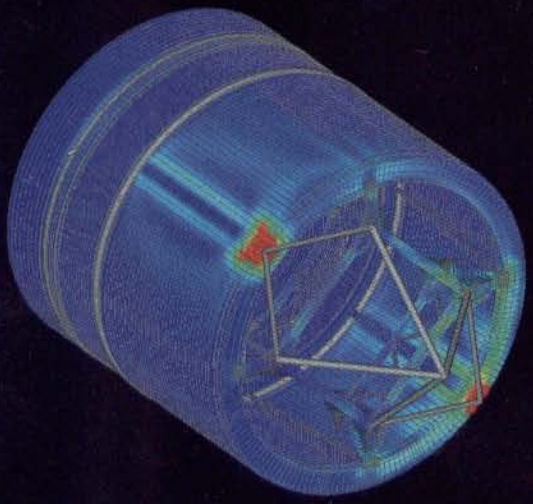
# NE/Nastran



## High Performance FEA for Windows

Turn your ideas into reality with high performance FEA on your Windows system.

Solutions in seconds not hours with the fastest direct sparse solver available today.

Reliable results using advanced hybrid finite elements that are accurate regardless of element shape or mesh density.

*Noran Engineering, Inc.*

**NE/Nastran is the product of over 15 years of continuous research and development.**

# NE/Nastran

## Element Features

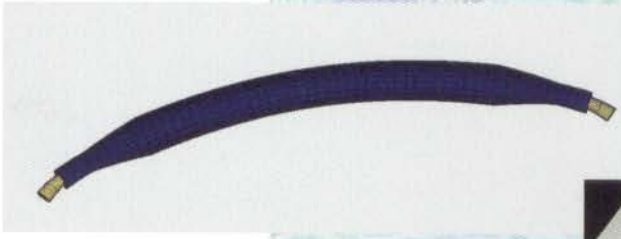
- Material properties include: Temperature and stress dependent isotropic, orthotropic, anisotropic, and laminated composite material models
- Robust shell and solid elements give accurate results even with high skew angles, large aspect ratios, and when used in a coarse mesh
- Both element and grid point stresses can be output in any coordinate system with one simple command
- Automatic mid-side edge node option for solid elements
- Automatic vertex drill degree of freedom for shell elements
- Nonlinear cable and adaptive gap and slide line elements

## Element Library

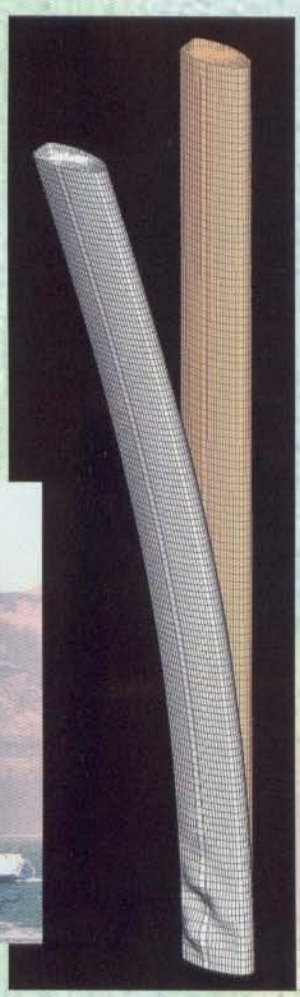
- Tapered beam
- Rod, tube, cable, and bar
- Quadrilateral and triangular plates (6 DOF/node), membranes, shells, shear panels
- Solids (four, five, and six-sided up to 20 nodes)
- Plane stress, plane strain
- Spring and mass
- Contact and friction
- Rigid general form, rigid rod, rigid bar, and rigid plate
- Interpolation
- Conduction
- Boundary surface

## Material Properties

- Isotropic
- Orthotropic
- Anisotropic
- Temperature-dependent
- Stress-dependent
- Von Mises, Tresca, Mohr-Coulomb, and Drucker-Prager material nonlinear yield criteria



