Polaris Reduces Weight of Snowmobile Structures up to 40% with solidThinking Inspire and OptiStruct

POLARIS®

Key Highlights

Industry
Automotive

Challenge
Reducing iterations while optimizing designs

Altair Solution
Coupling solidThinking Inspire with OptiStruct

Benefits
- Fewer iterations and significant weight savings
- Easy to do sensitivity studies for sets of load cases
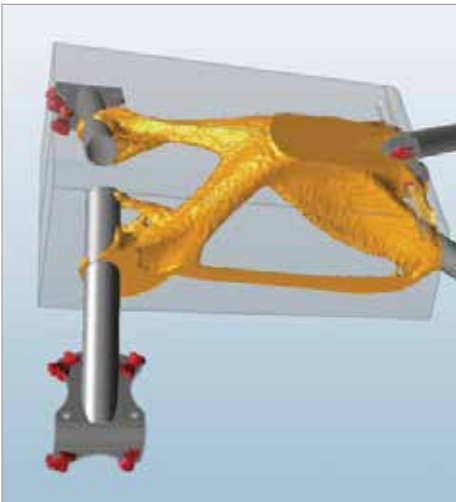
Customer Profile

Polaris, based in Roseau, Minn., is a renowned manufacturer of snowmobiles, and its Snowmobile Chassis Structures Group is engaged in design and testing that supports three different platform teams with chassis solutions for each set of requirements. Computer-based design and finite element (FE) analysis are integral parts of the Polaris snowmobile development process, as engineers work to create optimal structures that reduce weight without sacrificing performance.

The Challenge: Reducing iterations while optimizing designs

Snow Group Staff Engineer Rick Kerner is a key member of the team responsible for optimizing snowmobile designs. For many years, he relied on two basic FE tools to mesh computer models of the designs and analyze them for the most part using linear static modeling.

"The difficulty we had with conventional tools was the number of iterations we needed to refine the model," Kerner says. "Typically we'd go through 10 to 12 iterations to get the last degree of acceptability from the result."

Kerner looked for a solution that would help him meet his optimization goals while reducing the time and effort required to complete the optimization of new snowmobile structure designs.

The Solution: Coupling solidThinking Inspire with OptiStruct

In 2012, Kerner came across an online article in an engineering publication that captured his attention. It featured a demonstration design of a motorcycle frame created with solidThinking Inspire, Altair's 3D conceptual design tool that engineers use to generate and explore structurally efficient concepts in the earliest phases of the design process.

Polaris Success Story

> "Instead of the average 10 to 12 CAD/FE iterations we previously required, now we need only five to six iterations with Inspire and OptiStruct."

Rick Kerner
Staff Engineer
Polaris Snow Group

"It sparked my interest enough to talk to Altair," Kerner says. "Then, when I found out solidThinking was included in HyperWorks 11, I realized I had the tool available to me as soon as I upgraded to the latest version of HyperWorks."

Kerner employed solidThinking Inspire in the development of a new chassis project that incorporated some tough weight-reduction goals that needed to be met without sacrificing structural integrity. He used solidThinking for load-path ideation, simply creating what he calls "an amorphous design space," applying appropriate load cases and allowing solidThinking Inspire to generate a design that fit the requirements for the chassis.

He coupled the design-generation capabilities of Inspire with Altair's OptiStruct optimization tool, using OptiStruct to conduct topology analysis on a previous chassis to see if the tool could come up with a more efficient solution for the weight and strength of a subassembly of welded tubes and brackets.

"Once we went through the topology analysis, to speed up the process we started to employ Inspire," Kerner explains, "using it to get the load paths. Inspire gave us the basic shape and engineering, and then we moved to OptiStruct to refine the shape for manufacturability and stress requirements."

The engineers also teamed Inspire and OptiStruct to evaluate the weight-reduction potential of substituting aluminum for steel in subassembly structures.

"In Inspire, we removed all the steel except for anchor points," Kerner says, "and let Inspire come up with a shape that supported using aluminum. Then we assessed the shape, determining where we wanted to retain steel tubes and where it looked as if aluminum was feasible. We created designs from aluminum and married them to produce an assembly that met our weight and load requirements."
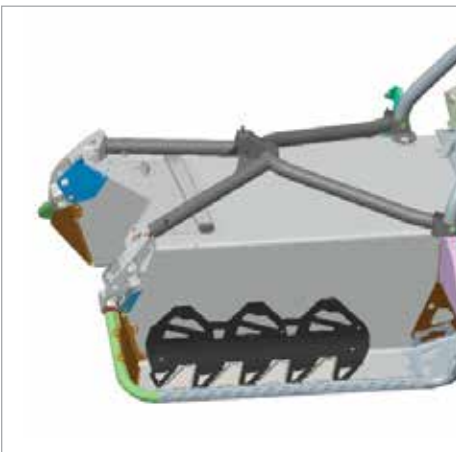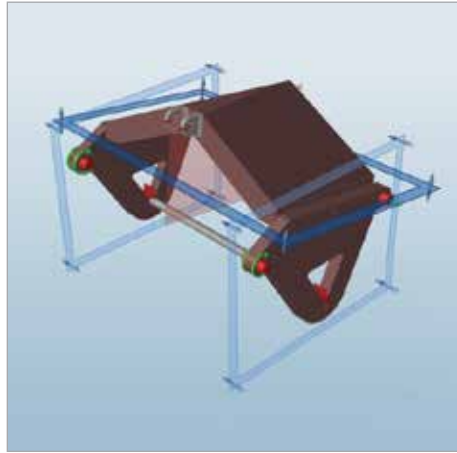

