



SOFTWARE

# NE/Nastran Version 8.2

As an ex-“Nastran of another color” user, the decision to switch to NE/Nastran for Windows was an easy one.

## Vince Adams

Noran Engineering's NE/Nastran for Windows is a full-featured FEA tool with support for all the common element types typically included with standard analysis packages. These help solve the most basic solid geometry to the most complex welded or kinematic assembly. NE/Nastran also includes several more specialized elements such as tension-only plates and line elements (for modeling cables.) NE/Nastran is also an h-element tool, which means that convergence is achieved by increasing the mesh density, or reducing local element size, near areas of rapidly increasing stress. NE/Nastran's quad, hex, and wedge elements use a higher order internal definition that provides greater accuracy for a given mesh density over standard h-element's aid in the convergence process. However, the software has not yet provided an automatic convergence or mesh adaptivity algorithm that many competing tools have installed, so convergence will still be a manual process.

Models for NE/Nastran for Windows can be developed in most major pre-processors or users can opt for their NE/Nastran Modeler (as we did) that is a licensed copy of a popular and powerful Windows-based pre- and postprocessor from EDS (Plano, TX; eds.com). The NE/Nastran solver writes an OP2 binary format output file that can be read into most post-processors that have Nastran support.

### NONLINEAR CONTACT CAPABILITIES

In addition to the basic geometric and material nonlinearity capabilities available in most codes, NE/Nastran for Windows caught my attention with its contact capabilities. As the level of sophistication of part-time or design-

engineering analysts increases, the call for the more realistic response that contact can provide is growing. NE/Nastran supports Gap, Slide Line, and general 3D Surface-Surface contact, all with friction capabilities. NE/Nastran has made the use of Gap elements more flexible than many other tools I've used by allowing the software to base the initial gap clearance on the initial geometric separation of the definition nodes. This allows for randomly or gradually varying gaps to be modeled as effortlessly as parallel surfaces. In other codes, the gap clearance must be explicitly defined prior to the creation of the element, which has made gap usage on nonparallel surfaces tedious at best and prohibitively difficult at worst. When the contacting areas are not as well-defined or larger sliding is expected, NE/Nastran for Windows also has very robust Surface-Surface contact capabilities, even permitting heat transfer across a contact interface. In testing, we were able to converge a contact model with even the coarsest of meshes with very little difficulty.

To reduce memory and resource requirements, NE/Nastran recommends limiting the size of the surfaces in a contact

pair definition so that the software doesn't have to evaluate unreasonable yet legitimate contact possibilities. If this isn't practical, NE/Nastran has an “auto” setting option that enables the software to make intelligent guesses about the contacting elements based on geometric proximity, which is extremely helpful in small sliding conditions. Surface contact can combine linear or quadratic elements as well as brick, wedge, or tetrahedral elements. Surface contact can also be used to bond or “weld” nonconformal mesh interfaces. Testing with this feature provided good results, even near the bonded interface, although good modeling practice dictates that these interfaces should be far from any area of interest so that reliable results can be expected in all cases. In general, we found the contact capabilities of NE/Nastran, with and without friction, to be up to any challenge we were able to throw at it. V8.2 also added the ability for the software to identify slightly interpenetrating initial Slide Line or Surface-Surface contact conditions, and make adjustments before kicking off the solution to resolve traditionally difficult problems with fictitious high stresses at these nodes and convergence issues. However, if this technique

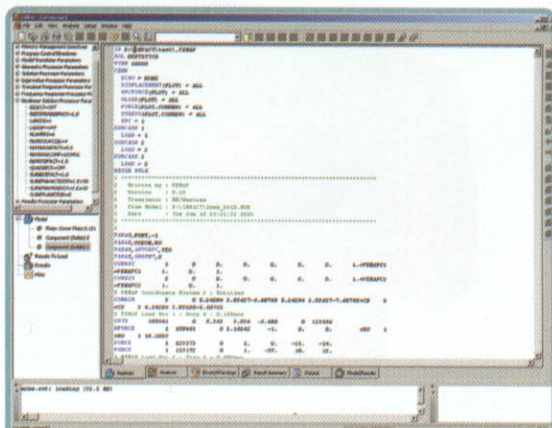


Figure 1: Version 8.2 NE/Nastran for Windows editor.

