SIEMENS

Automotive and transportation

Carbo Tech

Premier Formula One manufacturer reduces layup time by 30 percent with Fibersim

Product

Fibersim

Business challenges

Generate accurate flat patterns

Achieve consistent performance across multiple builds of composite chassis

Streamline detailed design and manufacturing process to reduce time-to-part

Keys to success

Reduce the number of parts while improving durability of advanced composite products

Results

Eliminated paper and standardized documentation and data sharing across teams

Reduced layup rate by 30 percent on the first car and 10 to15 percent on subsequent cars to achieve faster time-to-part

Delivered more robust parts than ever before within the specified timeframe

Carbo Tech created this highly complex and advanced single chassis part in carbon fiber for the Superfund Monocoque Project. The rigors of Formula One racing dictate that the chassis has to be durable enough to withstand extreme load conditions, yet lightweight enough to achieve optimal performance.

Carbo Tech enhances performance and streamlines design of composite chassis

Speeding the adoption of advanced composites

Carbo Tech Composites GmbH (Carbo Tech), located in Salzburg, Austria, is one of the leading manufacturers of composite products for Formula One racing. Its engineers work with some of the top Formula One teams and car manufacturers in the world, including Porsche and Audi. Carbo Tech's work in composites design has helped accelerate the use of advanced composite materials, including carbon fiber, in the most complex racecar parts.

Due to the rigors of Formula One racing, parts made of advanced composite materials must be durable enough to withstand millions of load changes, yet be extremely lightweight for optimal vehicle performance. To achieve this, engineers need to be able to easily evaluate design tradeoffs and make hundreds of design changes in an efficient manner.

“We significantly accelerated our design process and saved at least one week of composite ply layup time by using Fibersim. In the world of Formula One, where we manufacture cars at breakneck speed, this represents a very substantial time savings.”

Andrea Adriani
Design Engineer
Carbo Tech

As if that weren’t enough, Carbo Tech faced a more difficult test – the Superfund Monocoque Project, which called for developing a highly complex and advanced single chassis part in carbon fiber. So Carbo Tech needed to reduce the number of parts and improve product durability using advanced composites. This meant that the team would need to build the part from one composite design, and redesign the entire chassis from scratch.

With the accelerated Formula One timetables, it would be nearly impossible to meet delivery deadlines. In addition, because of the complex curvature of the part, engineers felt it might be impossible to even build the part as designed.

In light of these challenges, one of the solutions Carbo Tech turned to was Siemens PLM Software’s Fibersim™ portfolio of software for composites engineering. The engineers streamlined the development process using Fibersim to design the one-piece chassis in 3D and create accurate flat patterns to aid the manufacturing process.

The traditional way to produce carbon fiber parts was to manually create all the plies for the complex chassis and then make adjustments to the hand laid-up flat patterns and plies so they would fit perfectly on the tool, eliminating imperfections in the chassis that would hinder performance. However, this process prevented consistency across multiple builds, which meant that vehicle performance varied from test car to test car.

Carbo Tech changed that with the help of Fibersim. Now it is possible for Carbo Tech to achieve complete consistency working with an automated approach that supports the entire development process from conception through preliminary and detailed design, analysis, simulation, manufacturing and quality.

“We significantly accelerated our design process and saved at least one week of composite ply layup time by using Fibersim,” says Mr. Andrea Adriani, a design engineer at Carbo Tech. “In the world of Formula One, where we manufacture cars at breakneck speed, this represents a very substantial time savings.”

In fact, Carbo Tech reduced layup by about 30 percent on the first chassis compared to the standard manual process for providing flat patterns. The company saved 10 to15 percent on subsequent chassis.

A Monocoque chassis made of carbon fiber is one of the most difficult composite parts to design and manufacture for Formula One race cars due to the complexity of the shape and layup. Shown is a solid model of the final Monocoque chassis, which was designed and manufactured using Fibersim.

Implementing a complete digital product model

To streamline the development process, Carbo Tech first had to move to an approach based on a complete digital product model.

Fibersim operates inside commercial 3D computer-aided design (CAD) systems, which provide engineers with a familiar interface in which to create complex composite structures. Fibersim has specialized functionality for creating composites designs, including tools for ply definition, draping simulation, flat pattern creation and ply book generation.

Because Fibersim supports the entire development process, a single CAD master model is used to generate all the product information, providing a seamless link of data downstream to manufacturing and quality to help create a more accurate part and eliminate errors on the factory floor.

Once the plies are defined, the next step is to simulate the producibility of the design. Using Fibersim, Carbo Tech simulated how composite plies of material drape inside sharp-edge areas with very complex curvature, and utilized the grid spacing and analysis tools to determine areas of possible deformation and wrinkling that could create part inconsistencies or weaknesses. The software was used to highlight these areas, enabling engineers to test, re-evaluate and make design changes on the fly in order to make a more robust part.

Oftentimes the changes would include using the dart utility of Fibersim to solve manufacturing problems. With two cuts on the sides of the material, it was possible to flatten the complex shapes and manage overlap in the problem areas. This avoided large overlap areas along the entire length of the back edge, making a better-performing and more durable part.

Next, it was time to create accurate flat patterns. Though Carbo Tech had a flattening software tool for past projects, the company sometimes found it didn't create accurate flat patterns. Engineers were able to use Fibersim to create more accurate shapes so there were far fewer errors, reduced material waste and significantly faster layup time.

Carbo Tech also found the "marker" capabilities of Fibersim quite useful in the complete floor area of the chassis. A marker is any set of points or curves that define "locations of interest" in 3D. The user adds these to the ply, and then, after the simulation is run and the flat pattern is created, Fibersim is engaged to map the marker objects to the 2D flat pattern, printing a layup start point and direction on the protective plastic cover of the material. This provides a methodology

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Solutions/Services

Fibersim
www.siemens.com/plm/fibersim

Customer's primary business

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Customer location

Salzburg
Austria

for "layup hints" or "location features" to be identified in 2D, which helps with ply positioning on the tool, especially in the absence of a laser-projection machine.

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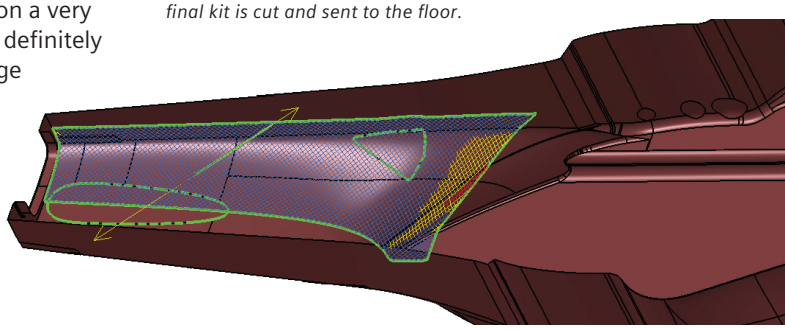
Fibersim was used to create this producibility simulation of a ply of composite material being draped over a tool used for creating the Monocoque chassis. The simulation depicts the true orientation of fibers as they conform to the complex curvature. Blue areas can be manufactured as designed. Areas of mild deformation are highlighted in yellow, and the red areas indicate excessive deformation of the composite material. With this feedback, engineers are able to quickly remediate any problem areas before the final kit is cut and sent to the floor.



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