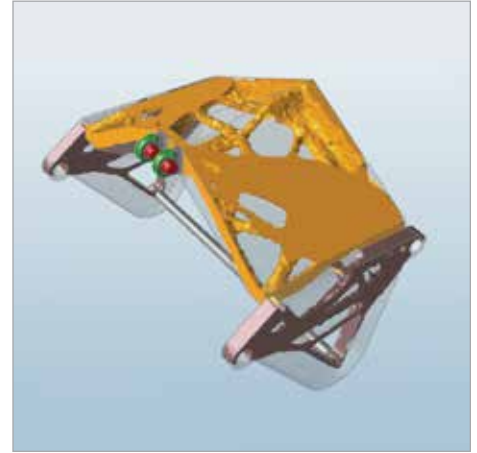*Existent design of a snowmobile chassis component*

New optimized concepts are explored in OptiStruct and Inspire
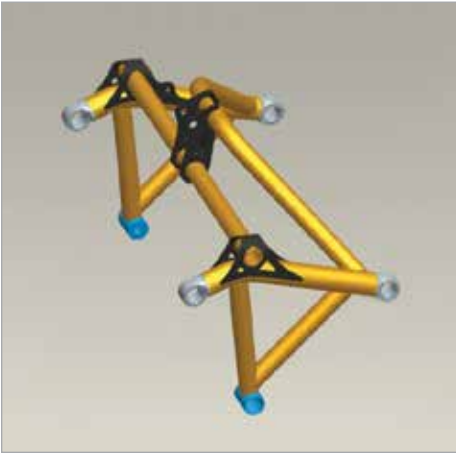
For a new suspension arm assembly, designers at Polaris started from the existing welded-tube design

Design space definition

Optimized shapes in solidThinking Inspire

Results: Fewer iterations and significant weight savings

Inspire and OptiStruct enabled the Polaris team both to reduce the number of iterations required for snowmobile designs and to substantially reduce the weight of those structures.

"Instead of the average 10 to 12 iterations we previously required in the CAD/FE loop, now we need only five to six iterations," Kerner reports. "This translates to cost savings, because rather than creating three generations of prototypes, as we previously had to do, we can typically get by with one now."

Moreover, the team was able to remove 15 to 20 percent of the weight of the previous chassis structure in its new model by using solidThinking Inspire and OptiStruct. Where the team could use aluminum instead of steel, the weight reduction reached 35 to 40 percent per unit volume.

"We saw there was a possibility of creating an aluminum structure that would provide the same stiffness as a steel design and stay within stress and durability limits," Kerner says.

Now, whenever Polaris needs a new structure, Kerner notes, "it's fairly easy to use the boundary conditions and put a design space in there for the load case. I'll use the geometry from solidThinking and run a linear static analysis or put the same design space into OptiStruct and see how it works with the same constraints with added stress limits. The results turn out to be very similar, which adds to my confidence level in what I'm seeing from the output. It helps me convince fellow engineers that the design is a viable solution, even though it may not look like the usual tube and brackets or casting."

Kerner says it was very easy for him to set up the model and load cases as soon as he became accustomed to solidThinking, and now he uses Inspire 9.0 to set up multiple load cases to produce an average solution. "That's a huge benefit," he says. "It cuts a lot of time out of the front-end thinking part of the process. Just create a design space and let the tool come up with the load path solution. It's also easy to do sensitivity studies for sets of load cases."

Furthermore, Kerner has been able to call on Inspire to manage what-if questions that arise during engineering reviews of structures. "It becomes a timely solution driver if it is used properly," he observes.

The HyperWorks units-based licensing structure also eases the design process for Kerner. "I don't have to think about licensing when I go to grab Inspire," he explains. "It's an easy one-for-one swap with other HyperWorks tools. OptiStruct uses more tokens, so it's simple to use a lower-token tool like solidThinking, especially when sharing tokens with the rest of the engineers. You don't have to announce you're going to be grabbing a big chunk of tokens from other people's workflow. And since we use the same HyperWorks units for solidThinking as for the rest of the suite, investigating more designs costs only our time."

About Altair

Altair empowers client innovation and decision-making through technology that optimizes the analysis, management and visualization of business and engineering information. Privately held with more than 2,000 employees, Altair has offices throughout North America, South America, Europe and Asia/Pacific. With a 28-year-plus track record for high-end software and consulting services for engineering, computing and enterprise analytics, Altair consistently delivers a competitive advantage to customers in a broad range of industries. Altair has more than 3,000 corporate clients representing the automotive, aerospace, government and defense, and consumer products verticals. Altair also has a growing client presence in the electronics, architecture engineering and construction, and energy markets.

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About solidThinking

solidThinking creates, develops and markets design software solutions. solidThinking software is sold and supported by a global network of distribution partners and is also available as part of the HyperWorks suite. solidThinking, Inc. is a wholly owned subsidiary of Altair.

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