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New Forms for Cost Savings in Wind Turbine Tower Design

Today's wind turbine tower must be taller and more structurally sound than ever before. Yet with rising commodities prices, increased regulations, and the need to go into more inaccessible regions to develop wind farms, wind developers are looking for ways to cut costs. As an expensive component in the world of wind energy, the turbine tower has seen a lot of innovation attention over the past couple of months and years. The following is an overview of some of the most interesting materials and installation tweaks being made to make wind energy more profitable.

Concrete and Hybrid Turbine Tower Design Developments

A tried and true material for construction is concrete, but components are heavy and difficult to transport, making them less than idea for remote installations. Yet several companies are looking for ways to optimize the use of concrete to provide the strength offered by concrete while eliminating some of the traditional problems with the material.

For instance, Alstom is also making waves with a recent global partnership with Freyssinet to develop a 119 metre concrete tower designed for the ECO122 wind turbine. Constructed of 11 concrete sections and a base diameter of 7.20 metres, the components will be manufactured at the Freyssinet mobile factory allowing them to minimize transportation costs dramatically. Additionally, Freyssinet has a unique installation method they call Eolift which uses heavy lifting techniques to assemble to heights exceeding 120 metres. Their methods also mitigate the risks or high wind conditions during installation.[i]

This partnership means that Alstom has two tower options to offer customers for their ECO122. They had previously developed an agreement with Max Bögl Wind AG to develop a 139 metre hybrid tower made with a concrete bottom and a steel top. The ECO122, which just completed a key milestone for certification for commercialization of the 3.0 MW version, offers a 6 percent higher yield than their 2.7 MW version, and is being billed as an ideal solution for low and medium wind environments onshore.

Drösslers's VENTUR is another leader in hybrid wind turbine tower design. This particular tower uses a pre-stressed, prefabricated component design employing a technique called climbing construction. By tapering wall elements, they continually place one on top of the other in a modular format. Most elements, which are transported to the site easily according to the company, are no more than three

metres in width and 10 metres long and are arranged in a polygonal shape, combining to form towers of up to 120 metres in height.[ii]

The lower portion of the tower is composed of pre-stressed concrete known as Resocret. This high-strength material has the advantage of lowering materials costs since much of it can be sourced locally. Additionally, the pre-stressed concrete prevents the formation of cracks, making for a very reliable foundation. What's more, it can be produced quickly and consistently, reducing production times and costs. [iii]

Lowering Turbine Tower Installation Costs with Ingenious Crane Technology

Yet some companies want to get around the problems of installation altogether by making innovations in the erection technology used. One such solution is offered by Max Bögl Wind AG, which was the subject of a recent Bauma award for innovation for their use of a Liebherr 630EC-H70 tower crane in the installation of a wind turbine in Germany. These cranes are configured so that the lifting height is attained with only one guying on the wind turbine tower, allowing it to lift loads up to 70 tonnes. The crane allows for the installation of the tower on a relatively small surface, while also eliminating the need for special permits and police escorts – costly additions for every turbine installed - for delivery. In the Germany installation, the crane reached a lifting height of 151 metres, making it possible to install the tower, nacelle, and rotor blades completely rather than requiring another type of crane to be pressed into service.[iv]

Liebherr 630EC-H70 Crane

Another unique, cost-saving crane option is offered by Wolffkran that is more affordable due to its small base footprint and easy of transportation to the site. Most cranes themselves are heavy and bulky, often requiring expensive transportation and ecological problems such as the need to clear forests to make

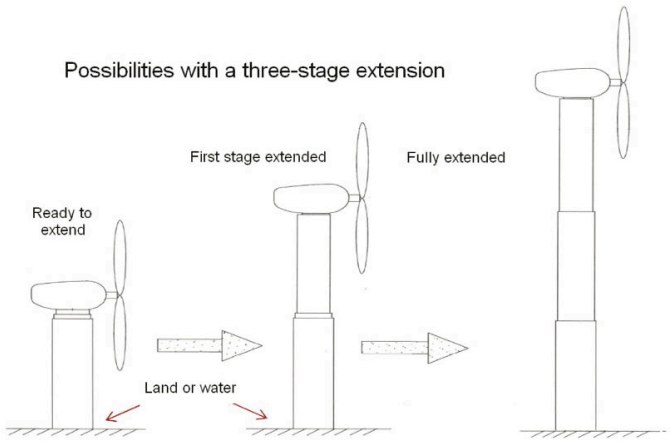
room for the boom. As Gerd Tiedtke of that company explains, "Typically, in wind turbine construction, crawler cranes are used. However, the transportation of these machines to the site is associated with high costs and an extreme logistical effort for the company assigned with the installation of the wind turbine."[v]

The tower crane has a smaller footprint and doesn't require a lot of space on the ground or for the boom, making it easier to manage in tight spots. What's more, by using a luffing jib crane with a 50 metre boom on a 100 metre mast, they're able to cover 100 metres of height with the crane tower and 50 metres with the crane jib. In all, that gives this method the capability of installing to hub heights of 140 metres.[vi] When combined with the elimination of transportation costs, this solution offers potential time savings and financial savings as well.