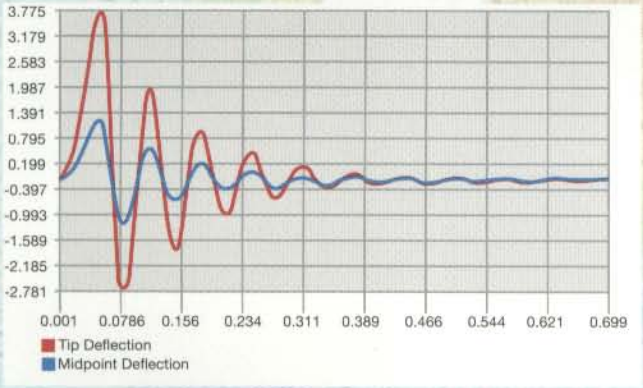
*Northwest Composites, Inc. used NE/Nastran to predict buckling loads in this luggage bin tie rod, which will be used in newer Boeing 767 Airliners. NE/Nastran predicted the critical buckling load within 0.5% of the average of 5 tests and was within 0.2% of the last one. This high degree of accuracy can be attributed to NE/Nastran's advanced element library, which contains a variable 8 to 20 node parabolic solid element that can be used to model the thin 0.05 inch wall of the tube.*

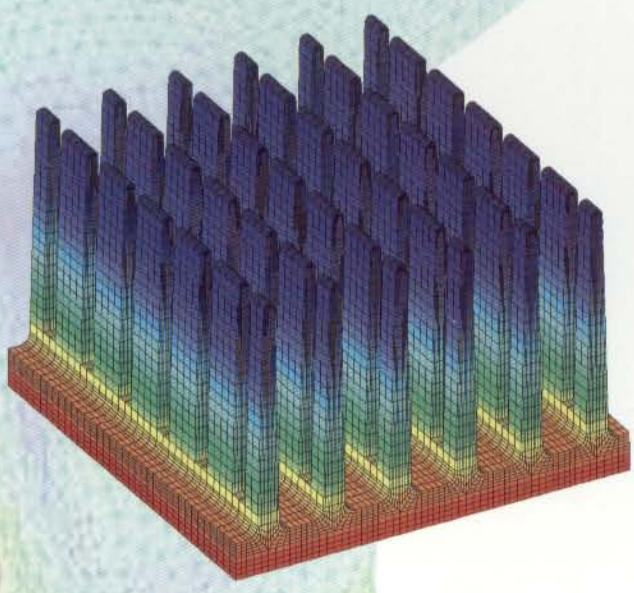


*Plytech Engineering Limited performed buckling analysis using NE/Nastran on the Sayonara sailing yacht's composite mast designed by Southern Spars Limited, New Zealand for the 1999 America's Cup challenge.*

Noran Engineering, Inc.

*Transient response analysis of a Northrop F-5E fighter aircraft wing and nose section. The wing is subjected to a 50 millisecond pressure spike. The out-of-plane deflections at the wing tip and mid point are plotted.*



*Temperature contours obtained from a nonlinear heat transfer analysis of a CPU heat sink. The CPU is thermally loaded by internal heat generation while the fins are cooled by a free convection boundary condition. The convection heat transfer coefficient is temperature dependent.*

## Loads and Boundary Conditions

- Nodal forces and moments
- Pressure loads
- Gravity and centrifugal loads
- Rotational acceleration and velocity
- Time and frequency dependent dynamic loading
- Nonlinear loads and follower forces
- Single and multipoint constraints
- Symmetric, antisymmetric boundary conditions
- Transient boundary conditions
- Multiple loading and boundary condition subcases
- Thermal loading and stress recovery
- Temperature dependent conductivity
- Isotropic and anisotropic thermal conductivity
- Temperature dependent internal heat generation
- Temperature dependent heat transfer coefficient
- Temperature gradient dependent heat transfer coefficient
- Radiation and convection loads
- Nonlinear functional forms
- Surface normal heat flux
- Grid point nodal power

