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Fibersim Fiber Placement Design and Manufacturing

Supporting the efficient design of components produced with automated fiber placement

Benefits

- Ensures that designs are producible using automated fiber placement
- Increases machine uptime by creating design features that minimize stoppages
- Eliminates late design changes discovered during path planning
- Reduces manufacturing engineering effort by re-using design data
- Supports all major fiber placement path planning solutions

Summary
Fiber placement machines combine the high rates of tape laying with the ability to produce parts with greater curvature. Fiber placement machines are increasingly being used to produce composite parts with the goal of enhancing quality, rate and repeatability. Achieving these goals requires designs that take into consideration machine capabilities and incorporate features to address the production process, including being mindful of strength and weight. Designing for fiber placement ensures the part is producible and problems are addressed before demonstrators are produced, eliminating the potential for costly unknowns.

In addition, manufacturing engineers are not spending time recreating or modifying designs and obtaining approvals for changes during path planning. If changes are required, the path planning data can be reviewed with a designer in the computer-aided design (CAD) environment.

The Fiber Placement Design and Manufacturing module in the Fibersim™ portfolio of software for composites engineering from Siemens Digital Industries Software enables designing for fiber placement manufacturing, and makes it simple to re-use data for path planning. The Fiber Placement Design and Manufacturing module supports NX™ software, CATIA V5 and PTC Creo.

Designing for fiber placement and optimizing rate
Characteristics of fiber placement machines include minimum or maximum material width, minimum cut angle and minimum course length, all of which can affect layer boundaries and weight. The Fibersim machine database enables you to capture these characteristics and identify affected layers, but then a design decision has to be made and executed.

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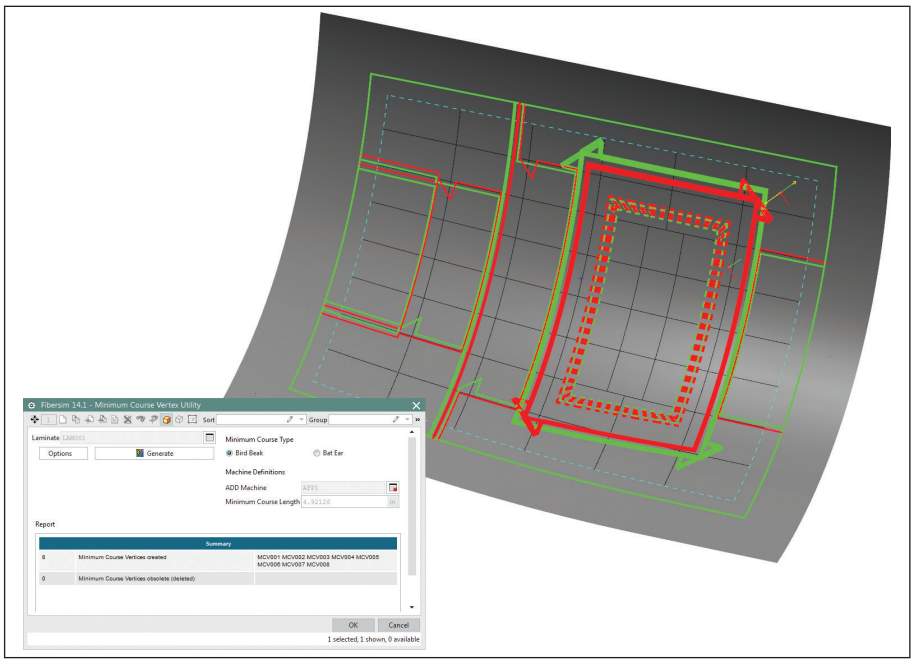
Features

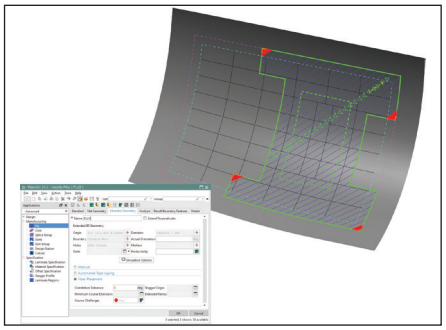
- Assess machine characteristics that affect designs
- Automatically address short course limitations
- Automatically ramp layer edges to eliminate lift up of previous layers
- Export composite and operational data in native formats for path planning
- Import path planning data for design feedback

