

## Trek Designs Green Bikes Faster with DS PLM Composites

Trek Bikes is a global leader in the field of competitive cycling, offering some of the top-performing designs on the market. Composite materials are an important part of making racing bikes light, fast and strong, and Trek depends on DS PLM to design and manufacture composites solutions that keep its bikes ahead of the pack.

By Jerry Fireman



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

Mark Wilke  
Chief Process Engineer-Composites,  
Trek Bikes

Bicycle manufacturers race to be first across the finish line with cool-looking designs and new features. In the world of high-performance cycling, Trek Bikes has been synonymous with innovation since 1989, when the company unveiled its first molded carbon-fiber frame.

Today, Trek continues to innovate, producing lighter, stylish new designs with complex geometries that 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. Every 6 Series Madone is built with Trek's most sophisticated carbon fiber—OCLV Red, which enhances performance but significantly complicates lay-up processes and schedules.

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

### Seamless transition to analysis

To save time, improve quality and beat its competitors to market, Trek performs design, virtual testing and manufacturing process evaluation in a single, unified CATIA environment. The ply layout is developed in CATIA Composites Design (CPD) by creating ply tables and composite cross-sections. The finite element model is prepared within CATIA Advanced Meshing Tools. Simulayt Composite Modeler provides bidirectional integration of the CATIA Composites model into the SIMULIA finite element analysis (FEA) software.

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

Abaqus analyzes the stiffness and load of different laminates to qualify frames to industry and Trek standards. Realistic simulation enables Trek engineers to compare the performance of multiple laminate designs virtually, and only send the best for physical prototyping and structural testing. This saves significant time and cost, yet allows Trek to try more laminate solutions than previously possible. 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.

### Improve the design before sending to the shop floor

Simulayt's Advanced Fiber Modeler, seamlessly integrated with CATIA, helps predict and correct fiber deformation in plies before the design is sent for cutting and lay-up. "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 validate the manufacturing process in a fraction of the time," Wilke said. "This iterative laminate development process is taking only two days, compared to two weeks in the past. This enables us to evaluate more design alternatives in less time, which helps us get products to market faster."

But Trek 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."

### Focus on Inceptra

Inceptra is Trek's value-added reseller for DS solutions and worked hand-in-hand with Trek to configure a complete composites design and analysis solution that fits the bicycle maker's needs. "We have worked with other companies in the Inceptra shops who provided outstanding technical support" JTJ 0ET q 0 8