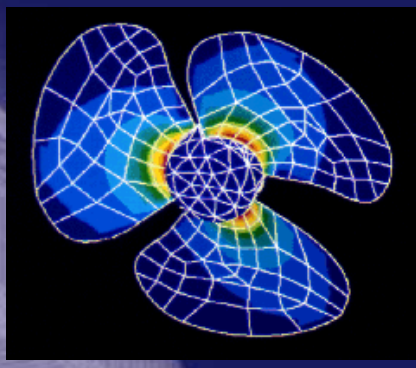
ANSYS News

Speed, Flexibility, and Power: Revision 5.2 Preview



See related article on page 3.

Inside this Issue

Third Issue

1995

"ANSYS went the extra mile to get us magnetic field solutions to optimize our traction motor designs."

John T. Jacobs
Director of Engineering
Fisher Electric Motor Technology, Inc.

ANSYS

ELECTROMAGNIFICENT

NOTHING DRIVES THE DESIGN PROCESS LIKE ANSYS/EMAG.

ANSYS/Emag. In one affordable package, you get everything required to make the most of your magnetic models—complete pre-processing, solution and postprocessing tools for performing comprehensive 2D and 3D static and low frequency analysis. ANSYS/Emag contains powerful design capabilities like full parametric solid modeling, design optimization, and automated meshing, that give engineers full control over their analyses. And with a Motif-based GUI and customizable macros it's easy to use, as well. Specific electromagnetic strengths that set us apart from the competition include:

- Coupled field capability
- Extensive circuit-EM field coupling
- Direct coupling to full ANSYS for thermal and mechanical studies.

With more than a decade of electromagnetic expertise, we understand well the problems faced by customers like Fisher Electric Motor Technology, Inc. So call one of our application engineers today. And be prepared for some electromagnificent results.

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ANSYS/Emag can be purchased separately or as a premium add-on to the full ANSYS program.

ISO 9001 CERTIFICATION INCLUDES ALL COMMERCIAL PRODUCTS

Certified Under ISO 9001: Analysis You Can Depend On

ANSYS again sets the standard for FEA software quality by receiving ISO 9001 certification. The quality assurance system we developed remains the best in the industry, providing the most reliable products on the market. ISO certification provides proof of our performance.

No other FEA provider in the world can claim ISO 9001 certification!

We undertook ISO certification to display our dedication to FEA users who seek quality in their products. Adhering to this strict international quality system standard demonstrates our ability as a world-leader in quality FEA software. ISO certification offers many user benefits. Because ISO 9001 certification involves an on-going six month audit cycle, customers can reduce their anticipated audit expenditures. Our guarantee of quality reduces the need for ANSYS users to extensively check results, and therefore saves time and money. This certification further emphasizes that ANSYS provides analysis you can depend on.

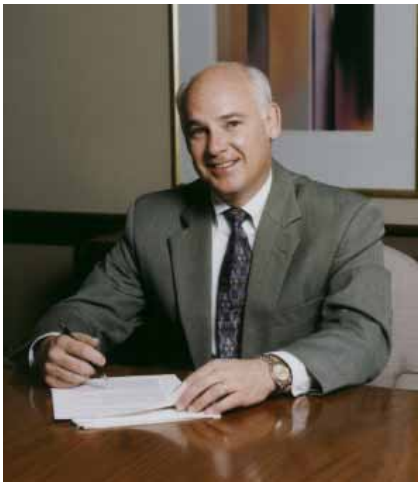
Underwriters Laboratories, Inc. conducted the ISO audits. No changes were required to the existing ANSYS system. In explaining how extraordinary this achievement was, Brian Fitzgerald of Underwriters Laboratories said, "It is exceedingly rare that any company can come through an ISO 9001 registration audit without at least one action request. I have only heard of one or two in the history of UL." Fitzgerald worked as lead assessor in the ANSYS audits.

This ISO 9001 certification exhibits the pride and confidence we place on product quality and in our quality system. In fact, we challenge our competitors to show their confidence by attempting ISO 9001 certification. Quality considerations should be a key deciding factor when choosing an FEA package.

