SIEMENS

Femap

Duraldur

Using Femap to test virtual prototypes of engine pistons saves time and money; enables customer confidence

Industry

Automotive supplier

Business challenges

Perform FEM and simulation activities in-house

Provide realistic engine piston prototypes to customers

Keys to success

Develop a complete virtual prototype of each piston design

Simulate and analyze mechanical and heat performance, plus combined loads

Minimize risks of destroying physical engines

Results

Users quickly gain proficiency with the software

Early project collaboration facilitates success

First physical piston samples are much closer to final products

Data is used in downstream casting and mechanical operations

Early project collaboration between Duraldur and customers facilitates success

Producing precision products for internal combustion engines

Leaders in the motoring industry for more than sixty years, Duraldur SpA (Duraldur) specializes in the production of cast and molded pistons for all types of engines, as well as cylinders and winged liners for internal combustion engines. Duraldur combines advanced technology and modern, high-precision machining in the constant pursuit of innovation and production flexibility necessary to meet the needs of an extremely demanding and varied client base. This approach has helped the company develop a range of high-quality products for the world's leading engine manufacturers, from farm machinery to automobiles and even Formula 1 race cars. Duraldur's customers include Audi, BMW, Bugatti, Lamborghini, Lombardini, Opel, Peugeot, Same Tractors, and many more.

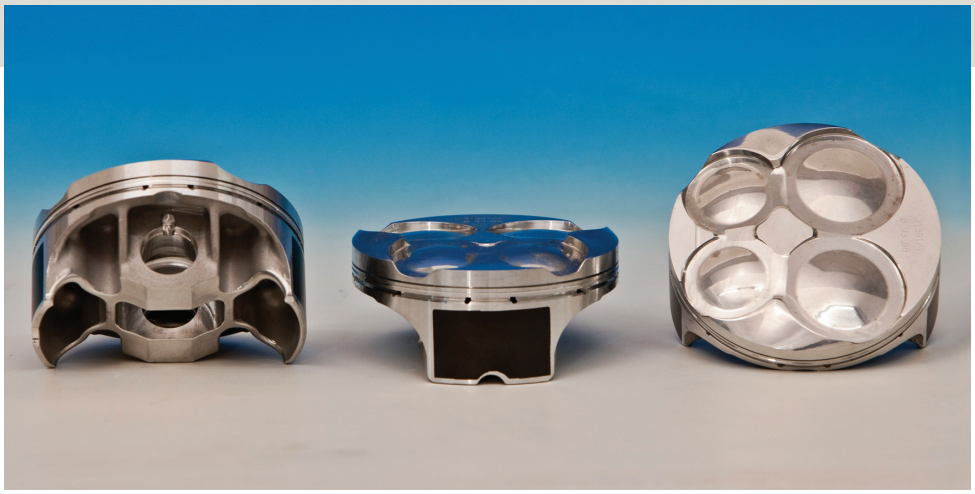
"At the outset of each project, we meet with the customer to define the main features of the piston, based on the engine's specifications," says Andrea Negrisolo, a mechanical engineer in Duraldur's technical department. "The customer provides us with as much information as possible regarding both the engine and the piston itself, such as the bore and compression height, plus information regarding the connecting rod, the pin and, in some cases, the cylinder and the segments. With regard to the engine, we need to know all of its main features, including number of cylinders, displacement, piston stroke, rated power, maximum torque and maximum pressure. For direct injection engines, the customer must also provide us with the design of the combustion chamber and its positioning upon the piston head."

Using all of this data, Duraldur's designers examine pressure and temperature requirements, and analyze all of the components that come into play while the engine is operating. "If the results are plausible with respect to the calculations

Results *(continued)*

Project turnaround is faster; overall process costs reduced

Digital proof of a prototype's viability promotes customer confidence/new business



provided by the customer or similar calculations carried out beforehand, we then conduct a thorough analysis using Femap," says Negrisolo. "These data are initially used to resolve the thermal issues and mechanical issues and ultimately to resolve the issues deriving from the combination of both phenomena."

