

Product Features

Structural Analysis Types

- ▶ Static analysis
- ▶ Modal analysis
- ▶ Harmonic response analysis
- ▶ Transient dynamic analysis
- ▶ Spectrum analysis
- ▶ Buckling analysis
 - Linear and nonlinear

Geometric Nonlinearity

- ▶ Large strain
- ▶ Large deflection
- ▶ Stress stiffening
- ▶ Spin softening

Contact Modeling

- ▶ Contact definitions
 - Surface-to-surface
 - Node-to-surface
 - Node-to-node
 - Beam-to-beam
 - Deformable-deformable

Deformable-Rigid

- ▶ Contact formulations
 - Penalty
 - Augmented Lagrange
 - Assembly contact (MPC)
 - Lagrange multiplier
 - Lagrange multiplier on normal and penalty on tangent
- ▶ Contact properties
 - Contact with friction
 - Thermal contact
 - Electric and magnetic contact
 - Spot welds

Boundary Conditions

- ▶ Solid and FE model BCs
- ▶ Initial conditions
- ▶ Tabular and function loads
- ▶ Structural and thermal loads
- ▶ Pre-stress loads

Material Modeling

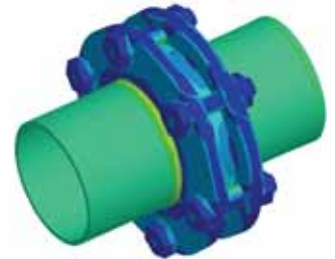
- ▶ Linear elasticity
- ▶ Inelastic
 - Rate-independent
 - Rate-dependent
 - Non-metal plasticity
 - Shape memory alloys
 - Cast iron
- ▶ Hyperelasticity (isotropic/anisotropic)
- ▶ Viscoplasticity and viscoelasticity
- ▶ Creep and swelling
- ▶ Piezoelectric
- ▶ Density, specific heat, thermal expansion
- ▶ Thermal and electric conductivity

Best-in-class simulation solutions for product design and optimization

In the present dynamic business environment, companies push the limits of their product development cycle by developing a variety of products in a shorter design cycle. This combined with the need for higher quality, competitive pressure and faster turnaround time has increased the use of simulation in the traditional product development cycle. ANSYS® Mechanical™ suite of products offer solutions to tackle these real world analysis problems by making product development less costly and more reliable.

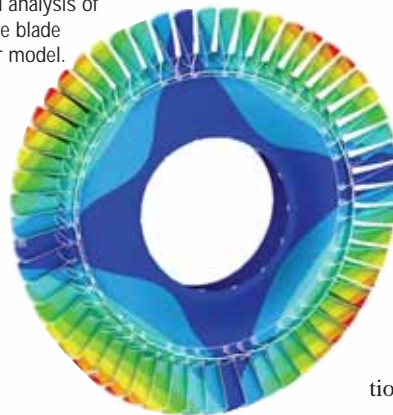
The ANSYS Mechanical solution offers best-in-class simulation tools for product design and optimization which increase productivity, minimize physical prototyping and help deliver better and innovative products in less time.

The Mechanical family of products offers a full depth of analysis from concept simulation to advanced analysis and breadth of simulation capabilities from linear to nonlinear coupled physics analysis. They provide simulation tools for users from designers to advanced analysts providing a full complement of nonlinear and linear elements, material laws ranging from metal to rubber and the most comprehensive set of solvers available. ANSYS Mechanical products are built upon years of proven and reliable technology and are widely used across industries including automobile, aerospace, biomedical, electronics and consumer products.



Stress plot of pre-tension bolt assembly analysis.

Cyclic symmetry modal analysis of turbine blade sector model.



Industry Needs and Product Benefits

Better Design through Innovation: Advanced analysis using Mechanical products offers better insight into product design and performance, leading to increased quality, lower costs and fewer rejected products. Shorter turnaround time through simulation offers greater design alternatives to develop innovative products.

Lower Costs and Shorter Cycles: Tighter product integration between CAD, meshing, simulation and optimization offers a one-stop solution for end users with reduced software training costs and shorter development cycles.

Optimized Solutions and Less Prototyping: Integrated optimization tools using Topological Optimization, Design Optimization and Probabilistic Design allow for tighter designs without repeated costly physical prototypes.

ANSYS, Inc. offers a suite of products under the ANSYS Mechanical solution available within an easy-to-use and tightly integrated ANSYS® Workbench™ interface environment.