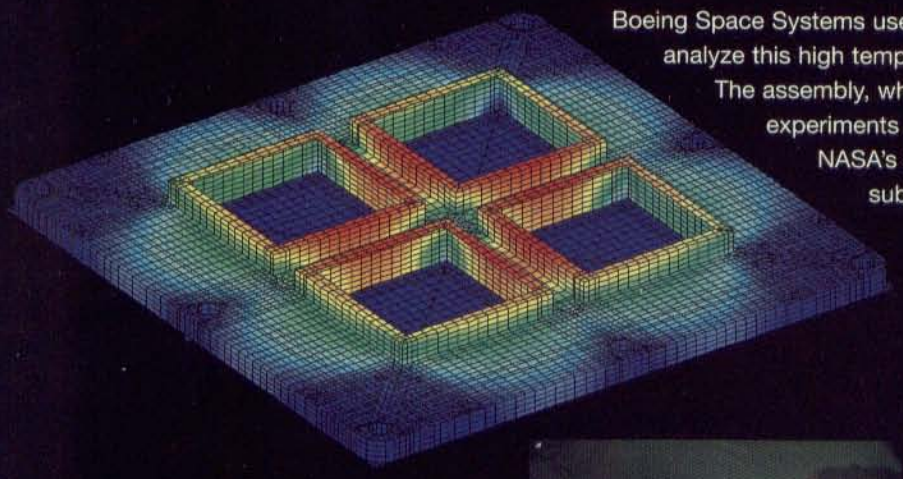
## Solution Features

- Model size limited by available disk space only
- Extremely fast sparse direct and iterative (PCG) equation solvers reduces solution times from hours to seconds
- Fast sparse subspace iterative eigenvalue solver with optional Lanczos starting vectors efficiently handles a wide range of eigenvalue problems
- Automatic mass and stiffness singularity detection and correction
- Decomposition mechanism detection and correction
- Solution error measure for static solutions, orthogonality loss, and error norms for eigenvalue solutions

## Performance and Control Features

- Fully integrated and customizable Nastran Editor controls program operation and provides results summary data through an easy to use GUI
- Uses the most current advances in finite element technology
- Extensive error checking at all stages of execution
- Complete online documentation and help
- Written in fast, optimized 32-bit Fortran 95 and C/C++

| Solution Capabilities Matrix | Version 8 | Version 9 | Version 10 |
|---|---|---|---|
| **Linear Statics** | • | | |
| Linear stress, strain, deflection | • | | |
| Thermal stress and deflection | • | | |
| Prestress | • | | |
| **Nonlinear Statics** | • | | |
| Large displacement and rotation | • | | |
| Nonlinear elastic, elastic-plastic, thermal elastic | • | | |
| Adaptive contact with friction, slide line | • | | |
| **Normal Modes** | | | |
| Natural Frequencies and Mode shapes | • | | |
| Modal Combination (ABS, SRSS, NRL, CQC, DDAM) | • | | |
| Component Mode Synthesis, Craig-Bampton | | • | |
| Linear and Nonlinear Prestress | • | | |
| **Buckling** | | | |
| Critical loads and mode shapes | • | | |
| **Dynamic Response** | | | |
| Transient Response | • | | |
| Frequency Response | • | | |
| Random Vibration | • | | |
| Enforced Motion | • | | |
| Response Spectra Generation | • | | |
| Linear and Nonlinear Prestress | • | | |
| **Nonlinear Transient Response** | • | | |
| **Nonlinear Steady State Heat Transfer** | • | | |
| Conduction, Convection, and Radiation | • | | |
| Temperature dependent material properties and loads | • | | |
| **Nonlinear Transient Heat Transfer** | • | | |
| **Direct Matrix Input and Output** | • | | |
| **Automated Substructuring** | | | • |
| **Design Sensitivity and Optimization** | | • | |
| **Parallel/Mutiple Processor Support** | | • | |



Boeing Space Systems used NE/Nastran to design and analyze this high temperature super alloy assembly. The assembly, which will be used to contain flight experiments mounted on the underside of NASA's X-34 Reusable Space Vehicle, is subjected to aero-thermal heating on vehicle re-entry. Temperatures accessed directly from the heat transfer solution were used to perform stress analysis using the same statics and dynamics model. Several critical design changes were made as a result of this coupled analytical approach, which ultimately resulted in the successful arcjet test at NASA Ames Research Center.

