Turbine Tower concept large hub heights can be constructed cost effectively and therefore more sites can be viable, e.g. forrests in the highlands in the Nordics or similar locations. Repowering of small turbine sites with power upgrade is possible owing to the small foundations required.

