

# SIEMENS

*Ingenuity for life*

Energy and utilities

## Ener Consulting

Pressure equipment design specialist achieves reliable results using Femap with NX Nastran

### Product

Simcenter

### Business challenges

Expand the portfolio of services for the verification and certification of pressure vessels and equipment

Automate finite element analysis in compliance with standards

Implement a nonlinear approach to extend the admissibility range of components

### Keys to success

Implement Femap with NX Nastran

Deliver faster results with nonlinear analysis

### Results

Automation of the finite element analysis process

Faster, easier and more reliable finite element analysis

Wider admissibility range for analyzed components

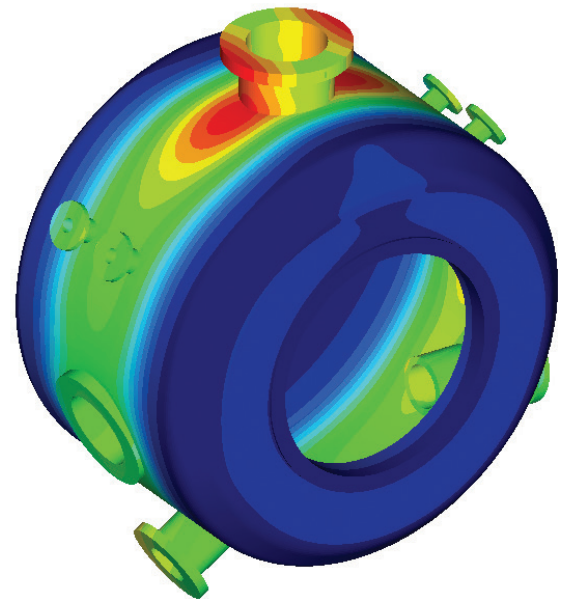
Accelerated postprocessing phase

**Ener Consulting automated the finite element analysis of pressure vessels in conformity with European and international standards**

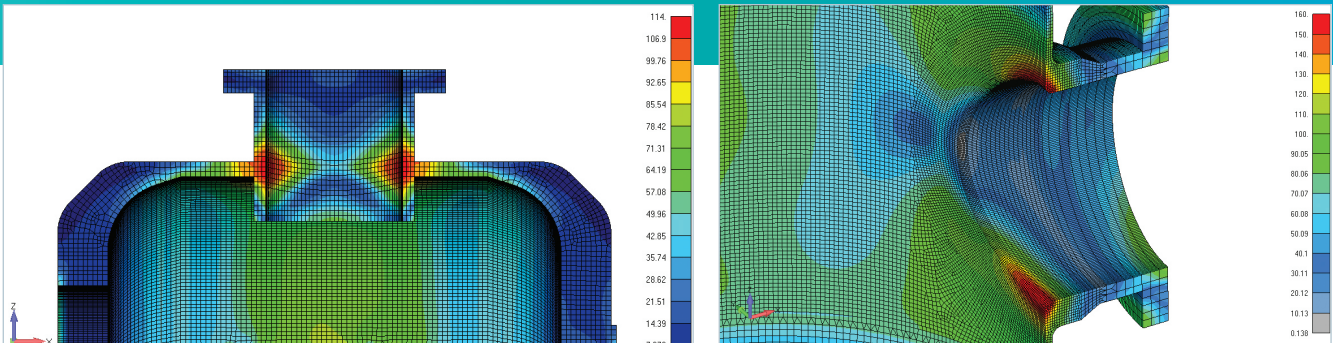
### Verifying designs of pressure equipment

Ener Consulting – Integrated Technical Services (Ener Consulting), founded in 2002 and with headquarters in Prato, Italy, offers engineering consulting to industrial customers. The company's mission is to work with dedication, to stay abreast of technological developments and to provide customers with reliable results. One of the core services of Ener Consulting is the verification of pressure equipment, exchangers, piping and vessels in the oil and gas, power and chemical industries. Over the years, the business has been gradually extended to other industries, including pharmaceuticals, food, pulp and paper, waste processing and many others.

"The design of pressure equipment has evolved over time for the type and complexity of analysis, requiring high-level specialization and analysis skills," says Stefano Milani, finite element modeling (FEM) manager at Ener Consulting. "Until the mid-1990s, finite element analysis was



regulated by loose standards; there were just a few guidelines with no proven procedures. Customers did not have extensive know-how, and without clear procedures, virtually all verifications of pressure vessels were based on manual calculations."



