Automated design of high voltage pylons

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Abstract

As new energy resources like solar, wind and hydropower are being used more and more over the world, the demand for transport of energy and with that the demand for powerlines is big. Also, in The Netherlands this is the case. TenneT (company responsible for the transport of energy in The Netherlands) had to realise a total of 75 km's of power lines in one project called Wintrack II. This includes 41 different kind of pole types that carry the conductors. The conductors are carried by so called bipoles, these are conical steel tubes.

To help TenneT a semi-automatic tooling was made to calculate and to model the different pole types. The poles are modelled with inventor and calculated with different software programs.

To validate the different calculations and used model's 3D FEM-calculations are performed as well as full scale tests. Several kinds of calculations and designs are made, especially in steel and concrete. For example, calculations are made on vortex, prestressing of anchors, flange connections and next to that measurements are being performed on full scale poles.

Keywords: High voltage pylons; automated design; flange and footplate connections

1 Project Description

1.1 Energy transition

Consumers of energy have a growing desire for clean, renewable energy.

In Germany and the Netherlands, traditional fossil fuel energy sources such as nuclear power and coal-fired power plants are being phased out, replaced by sustainable energy powered by wind and solar. This change – known as the "energy transition" - means that grid operators such as TenneT need to completely rethink the system that delivers this power.

Connecting new power sources to the grid, bundling and transporting the electricity, is much more complicated than it used to be. For example, think about connections to make use of wind and solar energy from Germany, wind energy from the North Sea or Hydropower from Scandinavia. To make sure TenneT can maintain her track record of supplying power 99.99 % of the time, new stronger powerlines are needed. [1].

1.2 Concept Wintrack

For above ground level situated powerlines TenneT has chosen to develop a new concept called Wintrack. This concept is developed by TenneT in combination with Movares. Besides the fact that this new concept gives towers that are more slender and smaller, these towers give a strong reduction of the magnetic field. The Wintrack concept in steel has been derived from the first idea of Movares to create towers constructed out of fibre reinforced polymers, in towers made from fibre reinforced polymers (FRP) even bigger reductions can be made in magnetic field and much smaller towers become possible. Compare Figure 1 with Figure 2 to see the impact on size of poles and magnetic field when it comes to FRP towers versus traditional lattice girders. The Wintrack concept, architecturally designed by Zwarts and Jansma architects [2], makes it possible to fit in these power lines closer to the urban environment which can be very desirable in a densely populated country like the Netherlands [3].

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