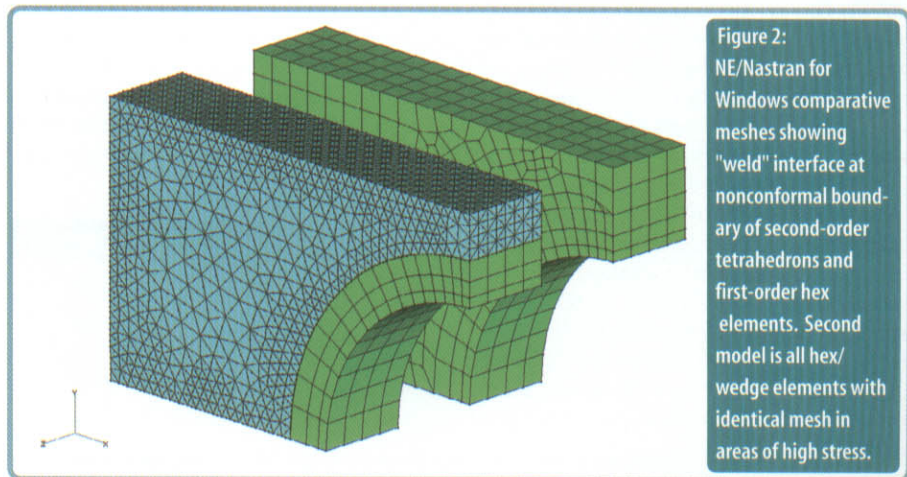


Figure 2: NE/Nastran for Windows comparative meshes showing “weld” interface at nonconformal boundary of second-order tetrahedrons and first-order hex elements. Second model is all hex/wedge elements with identical mesh in areas of high stress.

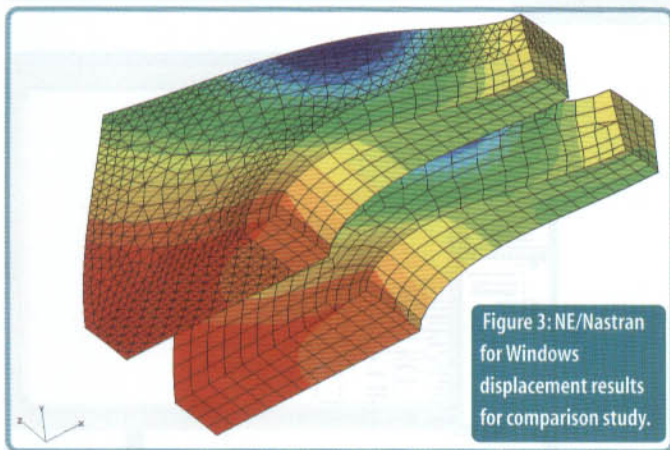


Figure 3: NE/Nastran for Windows displacement results for comparison study.

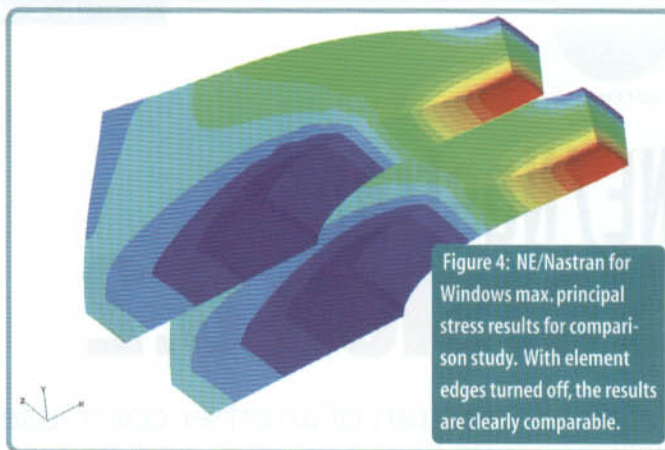


Figure 4: NE/Nastran for Windows max. principal stress results for comparison study. With element edges turned off, the results are clearly comparable.

is used to resolve more than slight penetrations, unreasonable starting conditions could develop when the initial mesh is adjusted beyond geometric reality.

