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Taking Steel Wind Turbine Tower Construction to New Heights

Taller, more powerful, and more durable. These are the demands being placed on wind turbine tower designers as the industry looks for ways to cut costs and make more money in wind energy development. As the industry matures, several manufacturers have led the way with inventive solutions to create wind turbine towers that are cost-friendly and up to the task of getting wind from ever-greater heights. The following case studies are a sample of some of the most well-known wind turbine tower inventions currently being used around the world.

Vestas' Large Diameter Steel Tower

One of the latest design innovations comes from Vestas. They've created a 140-metre tower with an extra-large diameter steel tower which increases power generation by 8 percent, according to the company. Designed to be used with the company's 3.3 MW turbines, this steel tower will support hub heights of 137 metres (V126-3.3 MW) or 141.5 metres (V117-3.3 MW). The increases in height are what gives the turbine the 8 percent increase in power compared to the 117 metre tower.[i] [ii]

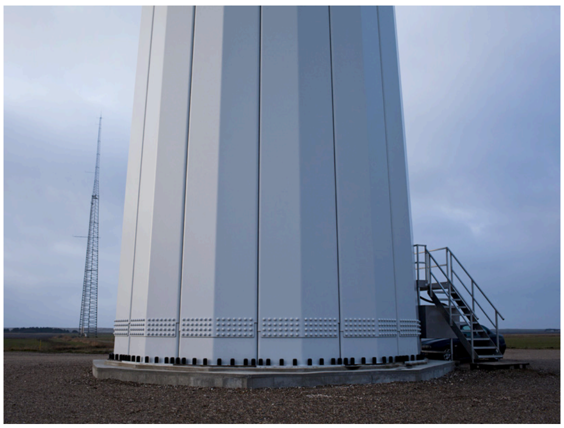
Known as the Large Diameter Steel Tower (LDST), Vestas has said that the wider diameter of the lower part of the tower allows an increase in height without adding extra steel. As a result, though normally a taller height would require thicker steel plates in the lower sections of a tower, they've claimed that their design needs only a slightly larger amount of steel, making the design a cost-effective way to increase hub height.[iii]

As Chief Technology Officer Anders Vedel from Vestas explained, "Vestas' product development strategy is to continue to optimise our technology in order to lower the cost of energy for our customers. The LDST is the most cost efficient solution in the industry to meet the demand for increased tower height for the 3 MW turbines."[iv]

Of course, with any mega-construction project like this, transportation is often an issue, and even more so for this wider diameter tower. However, Vestas has said that they are solving the transportation problem by delivering the bottom sections in three lengthways segments. In fact, they have said that the three lengthways segments can be easily transported on a flatbed truck and then be reassembled on site using vertical flanges to ensure strength. [v]

Already there have been 50 orders placed for this new design, with the first to be installed by Finnish developer TuuliWatti Oy with 30 V126-3.3 MW designs added to the new wide-diameter towers.[vi vii]

Siemen's Bolted Steel Shell Tower



Siemen's Bolted Steel Sheel Turbine Tower

Still a leading innovator is Siemen's bolted steel shell tower which seeks to solve the problems of increased energy yield without boosting transportation and erection costs. Able to reach hub heights of 140 metres or more, the bolted steel shell tower is constructed with multiple tower sections assembled and mounted onto each other at the site.[viii]

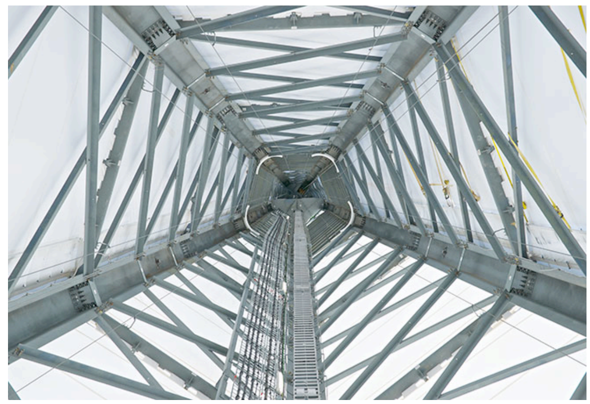
Being modular, transportation is much simpler and more cost-effective, and erection time is highly efficient as a result as well. Using HRC (tension controlled) bolts for securing the tower together, the design also lowers maintenance costs because they require no re-torqueing due to the fact that, without welded sections, they are not at risk of crack initiation and other long-term problems related with fatigue.[ix] Despite all of these innovations, however, the design has yet to be picked up extensively in the industry, though many predict that demand for this and other tall designs to increase as demand for more MW capacity goes up.[x]

GE's Space Frame Turbine Tower

In a category all its own is GE's new Space Frame wind turbine tower. Based on a latticework design similar to the Eiffel Tower, the Space Frame is a five-sided configuration with a base much wider than tube-style towers, adding rigidity and stability. The struts are locked together and then wrapped up by a translucent, UV-protected, non-weight-bearing PVC polyester fabric coating which gives the towers a solid appearance and has the added benefit of minimizing avian deaths common with other lattice structures. While the base is wider than conventional towers, it narrows at the top allowing the design to accommodate any nacelle without structural adjustments.[xi]

There are many benefits to this design. To start, it drastically reduces the need for steel, which substantially reduces costs of materials as well as transportation expenses. In fact, the components can fit into a standard 40-foot shipping container instead of an oversized flatbed truck, minimizing shipping costs and safety complications with conventional transportation.[xii] Plus, the lattice design is also much simpler to install, and the company estimates that it will be able to complete installation with this design in as few as four days (though the prototype required a full 30 days to erect). [xiii]

For additional strength, the towers uses spline bolts that have been proven to work well for bridge construction and sky scrapers over decades of wear and fatigue. Once installed, the splined bolts function like rivets adding exceptional strength. As a result, this design wipes out the concerns about conventional lattice towers' stress problems.[xiv] In fact, HALT testing shows that the design not only exceeds the 20-year standard, it may be closer to 40 years for hardiness in high-stress construction.[xv]


GE's Space Frame Tower

Also, this design has the advantage that it can be assembled using skills used in conventional construction, which means no additional training is required. The system uses standard short and tall cranes used for tubular construction and the turbine is equipped with a specialized lift that attaches to four or five tower legs in order to allow easy access to everything inside the tower.[xvi]

GE installed a prototype of the tower in the Mohave Desert in California for testing which reached a height of 97 metres (complying with FAA limits), but has a commercial version that reaches 139 metres tall. Yet the wider base allows for much higher heights and the company anticipates that they will be able to create towers in the range of 150 to 160 metres with this design. Greater heights will also increase the profitability of these wind turbines. [xvii] An additional benefit to the wider base is that it can accommodate the storage of advanced power electronics and battery storage to prevent weather wear and vandalism.[xviii]

These case studies are excellent examples of the types of changes being made within wind turbine tower construction and installation that the industry needs to become more profitable. With so many ways to tackle costs and strength challenges, more innovations on all fronts will continue to emerge in the coming years.

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Maryruth Belsey Priebe

Maryruth can't help but seek out the keys to environmental sustainability - it's the fire that gets her leaping out of bed every day. With green writing interests that range from sustainable business practices to net-zero building designs, environmental health to cleantech, and green lifestyle choices to social entrepreneurism, Maryruth has been exploring and writing about earth-matters and ethics for over a decade. You can learn more about Maryruth's work on JadeCreative.com.

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