WindSTAR

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

Design for the Automation of Composite Wind Turbine Blade Manufacture

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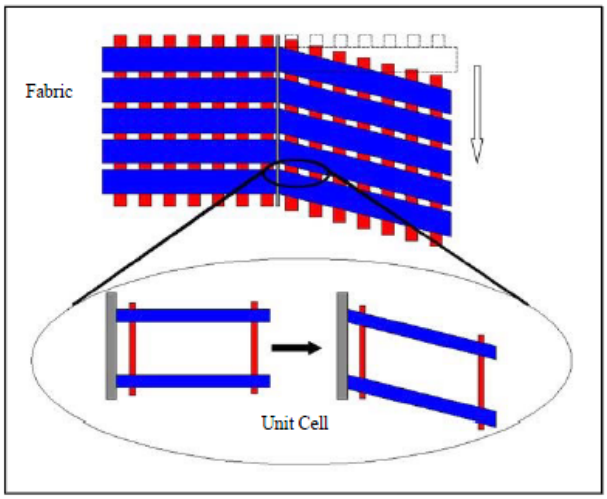
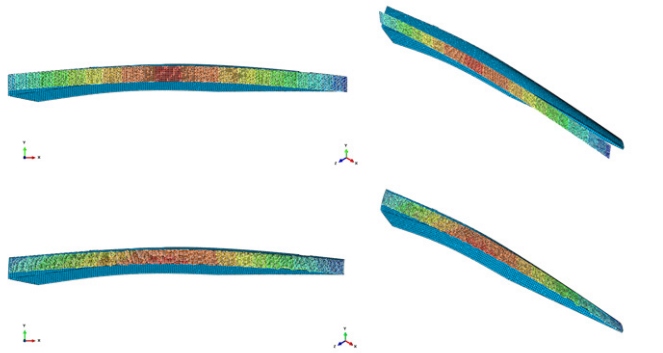
The composite wind turbine blade manufacturing process is very dependent on hand layup methods for fabric placement. While hand layup methods provide for "flexible" tooling, they can result in blade-to-blade variations of the fabric preform and the random precipitation of defects. The formation of such defects could be avoided through the use of a low-variability automated fabric placement process. One automated process that has been proposed is called shifting, and the finite element method has been proposed as a tool for simulation of the shifting process in an iterative design scheme.

During Year 1, extensive exploration was made into developing the modeling methodology for simulating the shifting method. The modeling was performed in Abaqus/CAE, and two fabric material models were investigated as candidates for use within the finite element modeling.

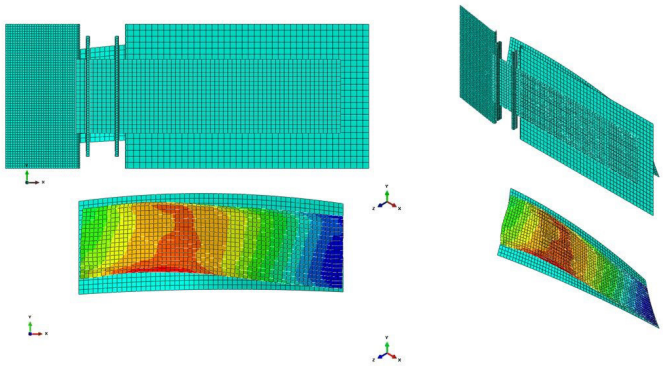
During Year 2, the shifting modeling method was fully developed, and simulations of shifting fabric placement using three different mold surfaces were completed. Significant modeling challenges were overcome to conclude a robust simulation of the automated fabric placement system. Progress was made toward the development of a Matlab-based graphical user interface (GUI) to enable a user to modify model parameters and iterate on fabric placement schemes. The GUI was designed to allow a user to create new Abaqus input files or to modify existing Abaqus input files.



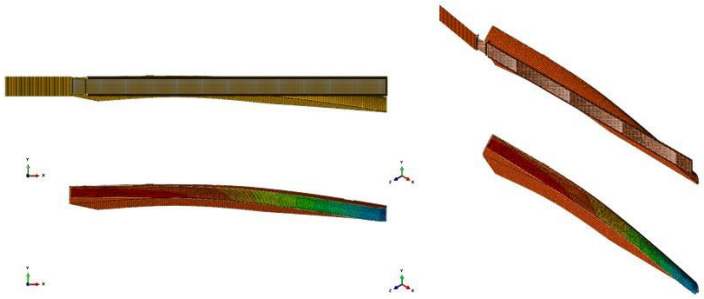
Schematic of shifting method.



Beam/shell fabric mesh being shifted and laid on trailing edge mold surface (a) before shifting, (b) halfway through shifting, (c) completely shifted and (d) pressed onto the mold. The color gradient is displacement in the y-axis direction.



First and last frames of model using rigid body tooling and trays to shift a beam-shell fabric blank into a curved shape and lay it onto a generic double-curvature mold surface. Color gradient is displacement in the y-axis direction. Plan views on the left and isometric views on the right.



First and last frames of model using rigid body tooling and trays to shift a beam-shell fabric blank into a curved shape and lay it onto a wind blade trailing edge mold surface. Color gradient is displacement in the y-axis direction. Plan views on the left and isometric views on the right.

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