Femap offers clear and tangible benefits in terms of speed, ease of use and reliability of results.

“Femap delivers reliable analysis results with both conventional and modern approaches.”

Stefano Milani  
Structural Design Specialist  
Ener Consulting

#### Automated analysis with Femap

In the 2000s, the pressure vessel sector made quick progress with the introduction of standards and technology tools to automate analysis tasks. In this context, Ener Consulting started to collaborate with SmartCAE, a Siemens PLM Software Solution Partner for Simcenter 3D, Femap and NX Nastran solutions. SmartCAE was also founded in 2002 by four mechanical engineers who had identified computer-aided simulation as an essential tool for product innovation and success in the manufacturing industry.

After using basic FEA software that could not perform accurate analysis and delivered unreliable results, Ener Consulting identified Femap™ with NX™ Nastran® software from Siemens PLM Software as a suitable solution for implementing engineering, analysis and design services, and keeping up with the requirements of target markets.

“Traditional FEA tools that are integrated in 3D CAD software are very simple and intuitive,” Milani says, “but they have limited capabilities and are inadequate to execute accurate analysis in conformity with the strictest standards or in-depth verification. Femap offers clear and tangible benefits in terms of speed, ease of use and reliability of results.”

The analysis conducted by Ener Consulting begins from 3D models with relatively complex geometries that are difficult to address with general-purpose FEA software. With Femap, Ener Consulting engineers can readily clean the geometry, eliminating unnecessary features for analysis purposes (defeaturing). Alternatively, the equipment to be analyzed can be modeled directly in Femap as a mesh.

*“Using Femap with a nonlinear approach offers a more immediate verification of the structural integrity of the pressure equipment.”*

Stefano Milani  
Structural Design Specialist  
Ener Consulting

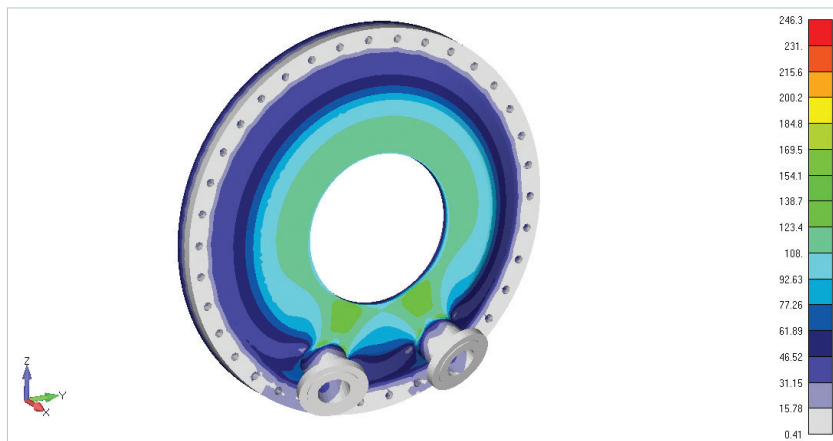
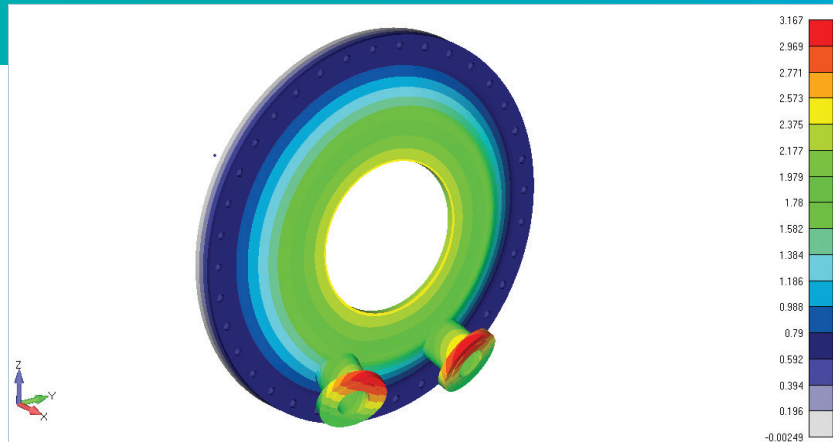
SmartCAE, in collaboration with Ener Consulting, developed an add-on module for stress linearization in Femap. "With this plug-in, engineers need only a couple of clicks on the screen to get the results they are looking for," says Francesco Palloni, business development manager at SmartCAE.