*"I have been very pleased with both FEMAP and NE/Nastran. The principal engineers at Wilson, Ihrig & Assoc., Inc. have been very impressed with the speed and confidence of the results. Thanks again."*

*J. E. Phillips*
*Wilson, Ihrig & Associates, Inc.*
*California, USA*

*"The timely and technically sound support we are getting from Noran Engineering does not even come close to the kind of support we [don't] get from two other leading finite element companies we have a license with. We have also found that NE/Nastran is more accurate. To say that we at L'Garde are very pleased would be an understatement."*

*Art Palisoc*
*L'Garde Inc.*
*California, USA*

*"NE/Nastran, bundled with FEMAP is for serious, accurate answers and documentation in the shortest time with the least cost and hassle."*

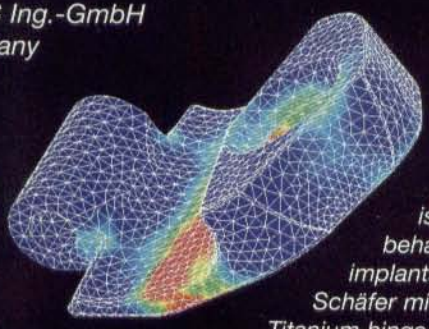
*Brooks Mitchell*
*Applied Structural Analysis, Inc.*
*Alabama, USA*

*"The greatest thing about NE/Nastran is Noran Engineering's continuous and unrelenting effort towards improvement. They are truly a customer-oriented company and maintain excellent relations with their NE/Nastran users."*

*Yutaka Zaiki*
*Numerical Systems Technology*
*Japan*

*"After an extensive evaluation we decided to use NE/Nastran as our solver due to its high accuracy, robustness and productivity."*

*Thilo Trautwein*
*ACES Ing.-GmbH*
*Germany*

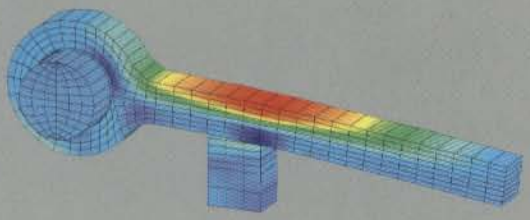


*Analysis performed using NE/Nastran by ACES Ing.GmbH in Stuttgart, Germany is used to predict behavior of medical implants manufactured by Schäfer micomed GmbH. A Titanium hinge that is part of a spinal implant was analyzed using a nonlinear static solution with contact and material nonlinearity.*

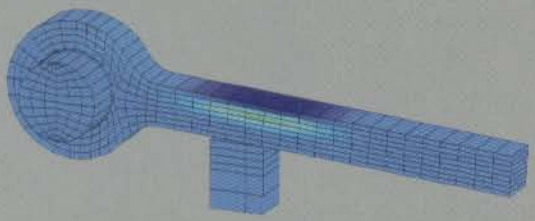
## Output Features

- Direct support for FEMAP results import using either Binary or ASCII FEMAP neutral file interface
- Results import support for other FEA and CAD applications using the NASTRAN Output 2 or PATRAN 2.5 neutral file interface
- Detailed tabular results output file
- Results measures include: energy, stresses, strains, forces, reactions, displacements, velocities, accelerations, heat fluxes, thermal gradients, temperatures, enthalpies, grid point force balance, global stiffness, mass, and damping matrixes, solution and mesh error estimates, element and grid point results
- Nonlinear results include: equivalent stress, effective plastic and nonlinear elastic strain, gap and slide line displacement and forces, contact stresses
- Frequency response results include: real/imaginary and magnitude/phase output
- Random vibration results include: power spectral densities, autocorrelation functions, and root mean square (RMS) stresses, strains, and forces, reactions, displacements, velocities, and accelerations
- Automatic and user definable measure sorting for handling multiple load case results
- Powerful grid and element set generator for generating sets that can be used to control output, define measure coordinate systems, generate grid point temperatures, and define measure sort commands
- Shell and solid element corner stress and strain output
- Grid point weight generator with complete mass properties
- Stress discontinuity/convergence error calculation
- Element and grid point stress, strain, heat flux, and thermal gradients can be output in any coordinate system including: material, grid point, basic, and global
- Intermediate bar and beam element output
- Composite failure index and strength ratio output
- Automatic generation of structural temperatures for direct modeler import or structural analysis
- Element and grid point thermal gradients and heat flux
- Heat flow into heat boundary elements

