

Realize Your Product Promise™

ANSYS®

Structural Mechanics





Diesel engine manufacturer Cummins realizes its product promise by using ANSYS tools to develop “environmentally responsible” technology. The company analyzes radical improvements, including the use of alternative materials and smaller engine footprints that reduce weight, improve fuel economy and reduce emissions — while also boosting performance.

Structural Mechanics Realize Your Product Promise

Supported by industry-leading physics, structural mechanics solutions from ANSYS can help make your products stronger, more durable and more innovative — so you can reduce costs and be first to market.

Structural integrity is one of the most critical considerations in product design. Across virtually every industry, product development teams must ask and answer foundational questions such as “How long will this product last under daily use?” and “What are the physical forces that can cause damage?” There are unlimited what-if questions as well: “What if I trim the thickness of this material by a millimeter to reduce raw material costs?”

Whatever your industry or application, your company faces enormous pressures to make products that are stronger, longer lasting and packed with customer-requested features. At the same time, the bottom line dictates that you drive time, costs and risk out of the product development cycle while creating ongoing innovations that position the company for market leadership.

How can you and your engineering team meet these conflicting demands? The answer lies in leveraging the power of engineering simulation to design and verify products in a virtual, risk-free environment, minimizing the need for physical prototypes and tests. With its power to slash money and time from the development cycle — while still ensuring a high degree of product confidence — engineering simulation has revolutionized structural engineering over the past four decades. Structural mechanics solutions from ANSYS have led this transformation, determining how underlying mechanical physics forces affect overall product integrity.

ANSYS: More Than 40 Years of Industry Leadership

We bring decades of experience to bear in solving your structural mechanics challenges. Whether the end product is a nuclear reactor or the latest electronic tablet, our solutions have helped businesses to incorporate innovative performance with the strength, durability and longevity to deliver on customer promises and to minimize warranty costs.

By leveraging our software, your engineering team can simulate all structural aspects of your product — conducting linear static analyses that reveal stresses or deformations, modal analyses that determine vibration characteristics, and advanced transient nonlinear studies that focus on dynamic effects and complex behaviors.



“Ocean-going merchant ships are slammed by natural forces and loads generated by complex FSI. We use software from ANSYS at the start of the design process to identify vibration and other problems early on and make changes to get the design right the first time.”

Dirim Şener

Planning Director

Delta Marine Engineering Co.



“Our customers want to buy state-of-the-art turbines that have proven technology and are able to run 20 years without any major problems. To achieve such strong structural components, ANSYS is very important for us.”

Michael Schuld
Team Leader, Structural Engineering
PowerWind

Drawing on many years of “firsts” and “bests” in structural simulation technology, our suite offers a wide range of material models and a comprehensive elements library that accelerate simulation setup. You can combine robust algorithms for structural mechanics with other leading ANSYS physics capabilities for heat transfer, fluid dynamics and electromagnetics to assess system-level performance and simulate such complex problems as acoustic noise, fluid–structure interaction, thermal fatigue and electromagnetic interference.

No matter how complex your own challenges, ANSYS delivers the broad capabilities, deep industry experience and industry-leading technologies to help you realize your product promise to your customers and your company.



Wimbledon’s Centre Court retractable roof and the Bregenz Festival’s operatic floating stage (which doubled as a set for a James Bond movie) meet operational design and completion targets as a result of ANSYS structural mechanics analysis.



In bicycle design, the stiffness and resistance characteristics of composite components can be optimally adapted to meet design requirements and improve process efficiency.

“Compared to typical trial-and-error development methods used in our industry, we reduced the number of cost- and time-intensive prototypes using ANSYS.”

Norbert Schramm
Dipl. Ing. Research Assistant
Chemnitz University of Technology

ANSYS: Shaping a Multitude of New Products

By combining ANSYS hallmarks of depth and breadth with speed, flexibility and high fidelity, our solutions are setting the pace in structural mechanics simulation.

In the product development sector, structural mechanics forms the backbone of product design. Engineers in virtually all industries are leveraging ANSYS solutions to solve large and complex simulations, supporting the dual challenges of speed and high-impact innovation.

In the aerospace industry, engineers rely on solutions from ANSYS to explore the strength and durability of lightweight composites and “smart” materials, which can improve fuel economy. Advanced capabilities make structural mechanics analysis fast enough to apply to vehicle structures, landing gear, wheels and brakes, gearboxes, and other critical components. Researchers investigate bird strike, crash and impact scenarios through explicit dynamics tools. Multiphysics capabilities study more complex issues, such as the performance of conformal load-bearing antennas integrated into the fuselage. Our products are instrumental in helping aircraft companies achieve their goal of zero rework, accelerating the development process and reducing design costs while enabling innovation, creativity and quality.

In consumer products, engineers use our software to perform materials stress and fatigue tests, product drop tests, noise studies and other critical analyses that ensure a range of consumer products — from cell phones to washing machines — operate as expected, minimizing warranty costs and manufacturer recalls.