Achieving ISO 9001 required every department within ANSYS to adhere to standards. ANSYS has always followed the Nuclear Regulatory Commission's standards, which in some cases actually provide more stringent standards than that of ISO. The NRC's standards, however, only apply to certain functional areas, whereas every department at ANSYS must conform to the ISO standards.

ANSYS represents the ultimate analysis tool for FEA users. Our

Message from the CEO



Peter J. Smith
President and CEO

quality assurance system includes over 5,500 on-going software verification tests, and over 4,000 platform acceptance tests. As one of the first FEA providers to develop its own quality system in the 1970's, ANSYS continues to drive product quality and customer satisfaction in new directions.

We know that the process of designing and analyzing a new product requires a robust and reliable design and analysis tool. ANSYS provides products you can trust, developed under a quality system that no other FEA provider can match. Engineers using ANSYS know our history in quality products and support. With ISO 9001 certification, we leave the rest of the FEA software industry even further behind.

For 25 years, ANSYS has developed a reputation for providing products of the highest quality standards. We now display that pride with ISO 9001 certification. As a world leader in the FEA software and services industry, we remain focused on customer satisfaction and setting the standards for others to follow.

I understand creating quality products requires an on-going commitment to continuous improvement. Please accept my assurance that ANSYS remains devoted to creating the best design and analysis products in the world.

Sincerely,

PETER J. SMITH
President and CEO

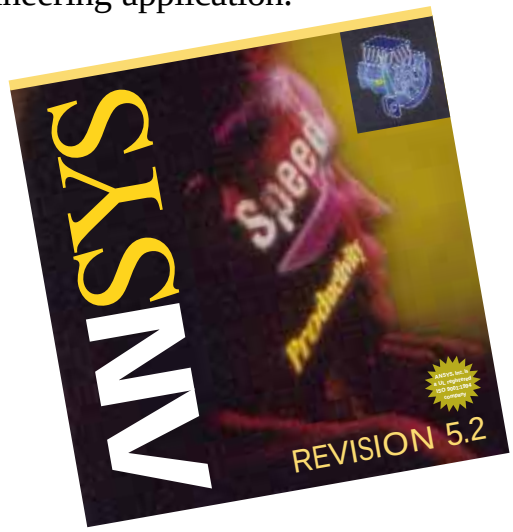
Published four times a year for ANSYS and FLOTRAN customers and others interested in the field of design analysis applications. There is no charge for a subscription; contact Mary Al Caldwell to be put on the mailing list or to change your address. Although the contents of *ANSYS News* have been carefully reviewed, ANSYS, Inc., does not warrant it to be free of errors or omissions.

ANSYS Revision 5.2 Release Preview:

Giving the User Speed, Flexibility, and Power

At ANSYS, Inc., the future of design simulation and optimization means speed, flexibility, power, and productivity. The ultimate goal is to create a design analysis tool that can be used quickly and easily on any engineering application.

We constantly strive to improve the algorithms used throughout ANSYS, to make the program easier to use and faster when solving, which translates into user productivity. Our never-ending task is to keep ahead of it, to continually provide the program features and characteristics that make our users successful in meeting their unique design challenges.



Leadership in Usability

We recognize that design challenges involve much more than individual engineering problems. While advanced capabilities are critical to giving our users powerful design analysis tools, there are additional considerations that are just as important to our users' success.

Program features and functions must be provided in a usable, flexible format. A program can have the most powerful capabilities in the world, but if you cannot obtain it on your particular platform; reuse files originally generated on a PC later on a supercomputer; use the files for additional studies such as CFD, electromagnetics, etc.; you are not getting the productivity benefits that are the actual purpose of the tool.

At ANSYS, Inc., we set the standard for usability in a number of areas. The ANSYS® program is the most flexible design analysis package in the world. We port to more hardware platforms than any other code, and we provide uniformity of user interfaces and file compatibility across all platforms, from PCs to workstations to supercomputers. A model used for a nonlinear structural analysis can be used for electromagnetic or computational fluid dynamics problems. The same model generated on a PC can be run on a Cray®.