## Nonlinear Static Analysis



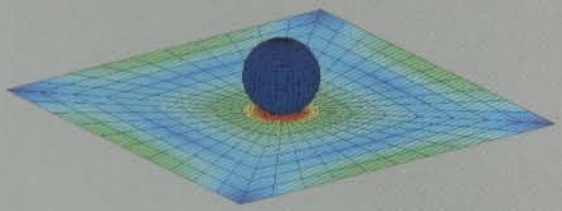
Fully loaded, plastic deformation



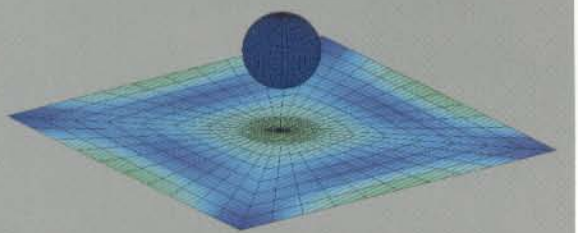
Fully unloaded, residual stress

*The above hinge is an example of contact, large displacement, and material nonlinear, all combined in one solution. The hinge is loaded with uniform pressure along the top surface. It moves immediately, contacts the stop, and begins to load resulting in plastic deformation. When the load is removed, residual stress and permanent set can be observed.*

## Nonlinear Transient Analysis



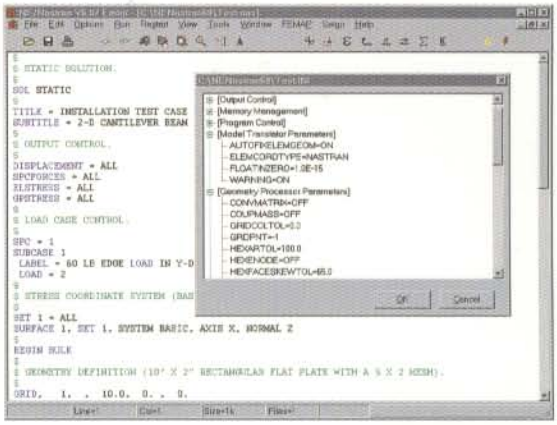
Time = 0.22 Sec, Velocity = 83 in/sec, Acceleration = -67 g's



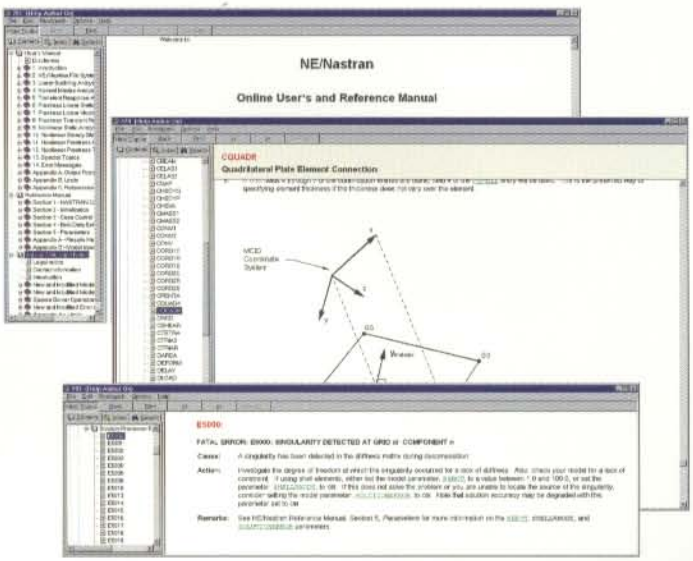
Time = 0.25 Sec, Velocity = 0.0 in/sec, Acceleration = 1 g

*The above drop test is an example of nonlinear transient response with contact and large displacement effects. The hollow steel ball is initially released from 10 inches and free falls until it impacts the aluminum plate. The ball then springs back while the plate resonates.*

*NE/Nastran contains a powerful, fully customizable graphical user interface making it easy to run models, modify settings, find and correct errors, and analyze results.*




*Detailed online documentation is provided in both Adobe Acrobat and Windows Help formats.*




## System Requirements

-An IBM or 100% compatible personal computer using an Athlon, Celeron, Duron, Xeon, or Pentium processor running Windows XP, or Windows 2000.
-256MB of available memory (2GB recommended)
-1 GB of available disk space (40GB recommended)
-A CD/DVD ROM drive

## Ordering Information

*For more information on features, benefits, capabilities and pricing, contact Noran Engineering via e-mail at* **noran@noraneng.com** *or call toll free at* **(877)NENastran**. *We accept VISA, Master Card, American Express, check or purchase order.*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