

Raising awareness of Torsional Loads impact during operational conditions on wind turbine blades.

28 June 2023

Through a 2-year project called CORTIR phase 2 blade experts from the entire value chain (14 WTOs, 5 ISPs, 1 insurance company, 1 OEM and 2 universities) have worked hard to investigate the impact of torsional loads on wind turbine blades under operational conditions moreover a huge effort was put on tackling these impacts throughout investigating testing standards and regulations, developing a solution to mitigate them and creating maintenance strategies for WTOs. On June 28th, Bladena celebrated with partners the finalization of the project.



Figure 1: 40 of the CORTIR II partners and WTO Blade Network, represented 16 WTOs, 4 ISPs, 1 insurance company, 2 consultancies and 2 universities, at the final seminar of the CORTIR II project.

During recent years, the size of the wind turbine blades has been increasing significantly. For offshore operations the blades length on working wind turbines has reached 60m+ and some OEMs even offer 100m+ blades. With increased blade lengths and growing energy production, the loads on the blades have also drastically scaled up giving rise to more structural challenges.

Within the CORTIR phase II project frame Bladena in collaboration with AAU and DTU Construct has investigated the impact of torsional loads on large blades (60m+) these studies showed a significant increase in Root Torsional Moment (RTM) with the scaling of blade length. The torsional moment and the tip deflection under the combination of flapwise and edgewise load components lead to significant out-of-plane deformation in the root transition zone of the blade. This out-of-plane deformation directly causes a significant increase of interlaminar stresses and peeling stresses in the bondlines.

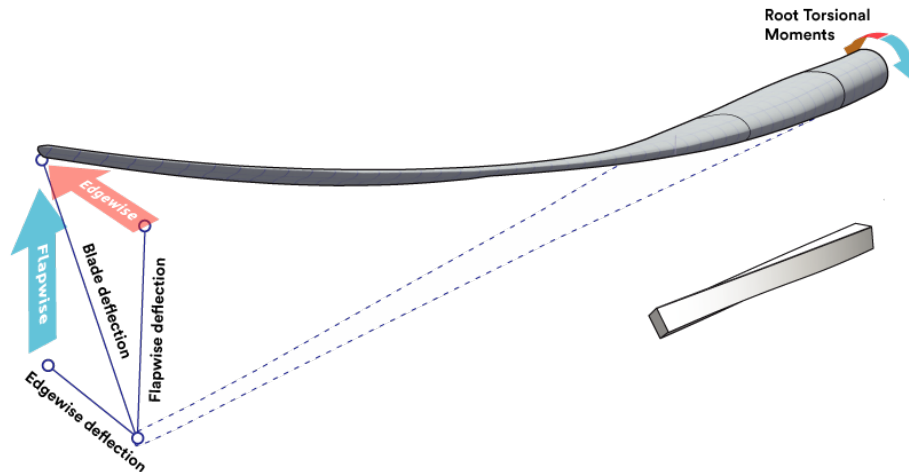


Figure 2: Flapwise and edgewise load components and tip deflection generate Root Torsional Moments (RTM).

The current standards and regulations do not require the application of torsional loads (combination of flapwise and edgewise loads with an offset) during the full-scale test program. By including torsional loads within the test requirements the risk of critical failure modes in the early stage of the blade's lifetime would be significantly decreased which would lower operation costs (OpEx) for the WTs and increase Annual Energy Production (AEP).

A multi-scale level test campaign was executed by Bladerna and DTU Construct to verify the findings of the FEM (Finite Element Model) numerical analysis regarding the increased peeling stresses in the aft shear web adhesive bondline due to the out-of-plane deformation of the composite panels caused by torsional loads. The tests successfully proved the FEM results and therefore Bladerna has developed a product to mitigate the issue. The RTZ Solution™ was developed and demonstrated in different test setups to decrease the out-of-plane deformation in the root transition zone and thereby significantly decreasing the risk of a critical failure mode.

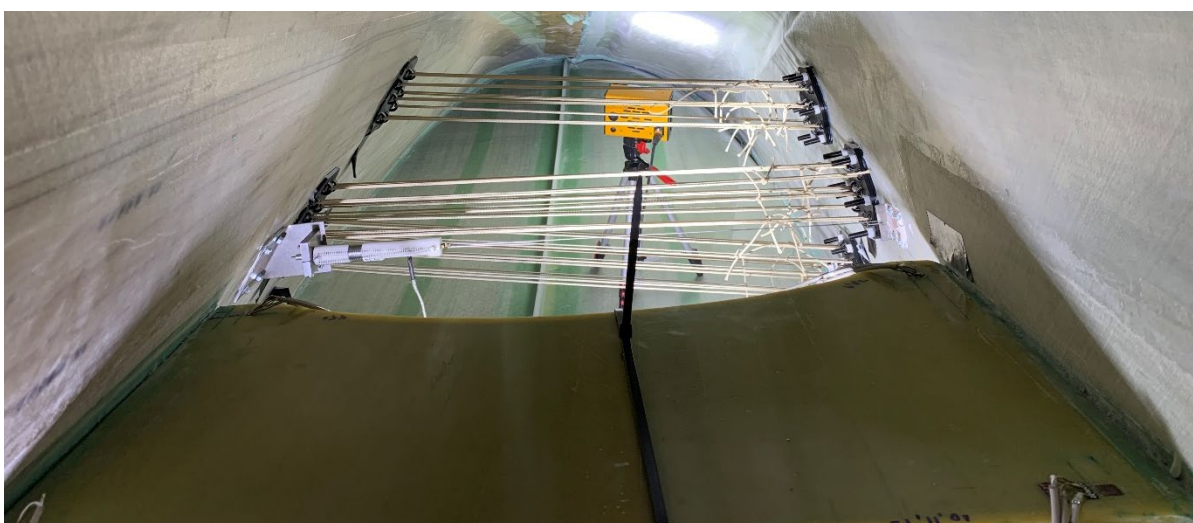


Figure 3: Installed RTZ Solution™ on large-scale test setup.

Phase 2 of the CORTIR project series focused on finding different ways to ease the pain caused by the torsional loads on large wind turbine blades. Besides the previously discussed findings, a new damage categorization scheme and efficient use of the damage tolerance approach were developed too in order to help the decision-making process of the WTOs.

The final report includes papers made within the CORTIR II project and they can be found in the appendix section of the report. The report with the appendices is available under the following link: www.bladena.com/all-downloads/xxxxxxxxxx.pdf

A great thanks also goes to the Energy Technology Development and Demonstration Program (EUDP), which is administered by the Danish Energy Agency (EUDP-program) for funding the CORTIR phase 2 project together with support from the whole value chain in the wind industry with the aim to reduce LCoE. During the period of the project the WTO Blade Network has grown to 55 members, we also would like to say thank you for the members to showing us support and interest towards solving serious issues together.

For further information please visit www.bladena.com, and/or reach out to the project manager of the CORTIR phase 2 project, Find Mølholt Jensen, CEO of Bladena at fmj@bladena.com.