Bringing simulation capabilities in-house

A 3D computer-aided design (CAD) model is exported in the Standard for the Exchange of Product Model Data (STEP) file format for subsequent analysis using Siemens PLM Software's Femap™ software. Femap provides an advanced engineering analysis environment that is compatible with all CAD systems and solvers. Femap was adopted at Duraldur in March of 2011, just as Negrisolo joined the company. He was hired to perform the analysis and simulation operations in-house, which up until then had always been entrusted to external consultants.

"Duraldur management had been pursuing this strategy for years," says Negrisolo, "But the analysis and simulation projects weren't very frequent, with just a few each year. Then the demand increased and management decided to acquire its own internal resources, in terms of both staff and technological tools.

"Thanks to Femap, our customers now involve us in the co-engineering stage, and we go directly to their production facilities with our computers to view the simulations together and decide how and where to alter the piston designs. We can perform calculations onsite and evaluate various options and hypotheses in real time. And because our company now has all of the necessary tools and skills in-house, our customer response times have naturally improved considerably compared to the past, when we depended on external consultants for these tasks."

Negrisolo optimizes the geometry, the mesh, the material properties and the applied loads for the 3D models exported from the CAD file. "The first stage involves a transient thermal analysis during a complete cycle to evaluate how the temperature varies within the piston," he says. "We subsequently evaluate the thermal and mechanical loads at critical points throughout the cycle. Finally, we evaluate the combination of both loads to verify whether the piston is likely to fail in real-world conditions."

Virtual prototyping is the key

The use of Femap provides a key contribution to determining the validity of the piston's design and to developing the piston's profile, which is essential to preventing seizures during the engine's initial physical testing stage. "Using the data obtained

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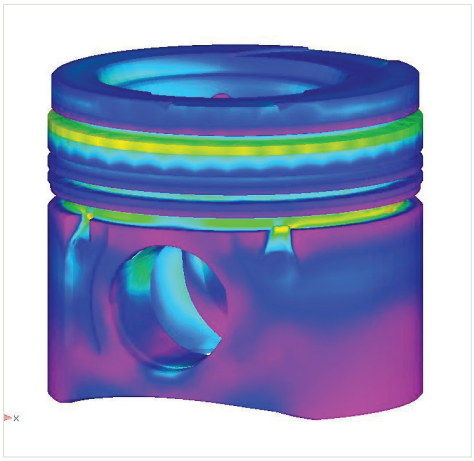
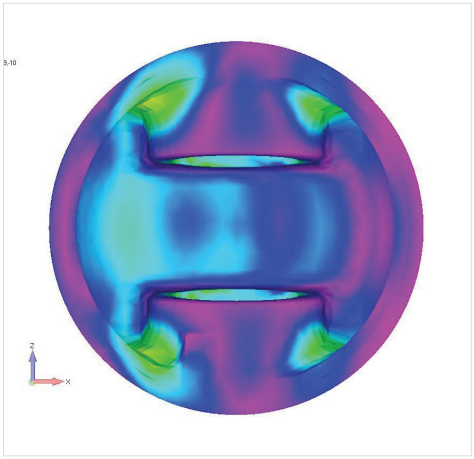
Andrea Negrisolo
Mechanical Engineer
Duraldur

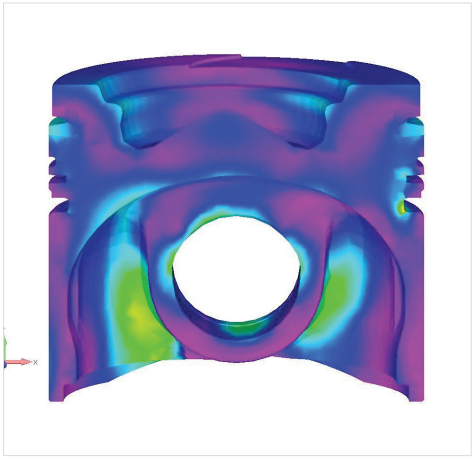
with Femap, we can determine whether or not the piston's initial design requires any major changes," Negrisolo says. "If major changes aren't necessary, the next step is to create the first castings and to carry out the subsequent mechanical machining operations to construct the piston to be tested. Today, these tests are becoming increasingly rigid in order to identify any potential problems. We conduct tests with high thermal shocks, tests with extremely slight play and tests with play factors that emphasize consumption. If the piston meets all of the project's requirements in all these instances, the project moves forward. Otherwise, any necessary changes are made.

