WindSTAR
Wind-Energy Science, Technology, and Research
Industry/University Cooperative Research Center

Structural Repair of Wind Turbine Blades

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The objective of this project is to provide the IAB with the knowledge and tools to analyze wind turbine blade repairs and optimize the repair cure cycle to minimize the downtime of the turbines. With a growing number of composite wind turbine blades in service, rotor blade repair is becoming a significant issue. Wind blades can undergo damage during operation due to demanding mechanical loads, environmental conditions, and manufacturing defects. If material damage is not extensive, the structural repair is a cost-effective option to recover strength. Scarf parches can be used to restore the damaged portion of the blade. Up-tower repairs are significantly affected by weather conditions and can cause turbine downtime longer than 24 h depending on the size of the damaged area. Currently, there are no best practices to repair damaged blades effectively. Optimizing the repair cure cycle is needed to reduce the turbine downtime. Insights on the effect of curing parameters are required to schedule repairs in optimal conditions. This work builds upon the material characterization of infusion and hand lamination resin systems and the computational tools developed in the previous year of this project. Five tasks are proposed to perform this work. First, our team will characterize a new Hexion repair system that operates in cold temperatures. Then, we will extend the substrate treatment study to understand the effect of moisture on adhesion. We will further develop and validate the repair app. The app will be translated from Matlab to Python to facilitate the access of the IAB to the tool. Finally, we will study more complex repair procedures that include balsa parts, which will be validated against actual repairs. Outcomes of this work will be insights into optimum procedures for repair as a function of the environmental conditions and the extent of the damaged area, together with the analysis of new resin systems with potential to extend the repair season for owners and operators, thereby providing cost savings. This work will also contribute to creating a tool for cure cycle optimization and a material database for the repair tool.

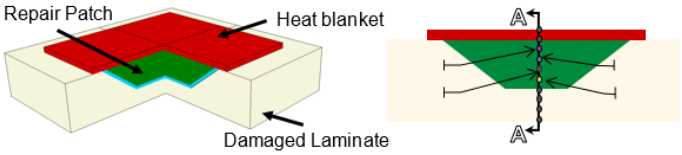

Figure 1: 3D and 1D discretization of repair patch for repair optimization study