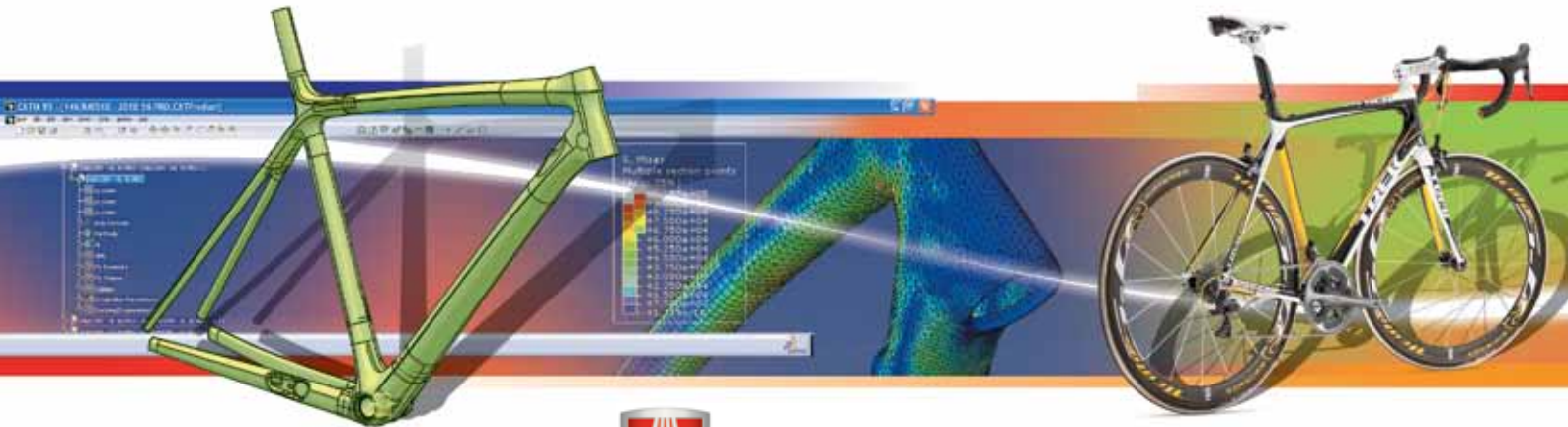


Trek Bikes

Designs greener bikes faster with unified DS PLM platform for composites



TREK

Overview

■ Challenge

To remain the leader in the highly competitive bike industry, Trek Bikes needs to get unique frame designs of superior durability and quality to market in less time than ever before.

■ Solution

Trek Bikes uses CATIA for virtual composites design and FEA (finite element analysis) from SIMULIA for virtual testing, plus CAA Partner Simulayt's solution for virtual composites lay-up simulation.

■ Benefits

With CATIA and SIMULIA from Dassault Systèmes, Trek Bikes has reduced its composites process time by 80%. It gets the design right the first time, eliminates waste materials, cuts costs and gives designers more time for market-leading innovation.

Continuous innovation helps to maintain leadership position

Bicycle manufacturers race to out-do each other by being first across the finish line with cool-looking designs that offer new features to consumers. In the world of competitive, high-performance cycling, Trek Bikes has been synonymous with innovation since 1989, when the company unveiled its first molded carbon fiber frame.

Today, the company continues to innovate by producing stylish new designs with complex geometries that are lighter and provide advantages unique to Trek. For example, the frame of the company's 2010 Madone bike is more than 5 ounces (150 grams) lighter than its predecessor, yet 17% stiffer for more confident handling at speed – a major advantage for competitive bikers. Every 6 Series Madone is built with Trek's highest-performance and most sophisticated carbon fiber – OCLV Red, which enhances performance but significantly complicates lay-up processes and schedules. The carbon fiber frame incorporates a pocket for a speed sensor that drives the on-board computer, and guides that allow the

cables to travel inside the frame. The resulting design is more aerodynamic and stylish, two factors important to discerning cyclists.