Advanced meshing with automatic contact mesh sizing offers robust meshing solutions for bracket assembly.

Product Features

- ▶ Material damping
- ▶ User materials
- ▶ Temperature-dependent properties

Element Technology

- ▶ 2-D, 3-D structural solids
- ▶ Structural shells elements
- ▶ Structural beams elements
- ▶ Structural pipes elements
- ▶ Structural solid shell elements
- ▶ 2-D, 3-D hyperelastic
- ▶ Coupled physics elements
- ▶ 2-D, 3-D thermal solids/shells
- ▶ Multi-point constraint
- ▶ 2-D, 3-D contact elements
- ▶ Gasket elements
- ▶ 2-D, 3-D surface effect
- ▶ Combination elements
- ▶ Element birth and death

Thermal Analysis

- ▶ Steady-state and transient
- ▶ Conduction
- ▶ Convection
- ▶ Radiation
- ▶ Phase change
- ▶ Mass transport

Coupled Physics

- ▶ Thermal-structural
- ▶ Acoustic-structural
- ▶ Thermal-electric
- ▶ Piezoelectric
- ▶ Acoustics

Optimization

- ▶ Design optimization
- ▶ Topological optimization
- ▶ Probabilistic design
- ▶ Variational technology
- ▶ Parametric simulation

ANSYS Parametric Design Language™ (APDL)

- ▶ If-then-else constructs
- ▶ Do-loop features
- ▶ Array parameters
- ▶ Array parameter operations
- ▶ Macros
- ▶ Trigonometric functions
- ▶ Parametric modeling

Additional Features

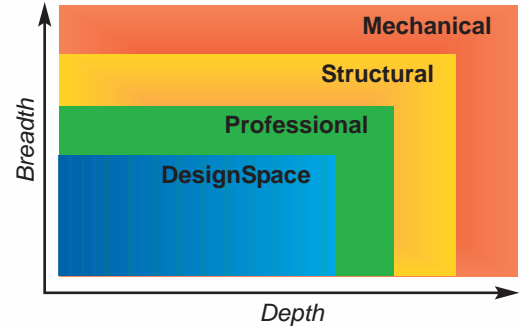
- ▶ Cyclic symmetry analysis
- ▶ Submodeling
- ▶ Adaptive meshing
- ▶ Component mode synthesis
- ▶ Substructuring
- ▶ 2-D rezoning (hyperelasticity/plasticity)
- ▶ Rigid body dynamics (ADAMS) interface

ANSYS Mechanical Suite of Products

ANSYS, Inc. offers four product subsets under its Mechanical solutions covering a wide range of depth and breadth of capabilities.

ANSYS® Mechanical™

The ANSYS Mechanical product includes a full complement of nonlinear and linear elements, material laws ranging from metal to rubber and the most comprehensive set of solvers available. It can handle even the most complex assemblies—especially those involving nonlinear contact—and is the ideal choice for determining stresses, temperatures, displacements and contact pressure distributions on all your component and assembly designs. Plus, the ANSYS Mechanical software offers the added advantage of fundamental matrix coupled-field (or multiphysics) studies involving acoustic, piezoelectric, thermal/structural and thermal/electric analysis.



ANSYS® Structural™

The ANSYS Structural product addresses the unique concerns of structural simulation, without the need for a lot of extra tools. The ANSYS Structural software provides all the power of ANSYS nonlinear structural capabilities—as well as all linear capabilities—in order to deliver the highest-quality, most-reliable structural simulation results available.

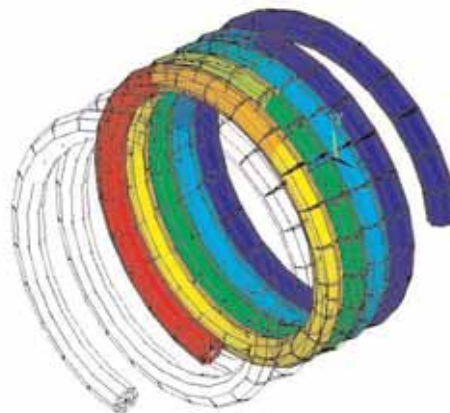
ANSYS® Professional™

The ANSYS Professional software is an inexpensive, easy-to-use program for structural/thermal analysis projects. Containing the power of the industry's leading simulation technology, the ANSYS Professional product gives users high-level simulation capability without the need for high-level expertise. It comes complete with a full contingent of linear elements, significant nonlinearities and the ability to solve complex assemblies—including shell-to-solid and the most requested set of solvers.