The automotive industry applies ANSYS to a broad range of applications, from cars and trucks to agricultural equipment, high-speed railways and workhorse construction vehicles. R&D teams fine-tune the internal combustion engine to increase efficiency while reducing



pollution; they also study structural integrity of engines built with new carbon fiber-based material. ANSYS tools optimize designs for improved aerodynamics and weight reduction by eliminating excess component materials. Whether the application is single-physics structural analysis of wheels, arms and booms or a multiphysics electromagnetic–thermal–structural modeling of advanced sensors and actuators, our tools are heavily used in advancing rapidly changing transportation technology.



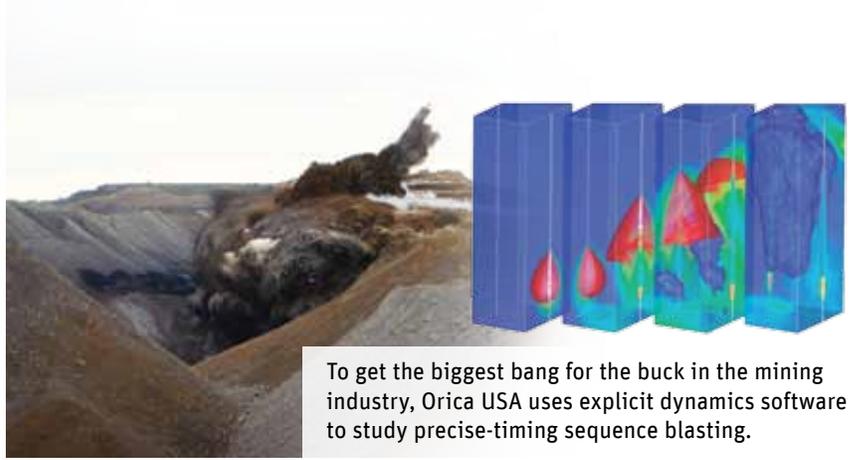
“We use ANSYS as a virtual laboratory, since it’s quite expensive to build experimental devices to conduct testing. ANSYS code is really close to the actual physics, and it assures you when something is a good idea — and demonstrates clearly when a design fails. It’s simply the best code when you compare all its features to other software.”

Benjamin Hagege

Assistant Professor

University of Technology of Compiègne



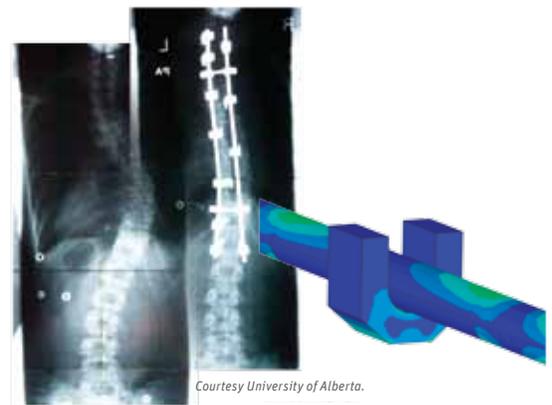


To get the biggest bang for the buck in the mining industry, Orica USA uses explicit dynamics software to study precise-timing sequence blasting.

Industrial equipment — robots, lathes, milling machines, separators — plays a backstage role to the materials and goods that make modern life possible. Competitive economics and consumer demands dictate high production rates; discerning businesses and consumers require high-quality products with tight tolerances. By design, factory machines have high inertial loads that require accurate consideration of dynamics and resulting stresses. Industrial machinery's key parameters include small size and low weight but high strength and reliability.

Turbomachinery engineers turn to ANSYS solutions to study essential issues such as fatigue, acoustic noise and thermal stress in industrial manufacturing environments. They rely on software from ANSYS to explore novel materials and new product designs — as well as equipment retrofits and manufacturing process improvements that extend product life and reduce maintenance expenses.

In architecture and construction, the structural integrity of any building is only as good as its individual parts. Civil engineers integrate the pieces into their building designs; at the same time, they must comply with increasingly demanding safety, government and “green” regulations. Our tools give designers the ability to assess a range of variables in a virtual environment, whether the application is high-rise buildings, bridges, dams, tunnels or stadiums.

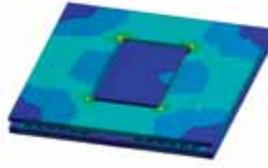


Courtesy University of Alberta.

The energy field continually finds new ways to leverage the power of ANSYS engineering simulation. For example, researchers use our tools to model and improve the entire coal supply chain, from mining to combustion systems and power generation processes. Other sectors leverage the advanced technology — whether addressing nuclear power regulatory compliance, drilling for oil and gas, identifying optimal materials for wind turbine blades, or retrofitting existing equipment.

Artificial hips and knees, spinal implants, and other replacement orthopedic parts present unique challenges related to material properties, human physiology, surgical procedures and manufacturing processes.

The pioneers who laid the foundation for the industry — many of whom are now leaders in developing orthopedic products — have relied on us to manage risk, improve insight and accelerate product development in biomedicine.



Marlow Industries applied ANSYS tools in evaluating mechanical strength and thermal performance of an innovative thermoelectric cooler design, used extensively for spot-cooling electronics. The analysis enabled the company to meet critical deadlines for launching its new product in a competitive market.

