

Automotive and transportation · Academic

Rochester Institute of Technology

Using Simcenter Femap enables RIT racing team to achieve almost three times more accurate torsion simulation

Product
Simcenter

Business challenges

Build a car from the ground up
Rationalize the decisions that went into developing the car
Provide hands-on engineering experience for team members

Keys to success

Integrate classroom and experiential learning
Employ teamwork, dedication and effective communication
Master new technologies

Results

Achieved almost three times more accurate torsion simulation
Gained important exposure to Simcenter Femap
Developed valuable experience working with composites



Kevin Ferraro is at the wheel in the autocross event at the Michigan Formula SAE event.
Photo courtesy of RIT Racing/Max Hautaniemi.

Siemens Digital Industries Software solution allows RIT to extend the use of composites

Building from the ground up

The Formula SAE® competition is a student design competition organized by SAE International (formerly Society of Automotive Engineers). The concept behind Formula SAE is that a fictional manufacturing company has contracted a design team to develop a small Formula-style race car. The prototype race car is to be evaluated for its potential as a

production item. The target marketing group for the race car is the non-professional weekend autocross racer. Each student team designs, builds and tests a prototype based on a series of rules that primarily specify minimum safety requirements. The rules promote clever problem solving by leaving teams free to innovate and design from a blank sheet of paper.

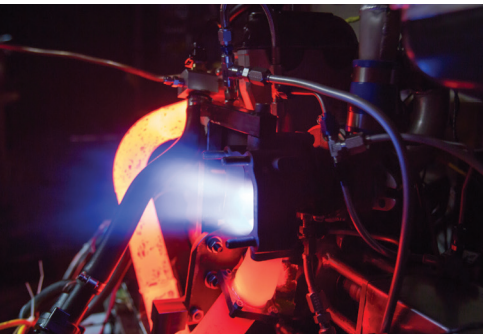
Formula SAE promotes careers and excellence in engineering as it encompasses all aspects of the automotive industry, including research, design, manufacturing,

Lead chassis designer Tim Moran takes it out for a run in a campus parking-lot-turned-test-track for the evening. Photo courtesy of RIT Racing/Max Hautaniemi.



“Composites are very straightforward with Simcenter Femap. It’s easier to change things using Simcenter Femap than it is in other programs. It opens new doors because we are able to achieve a level of analysis with composites that went far beyond what we were able to do in the past.”

Tim Moran
Lead Chassis Designer
RIT Racing Team



Pictured is the engine on the test dynamometer. The RIT team does all of its own engine testing and calibration with a dynamometer setup and labview software that it developed. Photo courtesy of RIT Racing/Max Hautaniemi.

testing, development, marketing, management and finances. Formula SAE takes students out of the classroom and allows them to apply textbook theories to real work experiences.

Rochester Institute of Technology (RIT) has been a long-standing participant in the Formula SAE event, entering its 21st car in 2013. Every year, the team from western New York builds a new car from the ground up, purchasing only the engine block, tires and bulk materials. It is entirely designed, constructed and completed by the students.

Switching to Simcenter Femap

The most acclaimed new solution in the team’s tool box for the 2013 season was Simcenter Femap™ software from product lifecycle management (PLM) specialist Siemens Digital Industries Software. Simcenter Femap is an advanced engineering simulation software program that creates finite element analysis (FEA) models

of complex engineering products and systems, and displays solution results. Simcenter Femap can be used to virtually model components, assemblies or systems and determine the behavioral response for a given operating environment.

Siemens Digital Industries Software provided RIT with an in-kind software grant of Simcenter Femap software through its academic program that develops the next generation of designers and engineers.

RIT engineering students typically participate in a five-year cooperative (co-op) program, interspersing one year of work with four years of study. Tyler Peterson, who served as chief engineer of the 2013 team, was introduced to Simcenter Femap during a co-op assignment at SpaceX. Peterson was so impressed with Simcenter Femap that when he returned to school, he recommended that the team replace its FEA software with the Siemens Digital Industries Software solution.

“It’s easier to change things using Simcenter Femap than it is in other programs.”