The Fibersim Fiber Placement Design and Manufacturing module enables quick design decisions and implementation. Some examples include:

- Short course limitations on ±45° layers are quickly identified and layer boundaries are automatically changed with the desired minimum course extension length and shape-eliminating machine stoppages for manual tow placement
- A large step or cliff edge from a stack of layers can cause layers that had previously been put down to be lifted or smeared by the compaction roller. Layer edges can be extended and ramped, eliminating machine stoppages for manual shimming
- Course staggering and repeat pattern ensures that the loss of strength resulting from laps and gaps is minimized. Stagger origins for the layers can be automatically assigned and are communicated to path planning solutions, eliminating the need to manually measure and define layer origins individually during path planning



The Fibersim minimum course utility enables you to identify and change the corners of 45° layers (green) and -45° layers (red) layers that need their boundaries modified for manufacturing. The pinwheels or birdbeaks at the corners were automatically added.

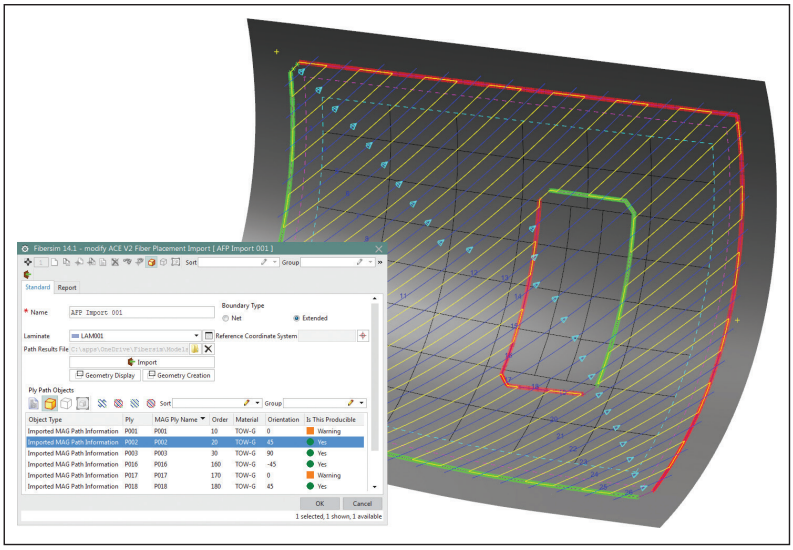


Manufacturing challenges with the design can be identified by using the characteristics in the Fibersim machine database. The areas of red in the corners of this 45° layer are highlighted, letting the engineer know that the design does not address short course limitations with the fiber placement machine.

Generating data for path planning
Using the Fiber Placement Design and Manufacturing module enables the manufacturing engineer to eliminate the need to recreate the composite part. The module can be used to automatically generate a composite part in a native format for the desired path planning solution. Although there are some differences between the data for the different path planning solutions, it typically includes:

- Machine alignment methods
- Mold tool and intermediate surfaces
- Composite layers: nongeometric data and boundaries
- Region controls for speed, feed, temperature and pressure

Using path planning to make informed decisions
Design changes may be necessary based on decisions regarding the fiber layup strategy used in the path planning solution, or even machine simulation that has identified collision limitations. In those cases, the Fiber Placement Design and Manufacturing module provides a means to review the postprocessed data, both visually and with additional information. The import provides engineers with tools to make the best design decisions by showing a display of features, such as centerlines, tow starts and stops, and giving feedback on fiber angle deviation, radius of curvature limits, roller height and collision avoidance angles.



The Fibersim fiber placement import has brought the path planning centerline curves (blue), course edge curves (yellow), tow start points (green) and tow stop points (red) into the design environment for making additional design changes as required.

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