

We4Ce Root Bushing Solution for Rotor Blades

M.A.R.S.2020

For over 10 years, We4Ce has been providing technology to connect rotor blades to wind turbines – the We4Ce Root Bushing Solution. The adaptation of more stringent certification requirements, together with the demand for a reduction in the main mould occupation time, pushes the launch of the We4Ce M.A.R.S.2020 project. We4Ce's vision and strategy is clear in this: a convenient, robust and cost-effective blade root connection technology, following the latest DNVGL-ST-0376 ed. 2015 guidelines.

We4Ce was founded in 2008. Its main design offices are located in Almelo, the Netherlands. We4Ce also has agencies in China and Russia and a partner in India. Its core business is rotor blade design, from aerodynamic and structural design to technology implementation at our customer's premises, next to accomplishment of the certification. Parallel to technology transfers which enables customers to manufacture the bushing connection in their own factory, We4Ce also provides prefab blade root parts as well as subcomponents since 2018.

We4Ce Root Bushing Solution

Since its foundation, We4Ce is focused on the development of bushing solutions for the root part of rotor blades and becoming 'the company' in this field. This solution has been widely used with great success, especially in the Chinese market. Recently, the European market also showed increasing interest. At present, over 25,000 turbines worldwide are equipped with our bushing solution.

Our motto is 'Simplicity is its strength!'. In the design office of 'We4Ce-The Rotorblade Specialist', our team is continuously working on further improvements and finetuning. The We4Ce Root Bushing Solution has the objective to fulfil at least the following criteria: easy to build/assemble, exchangeable with T-bolt-blade root connection, to be built as a prefab component, and to be strong enough for its application. Furthermore, only a minimum of activities may be required once the blades are demoulded.

The bushing of We4Ce follows the mechanical locking principle. It is a connection that finds its strength during the infusion moulding process of the blade root. The interfaces between the steel bushing and the surrounding laminate are of great importance. Since the assembly is done during the resin infusion process, this means that the connection is secured by the quality of the laminates. This leads to a higher strength than when using a bonded insert connection.

In 2008, the development of the We4Ce Root Bushing Solution started with the M30, directly followed by the M36. In 2018, a smaller design, the M20, was introduced for the European market. Having developed and tested these three different sizes, We4Ce gained valuable knowledge about the scale effect of bushings and the Critical to Quality (CTQ) effects to be considered.

The blade root bushing connection consists of an assembly of different sub-components, where the assembly tolerances are key to assuring quality. Although slight changes occur, a bushing connection involves the following sub-components: steel bushings, fibre material wrapped around the bushings, glass fibre elements between the bushings, core wedges to slope down the bushing thickness towards the rotor blade tip, and layers of laminate below and on top of the bushing assembly to integrate to the full rotor blade.

Sub-component Supply

Since 2018, We4Ce also produces the sub-components of the bushing assembly in their own workshop. The aim is to provide the customers with a robust and cost-effective connection technology during proto building. For We4Ce, this means to have the QA/QC and material selection at a consistent level, raising the characteristic strength. As a result, our customers are able to concentrate fully on the assembly process in the main mould, which is their core business.

Prefabricated Root 180 Degrees

To help blade manufacturers shortening their mould occupation time, We4Ce has started to supply 180 degrees prefabricated root parts. A few sets of relatively smaller roots have been manufactured and supplied from the east of the Netherlands to the southern European market. After a successful start-up and having finetuned the design for production, We4Ce transferred the technology to India for mass production.



The Launch of M.A.R.S.

In the second half of 2019, We4Ce launched the M.A.R.S. project. The acronym 'MARS' identifies the main characteristic features: being a Modular and Adaptive Root Solution, where Adaptive refers to the possibility to extend the number of bushings in a row, or to increase the loading level by shape adjustment.

Together with research institute TNO in Delft, the Critical to Quality items within a bushing-root are tackled more fundamentally, on an engineering level by analysis, as well as on a practical level by testing. Several material interfaces have been depicted as being critical for the strength of a bushing system. Next to the default prescribed materials, it was also decided to include special pultrusion elements into the test programme to quantify the effect of material tolerances on the strength by means of testing.

Offering root segments (modular parts) to our customers as a hardware product, is the next ambitious goal of We4Ce. For this purpose, a close cooperation with a Chinese partner will be explored. The goal of the cooperation is an efficiency improvement for our customers in terms of main mould occupation time and a consistent and reliable quality level, taking an attractive cost-level in mind.

To impeccably execute the M.A.R.S. project, We4Ce works closely together with several European certification bodies in a step by step approach.

The M.A.R.S. project is expected to be accomplished by the end of 2020, however first results and findings will be applied earlier, i.e. by the mid of 2020. ●

For more information, please contact us at: info@we4ce.eu

► Edo Kuipers

With more than 22 year of experience in blade design, Edo Kuipers is one of the founders and co-owners of We4Ce. His main responsibility is running the engineering department from the aerodynamic rotor blade design, structural design, up to accomplishing the certification documentation. His special interest is to have the in-house developed bushing connection being applied in as many possible rotor blades as connection technology between the rotor blade and the turbine. Edo studied Aeronautical Engineering in the Netherlands and holds a Bachelor of Engineering degree.

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