Tim Moran
Lead Chassis Designer
RIT Racing Team

"Simcenter Femap was much more accurate than our previous FEA software," says Peterson, a native of San Diego, California, who graduated in the spring of 2013 with a Bachelor of Science degree in mechanical engineering technology. "With Simcenter Femap, the car tested only 7 percent less torsionally rigid than the actual car, while the previous software tested about 20 percent lower than the actual car. Simcenter Femap proved to be just about three times more accurate. It gives us a much better understanding of what we need to do to get the car ready to race.

"It's also much easier to use than our previous FEA tool. It's very robust and enables you to move things around pretty quickly, so you can try different scenarios to see what works best. The interface is very powerful and flexible and allows you to arrange things 20 different ways. It doesn't try to push you in one direction or another. It allows you to organize it in a way that works best for you and enables you to think in your own terms."

Putting theory into practice

According to its mission statement, "RIT Formula SAE Racing Team is dedicated to designing, fabricating, testing, developing, racing, and promoting the finest Formula SAE racer in the world. We will strive to become the most professional, respected, and prestigious team in SAE. We will provide a constructive learning environment that will strengthen new team members by giving them the best hands-on engineering experience. Through our commitment to quality both in the shop and on the track we will better ourselves and our competition. We will accomplish this through teamwork, dedication and effective communication."

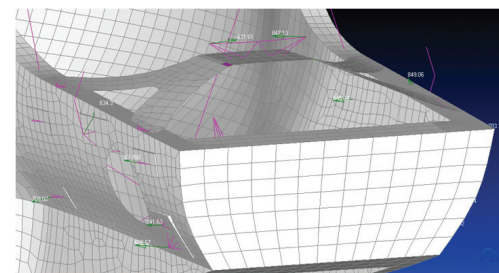
The RIT racing team attends up to three competitions annually. Its season starts with the original and largest Formula SAE competition, which is held in Michigan. It also tries to attend an international competition every year to show its strength to the world and compete with a different set of skilled teams.

The Formula SAE competition consists of 7 events that total 1,000 points, including 300 points for a 22-kilometer endurance test and 150 points for the engineering design event. In the engineering design event, each team explains and defends its design decisions to a panel of judges who work in the automotive, motorsports and aerospace industries.

"The real value of the SAE competition is it allows us to put into practice what we've learned in the classroom," says Peterson. "Combining theory with this kind of hands-on experience helps develop good young engineers who are ready to be productive right out of school rather than taking a year or two to get up to speed."

"The engineers on the team have been able to learn Simcenter Femap pretty quickly. It's so much easier to use than our old FEA program. The difference is night and day between the two programs."

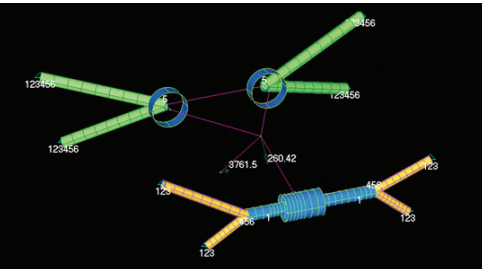
Brian Guenther
Project Manager
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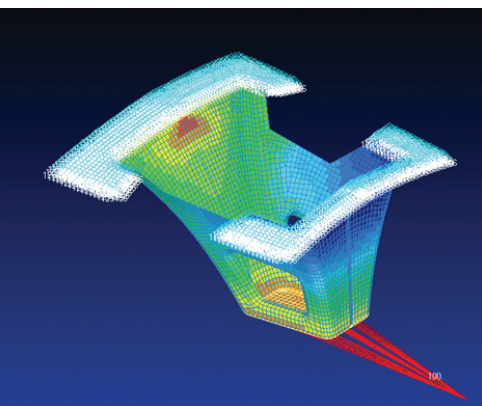
Analysis of the rear of the car performed with Simcenter Femap, with rear chassis brace and other metallic parts modeled. Suspension loads have been applied to each suspension point.



Chief engineer Tyler Peterson takes the car out for a spin on the occasion of its public unveiling. Photo courtesy of RIT Racing/Max Hautaniemi.



Beam model of the engine mount structure in the rear of the car as pictured using Simcenter Femap.



