A model designed to balance the bolting load of wind turbines is developed

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An advance simulation could save time and money in their construction and maintenance, according to Mikel Abasolo, an engineer at the University of the Basque Country

Mikel Abasolo, a researcher of the University of the Basque Country (UPV/EHU), has built a simplified simulation model for wind turbines. All one has to do is enter the characteristics that the tower and its parts will have, and in a matter of seconds the model predicts the load that has to be given to each of the bolts, which leads to great advantages in the construction and maintenance process. And it is a fact that in installations of such large dimensions, it is customary to have to adjust the bolts over and over again to balance the load. But this model enables these data to be known before the building begins. Abasolo has done this work in the ADM (Mechanical Analysis and Design) group of the Faculty of Engineering in Bilbao, in the line corresponding to renewable energies. He has subsequently defended his thesis entitled Metamodelo para la simulación y optimización de secuencias de atornillado en uniones de torres de aerogenerador (Meta-model for the simulation and optimisation of bolting sequences in wind turbine tower joints).

Owing to their great height, wind turbine towers are built in two or three parts and are subsequently bolted together. However, joining elements of such dimensions and quantities of bolts is very complex. "The aim is that all the bolts should have the same load so that they all work equally. But in practice, achieving this uniformity is no easy task. In an adjustment sequence, when you tighten one bolt, the previous ones lose part of their load," explains Abasolo. So, if in one sequence a load of 100 points (for example) is assigned to all the bolts one by one, by the end of the sequence most of them will not remain the same because when one is adjusted, the previous ones lose load. According to the researcher, only a few bolts will continue to have 100 points while the rest will be below that: "So, what do you do in order to keep all the bolts at the level of 100 points? You adjust them as many times as necessary (normally between three and four times), until you get a uniform load of 100 points on all of them. Naturally, this means a loss of time and money."

An exact load for each bolt

This is the reason why this simplified model is so valuable, because it can predict what load has to be apportioned to each bolt at the moment when the installation is assembled, so that by the end of the process the load ends up being uniform. You have to input into the model data like tube geometry, the exterior and interior diameter, the metrics and resistance of the bolts or the final load you want to achieve; this is enough so that in a matter of seconds the result that fits the circumstances is achieved. "The load that has to be assigned to each bolt will be greater than what one wants to obtain at the end, because it is lost in the sequence. If one wants to achieve a final load of 100, some will have to be assigned 110 and others 120, etc. The model tells us the exact load that has to be given to each bolt. This way the final load will be achieved in one single step, or, in two, at the most," asserts Abasolo.

This model can also be applied to maintenance tasks. As time goes by, the bolts of the wind turbine towers loosen, and just as when they are built, they have to be adjusted over and over again until the load is uniform once again, which means that here, too, a lot of time and money is lost.

As Abasolo explains, this simplified model is totally pioneering, since until now nothing like it geared towards wind turbines has been done: "Similar things have been done for pressure pipes, but there was nothing with respect to wind turbine joints. So we have taken advantage of a methodology never used before in this area." The model has yielded good results in a number of simulations that have been carried out over commercial programs, and has therefore been found to be useful. This researcher believes that in the future it could have applications as far as the market is concerned.
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About the author

Mikel Abasolo-Bilbao (Bilbao, 1982) is an industrial engineer. He did his research under the supervision of the tenured lecturer Josu Aguirrebeitia-Celaya and professor Rafael Avilés-González, both of whom belong to the Department of Mechanical Engineering of the Faculty of Engineering in Bilbao. So it was in the Mechanical Analysis and Design (ADM) research group of the UPV/EHU that Abasolo wrote up his thesis and defended it. Today he teaches at the University School of Industrial Technical Engineering in Bilbao and does research at the Faculty of Engineering.

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