A Solid Foundation for Rapid Innovation

ANSYS delivers structural mechanics leadership – depth, breadth, integrated multiphysics and a plethora of advanced capabilities – providing confidence that simulation results reflect real-world parameters.

Our software supports a wide range of structural study, including static, modal, harmonic, transient, spectrum and buckling analyses. Transient analyses include formulations for rigid body mechanisms analysis, mixed-rigid/flexible analyses, and implicit and explicit solutions for high deformation or high velocity phenomena. ANSYS tools can solve structural problems involving geometric nonlinearity and all possible configurations of contact; we also offer a comprehensive library of linear and nonlinear material models. You can link thermal capabilities such as convection, conduction and radiosity to structural analyses as well. Whatever your structural engineering challenge, ANSYS has the capabilities to deliver fast, accurate results.

Assembled over decades of application experience, our linear and nonlinear material models enable you to quickly and accurately analyze performance and properties of composites, plastics, metals, rubber and specialized materials, including cast iron and shape-memory alloys. You can account for strain-rate effects using viscoelastic or viscoplastic formulations. Our models aid in simulating debonding between parts and performing fracture mechanics analyses.

The comprehensive ANSYS element library means you can represent complex real-world geometries via beams, shells or solid-shells for thin structures, as well as solids that are used in a wide variety of applications. The ANSYS toolkit incorporates pretension, joints, gaskets and other special elements, such as nonlinear springs and smeared and discrete reinforcements. Structural engineers rely on our solutions to simulate the complex interactions between parts, including contacts and joints for flexible and rigid bodies.

ANSYS: Multiple Physics in a Single, Flexible Platform

ANSYS combines its structural mechanics leadership with best-in-class physics in fluid dynamics, heat transfer and electromagnetics. Structural engineers leverage multiphysics capabilities to address complex problems via ANSYS Workbench™, a powerful multi-domain environment that brings disciplines together in an interactive, seamless and flexible package.

Workbench offers a bidirectional link to all major CAD systems, eliminating the need to manually repair and update models as designs change. This powerful interface, and the resulting high level of automation, can take weeks out of your engineering process by streamlining file transfers and significantly reducing the time devoted to results translation and re-analysis.



V-ZUG leverages ANSYS structural mechanics in developing consumer appliances such as washing machines, evaluating many more design alternatives and iterating to a better solution.



Design engineers work every day with materials, components and assemblies that inherently behave in nonlinear ways. Buckling presents itself as a large deformation, for example. Using our software to solve nonlinear problems improves the accuracy of results and ultimately results in better-designed products.

The Need for Speed

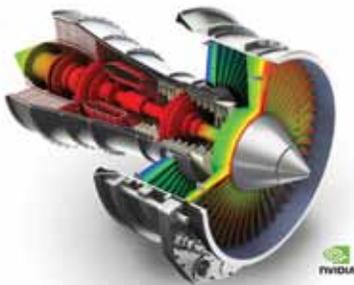
As product designs have grown in complexity, structural mechanics models have significantly increased in numerical size. Model structures today typically include a few million degrees of freedom, and the largest commercial simulations now exceed 100 million degrees. Furthermore, when structural analyses must consider other physical forces — such as heat transfer or fluid flows — simulations become even larger.

As you work to solve structural problems quickly in response to market-launch pressures, your engineering team must also support the company's product integrity promise. Our software enables structural engineers across all industries to combine high speed with high accuracy. Two reduction techniques — submodeling and substructuring — enable you to condense models for rapid computation,

without significantly affecting the accuracy of results. Parallel processing capabilities in ANSYS support the use of high-performance computing (HPC) resources. ANSYS partners with leading hardware vendors to ensure that customers get the coordinated expert support they need.

We also offer parametric analysis tools that speed up design exploration. The technology predicts the outcome of implementing modest changes in parameters or geometry without the need to run another simulation. Design of experiments analyses identify the relationship between performance and design variables.

With its tightly integrated technology structure and flexible, easy-to-use platform, ANSYS software can help you realize your product promise confidently, quickly and with a maximum return on your engineering investment.



The wide availability of HPC systems is enabling important trends in engineering simulation. Simulation models are getting larger — using more computer memory and requiring more computational time — as engineers include greater

geometric detail and more-realistic treatment of physical phenomena. ANSYS tools make light work of these higher-fidelity models, which are critical for simulation to reduce the need for expensive physical testing.

“Fermilab used ANSYS tools to reduce the time required to create analysis models. The software saved much time on the project because its graphical tools greatly streamlined the process of editing geometry and applying boundary conditions, loads, contacts and more.”

Ingrid Fang

Mechanical Engineer, Particle Physics Division
Fermi National Accelerator Laboratory

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ANSYS is dedicated exclusively to developing engineering simulation software that fosters rapid and innovative product design. Our technology enables you to predict with confidence that your product will thrive in the real world. For more than 40 years, customers in the most demanding markets have trusted our solutions to help ensure the integrity of their products and drive business success through innovation.

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