Shown is an analysis of the composite steering support structure generated using Simcenter Femap. The upper steering box and steering wheel are mounted off this piece that is bonded in the car near the driver's knees.

Ease-of-use and so much more

"The engineers on the team have been able to learn Simcenter Femap pretty quickly," says Brian Guenther, the team's project manager and a fifth year senior in mechanical engineering from Rochester. "It's so much easier to use than our old FEA program. The difference is night and day between the two programs.

"With Simcenter Femap, we can get our analyses set up much faster and more accurately than programs we've used in the past. The user interface is easy to use, and we're always finding new useful tools that make setting up the analysis even faster and easier."

As a relatively new user, there is one feature that particularly appeals to senior Tim Moran, the lead chassis designer who is a mechanical engineering major from Erie, Pennsylvania: "The undo button makes you confident enough to try new things because you know you can experiment without losing all the work you've already done.

"There are a lot of other features about Simcenter Femap that really stand out," says Peterson. "It enables you to import and integrate geometry seamlessly, and it has a lot of tools for postprocessing. For instance, Simcenter Femap provides lots of different ways to present data, which is really important because it allows you to present data as effectively as possible for a particular purpose."

Getting the most out of composites

Over the past few years, RIT has expanded the use of composite materials throughout the car. Simcenter Femap is a critical tool that has enabled the team to expand into composite structural analysis. The team has used it to analyze every carbon fiber part on the car (as well as a few other assemblies), including the entire chassis, a chassis brace, steering support, engine mounts, intake plenum, wings, under tray, drive shafts and steering shafts. Designed yearly, the chassis is a monocoque design that is developed with the purpose of emphasizing torsional rigidity, minimizing weight and enhancing ergonomics.

"Composites are very straightforward with Simcenter Femap," says Moran. "It's easier to change things using Simcenter Femap than it is in other programs. It opens new doors because we are able to achieve a level of analysis with composites that went far beyond what we were able to do in the past.

"For instance, we are able to group properties of 13 different layup schedules when we want to analyze the chassis. We're able to pull a lot of different elements into one analysis, and can model all the other components together, such as the suspension model tubes with the rest of the model. This gives us a much better understanding of what is going on with the car as a whole than was possible in the past."

"It's so much easier to use than our old FEA program."

Brian Guenther
Project Manager
RIT Racing Team

Solutions/Services

Simcenter Femap
siemens.com/simcenter-femap

Customer's primary business

Founded in 1829, Rochester Institute of Technology is a privately endowed, coeducational university with nine colleges, emphasizing career education and experiential learning. The Rochester Institute of Technology Formula SAE racing team is dedicated to designing, fabricating, testing, developing, racing, and promoting the finest Formula SAE racer in the world.

www.rit.edu/kgcoe/formula

Customer location

Rochester, New York
United States

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Tyler Peterson
Chief Engineer
RIT Racing Team



Kevin Ferraro drives the RIT entry at the Michigan Formula SAE event.
Photo courtesy of RIT Racing/Max Hautaniemi.

These new structural composite parts are stiffer and lighter than the other parts they're replacing. In addition, the use of the composite parts has opened up options for RIT in terms of packaging and mechanical design. The team can be very flexible with the parts that they design since they are not limited to traditional metallic part machining operations.

"We really like how easy it is to incorporate beam models into the analysis," says Guenther. "There's no problem adding any metallic part into the analysis of composites by modeling it as a beam. We've added fasteners, tube structures and other parts into the analysis of assemblies on the car. Using Simcenter Femap, we can accurately apply loads through the suspension members that are modeled as beams. It's very easy to pull out reactions and deflections from the results to plug into other analyses that we're working on."

"Simcenter Femap offered some real advantages when using composites," says Peterson. "It allowed us to change layup schedules and orientations quickly and easily so we could see the outcomes without having to put in a whole lot of work."

"The postprocessor is easy to use," adds Moran. "You can scroll through each layer so it gives you good granularity and enables you to find significant risks, and it provides insights into how to fix the direction of plies that are causing weakness."

One thing all three agreed on: When they walk into their first job after graduation, they'd be happy to find Simcenter Femap on their computer.

Siemens Digital Industries Software

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