ANSYS® DesignSpace®

The ANSYS DesignSpace product is an easy-to-use simulation software package that gives designers the tool to conceptualize, design and validate all their ideas right on their desktops. The

DesignSpace software, which is a subset of the ANSYS Professional product, enables users to easily perform real-world, static structural and thermal, dynamic, weight optimization, performance optimization, vibration mode and safety factor simulations on all designs without the need for advanced analysis knowledge.



Nonlinear contact analysis of a spring using the new beam-to-beam contact capability. View has been enhanced to show cross-sectional details of the beam model.

ANSYS Workbench

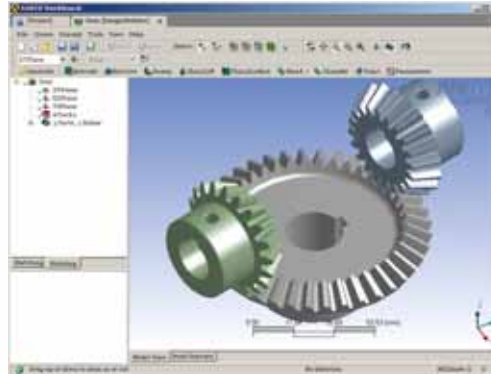
The ANSYS Workbench solution is a new-generation tool that offers an efficient and intuitive user interface, superior CAD integration, automatic meshing, access to model parameters and access to functionality available within the ANSYS Mechanical products, in one environment.

The ANSYS Workbench interface is the integration tool for ANSYS, Inc.'s advanced physics capabilities that enable users to model all applications from very simple to very complex. The integration of these, and the user's own, solver technologies can take weeks out of a CAE process by eliminating manual file transfer, result translation and reanalysis time.

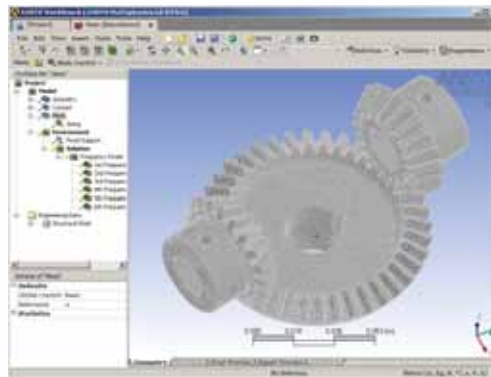
CAE tools integration does not stop with one solution. The ANSYS Workbench interface provides product performance results over the entire design domain, helping the user to understand the positive or negative impact of alternative designs without performing additional simulations.

With the many engineering professionals in an organization, the ANSYS Workbench platform allows experts to easily capture knowledge in the form of process wizards, vertical applications and standard simulation procedures. This action allows others to benefit from quickly adopting the shared expert knowledge.

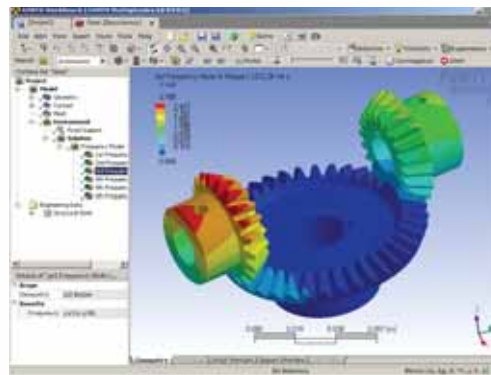
The integrated and automated ANSYS Workbench tool can provide the simulation data and product understanding needed to make quicker and less costly design decisions than with other simulation tools or testing methods.



CAD Integration and Design Modeling.



Robust Automated Meshing.



Advanced Simulation.

