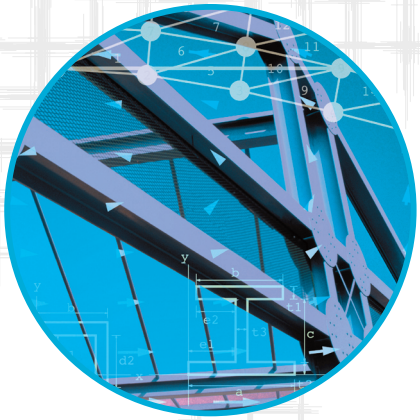
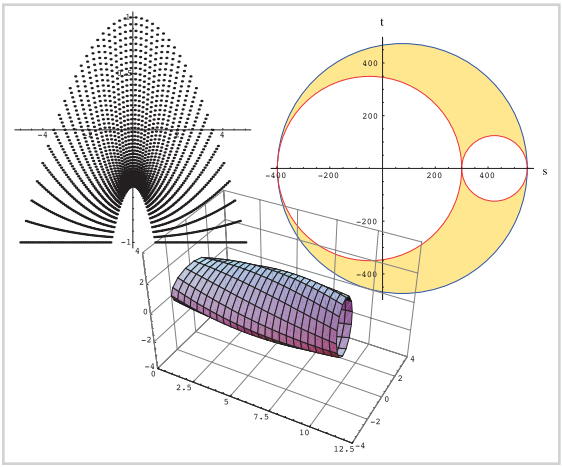


MATHEMATICA®
STRUCTURAL MECHANICS

ELASTIC SYSTEMS AND FINITE ELEMENTS WITH FULL SYMBOLIC CAPABILITY

Structural Mechanics is an application that allows users to experiment, gain new insights, and preprocess structural problems before launching into computationally expensive and time-consuming finite element modeling. With *Structural Mechanics*, users can derive basic cross-sectional properties for basic and composite sections, perform beam analysis, investigate torsional behavior and stresses, and perform two-dimensional finite element analysis. *Structural Mechanics* also allows you to easily access and symbolically manipulate lengthy equations for linearized theory of elasticity in Cartesian, cylindrical, and spherical coordinates.



Structural Mechanics offers extensive graphics and visualization tools that let users generate plots of bent or twisted beams, cross sections, meshes and deformed meshes, Mohr's circles, and much more.

KEY BENEFITS

- Derives basic cross-sectional properties for pre- and user-defined cross sections.
- Symbolically or numerically calculates bending functions, stress fields, and deflection of cantilever beams.
- Determines closed-form solutions for torsional stresses and displacements, as well as for a number of cross-sectional constants such as twist and torsional rigidity.
- Explores the finite element method using shape function generation tools, and performs two-dimensional finite element analysis.
- Computes principal stress components and directions as well as maximum shear stress and its direction.

For more information, visit **www.wolfram.com/structural**.

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Structural Mechanics and *Mathematica* provides a flexible interactive environment for the design and analysis of structural elements and models.

Structural Mechanics Features

Cross-Sectional Properties
Performs both symbolic and numeric calculations of cross-sectional properties such as areas, centroids, and moments of inertia ▪ Includes standard cross sections including rectangular sections, circle and ellipse sectors, right triangles, and parallelograms ▪ Allows the introduction of user-defined domain objects ▪ Computes moments of inertia and location of centroid for translated and/or rotated cross sections ▪ Numerically calculates the area, centroid, and moment of inertia of any polygon ▪ Generates graphical representations of cross sections and marks dimensions on cross-sectional plots

Beam Stress Analysis
Determines closed-form solutions for Timoshenko beams with circular, elliptical, equilateral-triangular, and rectangular cross sections ▪ Calculates the bending function, bending stresses, and center-of-line deflection ▪ Generates plots of bent beams

Torsional Analysis
Calculates the twist, torsional rigidity, stress function, displacements, and stresses in closed form ▪ Includes examples for torsional analysis of circular, elliptical, equilateral-triangular, rectangular, circle-sector, and semicircular cross sections ▪ Provides torsional rigidities for narrow-bar cross sections and hollow concentric circular sections ▪ Computes stress functions using complex polynomials ▪ Plots twisted beams and rotated cross sections

Finite Element Analysis
Covers one- and two-dimensional finite element method ▪ Constructs interpolation (shape) functions ▪ Includes Lagrange, Hermite, and serendipity elements ▪ Solves plane elasticity problems for both isotropic and anisotropic materials ▪ Provides intermediate steps for FEA training and educational purposes ▪ Generates mesh, using a triangulation scheme and isoparametric formulation ▪ Includes graphical tools for plotting mesh and deformed mesh

Analysis of Stress
Constructs and plots Mohr's circles ▪ Calculates the principal stresses, principal stress directions, and stress invariants from the stress state at a point ▪ Calculates the normal stress and shear components for given principal stresses and direction ▪ Includes failure theories such as maximum shear stress theory, distortion energy theory, and maximum normal stress theory

Equations of Elasticity
Allows manipulation of governing elasticity equations in Cartesian, polar, and spherical coordinates ▪ Calculates strain-displacement relationships ▪ Calculates stress-strain relationships ▪ Calculates equations of equilibrium ▪ Calculates elastodynamics equations

General *Mathematica* Features

Over 1900 built-in functions, including the world's largest collection of advanced algorithms for numeric and symbolic computation, discrete mathematics, statistics, data analysis, graphics, visualization, and general programming

Multi-paradigm symbolic programming language with support for procedural, functional, list-based, object-oriented, and symbolic programming constructs

Automatic precision control and support for exact integers of arbitrary length, rationals, floating-point real and complex numbers, and arbitrary-precision real and complex numbers

User-defined or automatic algorithm selection for optimal performance

Fully programmable 2D and 3D visualization with over 50 built-in plot types

Fully integrated piecewise functions

High-speed numerical linear algebra with performance equal to specialized numeric libraries

High-performance optimization and linear programming functions

Wide-ranging support for sparse matrices

Flexible import and export of over 70 data, image, and sparse matrix formats

Industrial-strength string manipulation

Highly optimized binary data I/O

Built-in universal database connectivity

Integrated web services support

Language bindings to C, Java, .NET, and scripting languages

MathematicaMark™ benchmarking tool

Toolkit for creating graphical user interfaces

Technical Requirements

Structural Mechanics requires *Mathematica* 4, 4.1 or 4.2 and is available for Windows, Mac OS X, Linux, and Unix.
For a more detailed list, see www.wolfram.com/mathematica/platforms.

Related Products

The *Mathematica* Applications Library is a continually expanding collection of software used in conjunction with *Mathematica* to quickly handle specific tasks in engineering, finance, data analysis, and many other technical areas.

Some of the software packages available are:
Neural Networks ▪ *Control System Professional* ▪ *Advanced Numerical Methods* ▪ *Wavelet Explorer* ▪ *Time Series* ▪ *Experimental Data Analyst* ▪ *Mechanical Systems*

Find the latest products and buy online throughout the world at **store.wolfram.com**. Choose from over 50 technical software products, more than 200 books, *Mathematica* posters, T-shirts, and other items.

For more information, visit **www.wolfram.com/structural**.

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