Expert Interview

Vestas: Testing and Simulation for the new V164

Mr. Rens Verhoef is the Lead Structural Engineer at Vestas Wind Systems A/S in Denmark, and just before his presentation at this year's Rotor Blades Conference, IQPC's Vasiliki Barakaki had the chance for an exclusive interview. Read the full interview here and hear about Vestas' testing tools and systems for their new V164!

Vasiliki Barakaki: Mr. Verhoef, I would like to ask you a few things regarding your upcoming presentation. V164 is one of the largest rotor blades. What were the challenges regarding the design process and materials?

Rens Verhoef: I think first of all, the decision to go for this big rotor, the V164, has been a big step for Vestas. So we have not taken it lightly to design this blade. I think the biggest challenge for us going from a rotor that was a 55 meter or 112 meter to a 164 meter diameter was that the larger the blades becomes, the more dominant the edgewise loads become in relation to the flapwis loads. The flapwise loads increase less than the edgewise loads, because the edge loads are much more affected by the own weight of the blade. So in the design process, we needed to take into account how we deal with this massive edgewise load, and how we transfer this load from the tip of the blade all the way down to the root.

Vasiliki Barakaki: And regarding materials?

Rens Verhoef: From a materials point of view, we are using carbon in the blades. That is nothing new for Vestas. But I think the bigger the blades become, the more important it is to save weight. So using carbon is definitely a good idea to try to minimize the mass moment of the blade. So we didn't change the materials for this blade but definitely looking for options to improve the performance, specifically to reduce mass moment of the blade.

Vasiliki Barakaki: New design procedures also require new testing tools and systems. Did you have to implement new tools or adapt new procedures in your testing strategy?

Rens Verhoef: The testing strategy as such has not changed a lot from what we normally do for blades. We test our blades quite rigorously. But yes, we did need to create new tools, because when we test our blades, we usually do it as such that we make sure that the interface at the root is identical as what we have on the turbines. So we actually implement a whole hub including blade bearing, and then bolt the blade to the hub.

This means for us that we needed to have a complete hub ready for our test set up, and of course, all the equipment to attach the hub to the ground. It has been a massive investment in testing equipment and also infrastructure which was needed to increase our testing capacity to this size of blade.

But from a testing strategy, as I said, we are not changing a lot. We test materials on coupon level and components on sub-structure level and subsequently the blade on full scale. The sub-structure testing of critical design details and full scale testing are verified by FE simulations. Once we have validated our FE models, we use this to validate other design details in the blade. So apart from direct structural validation, we use testing to validate our FE models, which are used widely in our structural evaluation.

Vasiliki Barakaki: And was it easy to adapt your simulation process for the new V164?

Rens Verhoef: Yes, that was not an issue. I mean, the simulation tools that we are using are fully parametric, so we can easily go up and down depending on what blade size we are using. The

concepts or the simulation method is not any different, so this was not an issue at all. It is hard to imagine how big the blade is on the screen, so it is feels like as any other blade.

Vasiliki Barakaki: Regarding the component test that you mentioned, did you have to run more component tests to ensure a successful full-scale test?

Rens Verhoef: No, I wouldn't say so. As I mentioned, we tried to focus on some key details, like the root structure and some details like material transitions. But that is something we normally do on smaller blades as well. We do a lot of testing in general, but it is not excessively more. What of course is very important with such a large blade is that you do your planning and your evaluation or simulation of the test itself up front and in great detail, because the testing situation is different from real life. So whatever test load you put on the blade we also simulate in FE to make sure that the blade is capable of taking these loads, but also that the test equipment is capable of taking these high loads.

Vasiliki Barakaki: And it is also important, I guess, to keep the testing period as short as possible?

Rens Verhoef: Exactly. We need to be able to predict what is happening during the test. Unfortunately, we have seen occasions where we don't take our time to go through the test method enough and then suddenly something happens, and you might damage the blade while you are on the test rig. This is why extensive planning and simulation is of such vital importance.

Vasiliki Barakaki: I see, thank you Mr. Verhoef for taking the time. This would be it from my side.