"The multitude of innovations that our industrial designers and design engineers come up with on almost a daily basis force us to engineer increasingly more complicated and difficult composite frame solutions," said Mark Wilke, chief process engineer-composites for Trek Bikes. "Traditional design and lay-up methods aren't up to the challenge of creating innovation at the pace needed to maintain our leadership position."

In the past, the company designed frames in 3D computer-aided design (CAD) software, translated the designs to a neutral file format, and then imported them into a finite element analysis (FEA) software to verify their strength and durability. Then engineers manually exported the revised designs into a dedicated but non-integrated composites tool, where they then evaluated the manufacturing process. "This process required six different files to complete, and we ran the risk of errors at each translation step," Wilke said.



"CATIA and SIMULIA help us make better decisions, which give us tenfold more control over the outcome of our products."

Mark Wilke, Chief Process Engineer-Composites, Trek Bikes



Seamless transition to analysis

To save time, improve quality and beat its competitors to market, Trek moved to a new process in which all of these steps are accomplished in a single, unified CATIA environment for 3D design, virtual testing and manufacturing process evaluation. The ply layout is developed in CATIA and CATIA Composites Design (CPD) by creating sequence charts, material tables and lay-up books. The finite element model is prepared within CATIA Advanced Meshing Tools. Simulayt Composite Modeler provides bidirectional and seamless integration of the CATIA Composites model into the SIMULIA FEA software.

“The seamless transition from CATIA into SIMULIA Abaqus makes it possible to analyze many more design concepts than was possible in the past by eliminating the need for data translation,” Wilke said. “This helps us get lighter and stronger designs to market faster.”

Abaqus is used to determine the stiffness and ultimate load of different laminates to qualify frames to industry and Trek standards. Realistic simulation enables Trek engineers to analyze and compare multiple laminate designs and their performance prior to the first prototype and structural testing. This allows Trek to iterate numerous laminate solutions using FEA, then put the best ones through the prototype and testing process. This saves significant time compared to physically building all of the proposed laminate solutions, and allows Trek to try more laminate solutions that previously possible due to time and cost restrictions.

Virtual design and testing help reduce the number of prototypes required to bring a new model to market and also help reduce scrap when starting up manufacturing of a new bicycle. Reducing the use of physical prototypes not only reduces time and costs, but also eliminates wasted materials and reduces energy use, critical

considerations in Trek’s ongoing quest for improved sustainability and reduced environmental impact.

Perfect the design before sending to shop floor

Simulayt’s Advanced Fiber Modeler, which is seamlessly integrated with CATIA, is used to evaluate possible fiber deformation in plies and make corrections before the design is sent to the shop floor for cutting and lay-up. “We can now visualize how the plies are stacking and tweak the laminate structure to eliminate wrinkles and other issues before we send the design to the shop,” said Tim Hartung, composites manufacturing engineer for Trek Bikes.

“In every case where we have used the new CATIA-based composite design process, we’ve been able to evaluate multiple ply lay-up options, select the one that met strength and durability requirements, and validated the manufacturing process in a fraction of the time that was required in our old process,” Wilke said. “This process is taking only two days, compared two weeks in the past. That’s an 80% improvement. CATIA and SIMULIA enable us to evaluate more design alternatives in less time, which helps us create better products.”

But Trek Bikes sees even more potential to improve its processes and its products with DS solutions. “We have already utilized the powerful surfacing capabilities in CATIA to reduce the time needed to design manufacturing tools with complex curvatures,” Wilke said. “CATIA’s surfacing capabilities will become even more valuable as we utilize more complex shapes in our products. As a next step, we are considering implementing CATIA for Mold and Die, which should enable us to perform mold design and manufacturing engineering in the same CATIA environment for additional time and cost savings.”



“With CATIA Composites Design, we validate ply stacking on the computer so it lays up without any problems on the shop floor.”

Tim Hartung, Composites Manufacturing Engineer, Trek Bikes



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