#### SPEED AND ACCURACY

Noran Engineering publishes several benchmarks against other Nastrans that show it to be as fast or faster in most scenarios. You can obtain copies of these benchmarks directly from Noran if you want to explore this further.

In our tests against the Windows-version of a more well-known Nastran, using primarily linear static benchmarks, we found that NE/Nastran compared favorably in all cases, both in speed and accuracy. This makes NE/Nastran an exceptional value, even if the capabilities were similar for the base packages. However, NE/Nastran's basic nonlinear module includes the more sophisticated Surface-Surface contact capabilities that require an advanced nonlinear module in that other Windows-based Nastran.

#### THE NE/NASTRAN FOR WINDOWS EDITOR

While most users, from the more advanced analysts to the part-time design analysts, want to perform the bulk of their work in the graphical, geometry integrated preprocessor, there are many times that minor edits of the actual analysis input file can greatly enhance productivity by getting to simple inputs without the baggage of the graphics. NE/Nastran provides a very straightforward Editor interface that provides access to the entire input file in a format much like a VB or C++ editor. The Editor provides access to property-based sensitivity studies to evaluate the impact of shell thickness or beam cross-section property variations. Since it isn't directly tied to a CAD system, geometric sensitivity for solid models isn't yet supported. From within the Editor, a Queue, or batch process can be initiated for rapid batching of multiple runs. On a

recent project, we analyzed several iterations of a 7-piece weldment and the batching allowed us to keep the CPU crunching by evaluating results on one design while another design was solving. Updates to the previously solved model were added to the queue without missing a beat. The Editor also provides easy access to all the solution parameters and options so they can be changed without cumbersome deck editing.

#### ENHANCEMENTS TO VERSION 8.2

The Editor in NE/Nastran for Windows Version 8.2 also includes real-time graphing capabilities to monitor the convergence of nonlinear parameters and solution controls as well as a graphing tool for tracing nonlinear or dynamic results.

Other enhancements that have been added to v8.2 include a faster Lanczos solver for improved solution time on large modal, or natural frequency, models. The run time for these types of solutions has always been a roadblock for dynamic analyses. Von Mises Stress output for frequency response analyses has also been added thus simplifying the documentation of dynamic stress results. In the nonlinear world, v8.2 includes improved support for initial strain, either input manually or by inputting the results of a prior analysis as the starting point for the subsequent study. This makes the study of prestressed systems more straightforward. Additionally, a user can specify nonlinear solution termination at a given nodal displacement versus just the predefined load step configuration.

#### COMPANY INFORMATION

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#### TECHNICAL SUPPORT

Noran Engineering offers technical support from 8:00 AM to 6:00 PM PST Monday through Friday. Having provided technical support for various analysis codes over the years, I can honestly say that the tech support I've received from Noran as I made the transition to its particular brand of Nastran has been top-rate. The response time has been excellent and I usually receive one or two alternative solutions to a problem, sometimes later that day, which clearly indicates that the support engineers are actually looking at the problem and not just scanning a database or a list of tech notes. If I had a knock, it would be the time zone difference between the Midwest and California, which often forces me to wait on early or overnight issues until later in the morning. Users who are considering a jump into a more complete analysis tool should seriously consider the commitment the vendor makes to its customers, regardless of installation size. This is clearly important to Noran Engineering.

#### SUMMARY

NE/Nastran for Windows provides a viable alternative to more expensive FE tools while continuing to keep its capabilities state-of-the-art. V8.2 addresses two important areas: speed and contact. Optimization, both shape and topology, along with mesh adaptivity for automatic or semiautomatic convergence, would be ideal areas for the company to focus on in upcoming releases. However, as packaged today, NE/Nastran v8.2 is an excellent value that can address most of the analysis needs of any company, from beginner to expert.

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