"The end customers in our reference markets need to check products with a quick and reliable method," Milani says. "Femap helps us deliver the desired results following either a traditional approach or a more modern and advanced method."

#### The benefits of nonlinear analysis

For the structural verification of pressure vessels, a traditional design-by-analysis approach (stress categorization) often results in component oversizing, because the conventional linear static analysis approach, while proven and easy to apply, is conservative. Engineers must also consider that the linear analysis procedure is articulated and time-consuming when applied to complex geometry. Currently, pressure equipment regulations allow the application of more accurate analysis methods, including using tools such as Femap with NX Nastran for nonlinear calculations.

"The ASME boiler and pressure vessel standard, for instance, allows for checking pressure vessels using a nonlinear constitutive equation," Milani explains. "On one hand, it forces the analyst to introduce a more complex constitutive equation in the mathematical model; on the other it requires a tool like Femap with NX Nastran to solve this type of analysis," Milani explains.



"The Femap nonlinear approach offers a wider admissibility range," Palloni adds. "With the same geometry and materials, a component can offer higher performance than those predicted with elastic linear analysis. Another benefit is obtained in the postprocessing phase, which is faster and immediate."

The effectiveness of the Femap nonlinear approach was proven in the case of a vessel with a flat bottom of variable thickness. When analyzed with a conventional linear analysis procedure, the component did not pass the elastic test; however, it proved suitable and compliant with applicable standards when it was checked with a nonlinear approach.

**Ener Consulting identified Femap with NX Nastran as a suitable solution for implementing its engineering, analysis and design services.**

**"With the add-on module for stress linearization developed in collaboration with SmartCAE, engineers need only a couple of clicks on the screen to get the results they are looking for."**

Stefano Milani  
Structural Design Specialist  
Ener Consulting

### Solution/Service

Femap with NX Nastran  
[www.siemens.com/simcenter](http://www.siemens.com/simcenter)

### Customer's primary business

Founded in 2002, Ener Consulting S.r.l. offers technical design and consulting services in oil and gas, chemical, power, waste processing, pharmaceutical, food, paper and other industries.  
[www.enerconsulting.it](http://www.enerconsulting.it)

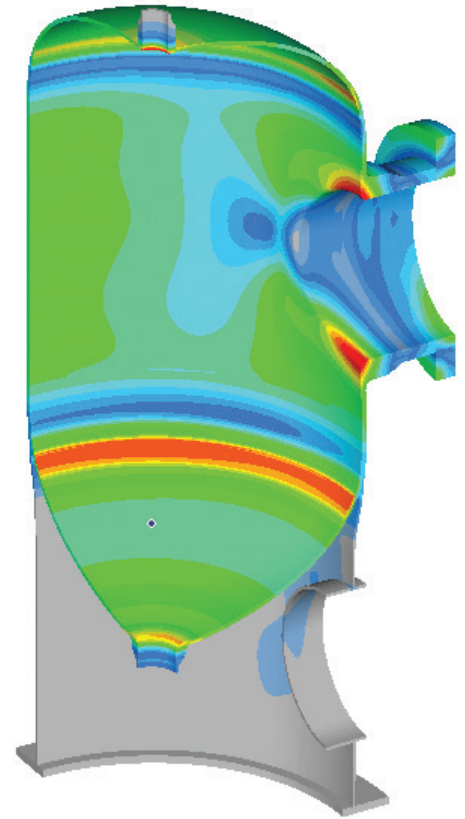
### Customer location

Prato  
Italy

### Solution Provider Partner

SmartCAE  
[www.smartcae.com](http://www.smartcae.com)

The linear approach to pressure vessel verification is constrained by significant design loads which, combined with linear stress analysis methods, results in the noncompliance of the design. Consequently, the initial geometry has to be modified or the load values have to be reduced to fit into the admissible range. Using Femap with a nonlinear analysis approach requires more computing power than linear calculations and greater attention to plastic collapse, but offers a more immediate verification of the structural integrity of the pressure equipment.



*“Today, pressure equipment regulations allow us to apply a more accurate analysis method, using a tool like Femap with NX Nastran for nonlinear calculations.”*

Stefano Milani  
Structural Design Specialist  
Ener Consulting

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[www.siemens.com/plm](http://www.siemens.com/plm)

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