"In the past, we began with a physical piston and proceeded with testing step-by-step. Today, no one has the time or the resources to carry out many physical tests. If a piston seizes, the whole cylinder has to be thrown out and, in some cases, even the base of the engine, thus resulting in unsustainable costs. With Femap, however, this risk is minimized because we can get much closer to the final result. The software has proved itself to be crucial to overcoming the initial testing stage without seizures and for avoiding breakage during the piston's durability testing. Using Femap results in significant and measurable time and cost savings."

In addition to adopting Femap for initial testing and durability testing, Duraldur implemented the software to be able to present the customer with data and concrete proof of the proposed solution's validity. "Without this reasonable certainty, no customer will proceed with a project," says Negrisolo. "Duraldur management thus decided to enhance the company's services and adopted the use of Femap to present customers with in-depth studies that are as close as possible to the real finished product. Today, we bring complete virtual prototypes of the pistons to our meetings with our customers."







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Solutions/Services

Femap
www.siemens.com/plm/femap

Customer's primary business

Duraldur specializes in the production of cast and forged pistons for all kinds of engines, as well as cylinders and winged liners for internal combustion engines.
www.duraldur.it

Customer location

Desenzano del Garda, Brescia
Italy

Partner

Cosmos Italia
www.cosmositalia.it

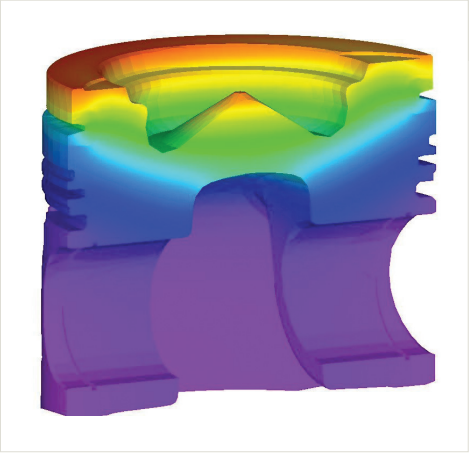
Femap is intuitive, easy to use

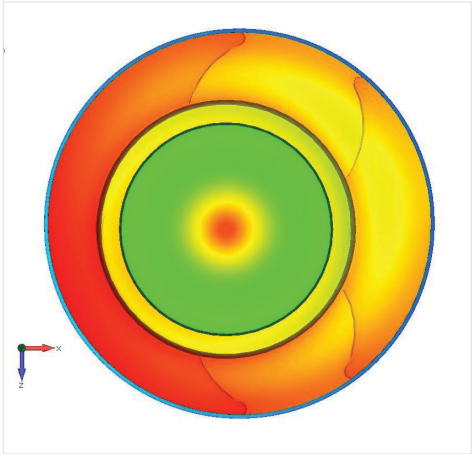
Prior to joining Duraldur, Negrisolo only had one university experience using CAD and finite element modeling (FEM) tools and had never used them extensively. It only took him a brief course and a few weeks of onsite practice to become fully proficient in the use of Femap.

"Femap is extremely intuitive and simple to use," he says. "I can use the software on different machines and, if necessary, I can even prepare and have the computer execute the most complex calculations over the weekend and find the complete results ready on Monday morning.

"For any requests or requirements, I have always been able to count on the support of Siemens PLM Software partner Cosmos Italia, who implemented the Femap software within our company. Cosmos Italia technicians are fully qualified and extremely helpful, and I always get useful replies whenever I submit a problem or send them a model to be analyzed via email."

Negrisolo concludes, "Ours is a small company that is dedicated to remaining flexible in order to compete with the larger multinationals. If a customer asks us for just thirty pistons, we have to be able to oblige. Our competitiveness is based on this extreme flexibility and Femap is just what we need for this purpose."





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