Product Features

Solvers

- ▶ Iterative
- ▶ Sparse direct
- ▶ Frontal (wavefront)
- ▶ Distributed PCG
- ▶ Distributed JCG
- ▶ Distributed Algebraic Multi-Grid (AMG)
- ▶ Domain Solver (DDS)
- ▶ Eigensolvers
 - Block Lanczos
 - Subspace
 - Reduced
 - QR-Damped

ANSYS Supported Platforms

- ▶ HP Alphaserver
- ▶ HP PA 8000 64-bit
- ▶ HP Itanium IA64
- ▶ IBM 64-bit
- ▶ SGI 64-bit
- ▶ Sun UltraSPARC 64-bit
- ▶ Fujitsu PrimePower
- ▶ Intel IA-32 Windows
- ▶ Intel IA-64 Windows
- ▶ EM64T, AMD64
- ▶ Intel IA-32 LINUX
- ▶ Intel IA-64 LINUX
- ▶ Intel Xeon EM64T
- ▶ AMD AMD64

Workbench Supported Platforms

- ▶ Intel IA-32 Windows
- ▶ EM64T, AMD64
- ▶ Sun UltraSPARC 64-bit
- ▶ HP PA 8000 64-bit
- ▶ Red Hat 7.3

ANSYS Workbench Modules

DesignModeler™

The DesignModeler tool is a Workbench application from ANSYS that provides modeling functions unique for simulation that include detailed geometry creation, CAD geometry modification and concept model creation tools.

DesignXplorer™

The DesignXplorer tool works from within the Workbench solution to perform Robust Design analyses of any Workbench simulation, including those with CAD parameters. The DesignXplorer software allows users to study, quantify and graph various structural and thermal analysis responses on parts and assemblies. It incorporates both traditional and nontraditional optimization through a goal-driven optimization method.

Fatigue Module

The Fatigue module adds the capability to simulate performance under anticipated cyclic loading conditions over the anticipated product life span. The Fatigue module supports constant amplitude, proportional loading and non-constant amplitude, proportional loading. Contour plots display fatigue life, damage, factor of safety, stress biaxiality, equivalent reversed stress and fatigue sensitivity.

	ANSYS DesignSpace	ANSYS Professional	ANSYS Structural	ANSYS Mechanical	ANSYS Workbench
Analysis					
Static	✓	✓	✓	✓	•
Transient		✓	✓	✓	[C-1]
Modal	✓	✓	✓	✓	•
Spectrum		✓	✓	✓	
Harmonic		✓	✓	✓	•
Random Vibration			✓	✓	
Buckling	✓	✓	✓	✓	[C-2]
Shape Optimization	✓	✓	✓	✓	•
Substructuring			✓	✓	
Structural Nonlinearity					
Geometric		[C-3]	✓	✓	•
Material			✓	✓	•
Element		✓	✓	✓	•
Structural Contact/Common Boundaries					
Surface-to-Surface	✓	✓	✓	✓	•
Node-to-Surface			✓	✓	•
Node-to-Node		✓	✓	✓	
Beam-to-Beam		✓	✓	✓	
Pretension (bolts, etc.)	✓	✓	✓	✓	•
Interface (gaskets)			✓	✓	
Spot Welds		✓	✓	✓	
Thermal					
Conduction	✓	✓		✓	•
Convection	✓	✓		✓	•
Radiation		✓		✓	[C-4]
Phase Change		✓		✓	
Coupled Physics					
Thermal/Structural	✓	✓		✓	•
Acoustics/Structural				✓	
Thermal/Electric		✓		✓	
Piezoelectric				✓	
General					
HTML Report Generator	✓	✓	✓	✓	•
Probabilistic Design System		✓	✓	✓	•
Submodeling		✓	✓	✓	
Design Optimization	✓	✓	✓	✓	•
CAD Parameter Control	✓	✓	✓	✓	•
Post-Processing					
Contour Displays	✓	✓	✓	✓	•
Vector Displays		✓	✓	✓	•
Isosurface Displays		✓	✓	✓	•
Slicing Planes and Animations	✓	✓	✓	✓	•
Results Listing	✓	✓	✓	✓	•
Pre-Processing					
Solid Modeling and Defeaturing		✓	✓	✓	•
Automatic Free-Meshing	✓	✓	✓	✓	•
Automatic Hex-Meshing	✓	✓	✓	✓	•
Hex Dominant Meshing	✓	✓	✓	✓	•
Solid Model Boundary Conditions	✓	✓	✓	✓	•
Tabular / Function Boundary Conditions		✓	✓	✓	

[C-1] Limited to thermal transients only.

[C-2] Limited to linear buckling analysis only.

[C-3] Not available for 2-D plane and 3-D solid elements.

[C-4] Limited to radiation to ambient only with specified emmissivity.

For a complete list of ANSYS products, including add-on modules for Mechanical solutions, please visit www.ansys.com/products.