Innovations in Wind Turbine Tower Design

The technologies already discussed for constructing and installing wind turbine towers have already been used in the real world, but several researchers are working on solutions that are just making their way onto the international stage. In one such innovation in erection technology, inventor Phillip M. Schmidt of Schmidt Equipment, Inc. has developed a telescoping wind tower concept that is said to be able to cut $200,000 from the cost of construction per turbine by eliminating the need for a 100 metre crane. The concept works by using a fluid air actuated telescoping system powered by compressed air and expandable seals to raise the segments of the tower from the ground up rather than having to lift the components one on top of the other, thereby removing the need for a crane altogether.[vii]

Most importantly, this design means the height of the turbine isn't limited by the capacity of the crane, which could open up possibilities for even taller turbine towers in the future. Plus, because it does not require crane technology for installation, it makes erection of a tower on difficult terrain more feasible, potentially opening up regions with big wind resources that had previously been written-off due to inaccessibility or unsuitable land.[viii]



Phillip Schmidt's telescoping tower design

Additionally, the telescoping tower would allow the nacelle, hub, and blades to be installed before the tower extends, meaning these heavy components are only lifted one-third the height as they would be in a conventional tower design, reducing the size of the crane needed for that portion of the installation. What's more, maintenance of the turbine would be much simpler and cost-effective as well, making it idea for offshore and onshore installations.[ix]

Other studies have looked at inventive ways to put turbine tower components together. In a recent study out of Canada, researchers looked at a spirally welded design for wind turbine towers – a method common in the pipeline industry - to determine whether the manufacturing method could lower transportation costs and risks. Given the slender steel shells used for most conical turbine towers, they are prone to buckling, making them sensitive to geometric imperfections and therefore riskier or costlier.[x]

By making use of on-site manufacturing systems, the spirally welded method would allow for more optimally designed tower geometries. The study indicated that this design provides considerable weight savings for large towers. The conclusion of the study was that spirally welded wind turbine towers would become more economical by decreasing geometric imperfections, though they indicated that these were only preliminary design studies and that further work would be required to ensure an effective final design was developed that would meet all Eurocode requirements.[xi]

This quick survey of some of the more interesting developments in wind turbine tower design show how advances in a fast-maturing industry are helping to bring the costs of this energy down to be more competitive with other forms of power. They've shown that by attacking various logistics and costs, many more innovations are likely to come as designers and manufacturers continue to look for ways to make wind energy more profitable.

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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

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Sources

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[i] *Alstom innovating to improve and expand its onshore wind turbine offering*. (2014, March 31). Retrieved April 21, 2014, from Alstom.com: http://www.alstom.com/press-centre/2014/3/alstom-innovating-to-improve-its-onshore-wind-turbine-efficiency/

[ii] *VENTUR*. (n.d.). Retrieved April 21, 2014, from Droessler-ventur.de: http://www.droessler-ventur.de/images/Downloads/Web_Prospekt_8seiter_Ventur_10_2011_engl.pdf

[iii] *VENTUR*. (n.d.). Retrieved April 21, 2014, from Droessler-ventur.de: http://www.droessler-ventur.de/images/Downloads/Web_Prospekt_8seiter_Ventur_10_2011_engl.pdf

[iv] *Liebherr tower cranes offer a new concept for the construction of wind turbines*. (2012, May 11). Retrieved April 21, 2014, from Liebherr.com: http://www.liebherr.com/en-GB/136243.wfw

[v] *Tower cranes for wind towers*. (2013, November 6). Retrieved April 21, 2014, from Cranes Today: http://www.cranestodaymagazine.com/features/tower-cranes-for-wind-towers/

[vi] *Tower cranes for wind towers*. (2013, November 6). Retrieved April 21, 2014, from Cranes Today: http://www.cranestodaymagazine.com/features/tower-cranes-for-wind-towers/

[vii] Dvorak, P. (2013, November 26). *Telescoping-tower idea could lower install and maintenance costs*. Retrieved April 21, 2014, from Windpower Engineering & Development: http://www.windpowerengineering.com/news/telescoping-tower-idea-lower-install-maintenance-costs/

[viii] Dvorak, P. (2013, November 26). *Telescoping-tower idea could lower install and maintenance costs*. Retrieved April 21, 2014, from Windpower Engineering & Development: http://www.windpowerengineering.com/news/telescoping-tower-idea-lower-install-maintenance-costs/

[ix] Dvorak, P. (2013, November 26). *Telescoping-tower idea could lower install and maintenance costs*. Retrieved April 21, 2014, from Windpower Engineering & Development: http://www.windpowerengineering.com/news/telescoping-tower-idea-lower-install-maintenance-costs/

[x] *Imperfection Analysis and Optimized Design of Tapered Spirally-welded Wind Turbine Towers*. (2014, March 25-28). Retrieved April 21, 2014, from Annual Stability Conference, Structural Research Council, Toronto, Canada: http://nuweb5.neu.edu/atm/wp-content/uploads/2014/04/Jay_et_al_SSRC_2014_FINAL.pdf

[xi] *Imperfection Analysis and Optimized Design of Tapered Spirally-welded Wind Turbine Towers*. (2014, March 25-28). Retrieved April 21, 2014, from Annual Stability Conference, Structural Research Council, Toronto, Canada: http://nuweb5.neu.edu/atm/wp-content/uploads/2014/04/Jay_et_al_SSRC_2014_FINAL.pdf