This combination platform/file flexibility is unique to ANSYS. No other design analysis software provider has this feature. Consider the MacNeal-Schwendler Corporation (MSC). Their different capabilities are packaged in separate pieces of software with different interfaces, none of which communicate with one another very effectively. The file compatibility available with ANSYS is not available with MSC products, nor have they taken the trouble to develop native ports to emerging operating systems, such as Windows NT.

Such a lack of flexibility can create real problems down the road. At ANSYS, we view issues of usability to be as important as program features. That is the difference between a business partner, which considers user concerns such as integration, file compatibility, and the impact of software implementation across the enterprise, and the standard software vendor. We take the time to examine the ramifications for users in the development of new products, capabilities, and platform ports. A good example of our flexibility is the development of the powerful ANSYS p-element capability.

Enhanced P-Element Capability

ANSYS offers, for the first time, a comprehensive set of solid and shell p-elements that can be used for linear elastic structural analysis. This capability offers much more with respect to solution accuracy control and manipulation. Also available is a very complete set of user friendly postprocessing features. For "what-if" studies p-solutions can be cost-effective.

ANSYS, Inc. took the time to develop practical p-elements that are productive in a real-world engineering setting;

in other words, p-elements that provide fast solution times without burdensome disk requirements. Preliminary, unofficial benchmarks of the ANSYS p-element capability against competitive p-method codes, including Rasna,® revealed solutions times that are generally two-to-three times faster.

P-elements can allow the polynomial level to change from two to eight, depending on the solution accuracy desired. You can control the elements that change polynomial level thereby reducing solution time. No remeshing is required, saving additional time.

Solution convergence is user-controllable and can consist of three independent criteria: elastic strain energy, displacement, and stress. Separate convergence tolerances can be applied.

Element displays are very realistic. Less elements are required because internally the element polynomial level changes. Therefore, to enhance graphical images each element can be displayed using a faceted representation. The PowerGraphics visualization features, explained later in more detail, are available for element and contour displays and applicable to both p- and h-elements.

ANSYS users will find the postprocessing features, added to complement the p-element offering, to be very intuitive. The results for shell elements are displayed on the surface that is visible to the viewer. Users can display the individual element polynomial levels and produce convergence plots for the various criteria chosen. Solution results can be obtained at a series of locations by using the new query feature.

Element results are available in three forms: nodal, element centroid, and element subgrid (up to 25 locations on each shell element and 125 locations on a 3-D solid element). The new results picker probes data results at the location your mouse is pointing. The data probe allows automatic viewing of the minimum and maximum solution values. Results are not averaged automatically at geometric discontinuities. The obvious case would be the edge between adjoined perpendicular plates. You can also invoke non-averaging of results by material property and real constant differences.

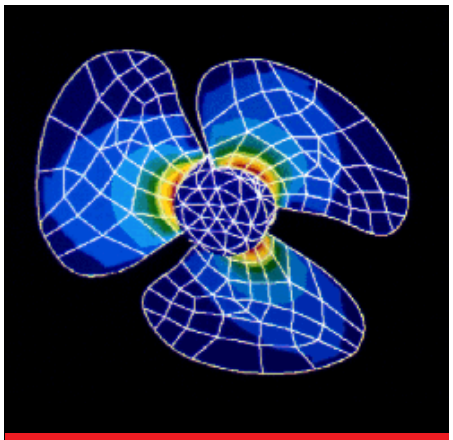


Figure 1

Fan model created and analyzed using ANSYS solid/shell elements with p-method.

To really give the enhanced p-element offering some punch, the ANSYS p-method supports the ANSYS PowerSolver, allowing fast solutions for large problems.

A good example of productivity improvement employing p-elements comes from Rocketdyne, Inc., located in Canoga Park, California. Rocketdyne, a subsidiary of Rockwell International, conducted a porosity sensitivity study in connection with the NASA Space Shuttle using the beta form of p-elements that was offered with ANSYS Revision 5.1. By utilizing the controls on polynomial levels and the need not to remesh, they were able to complete the study in two months, when they had originally estimated the study time to be over one year.

The plot shown to the left (Figure 1) utilizes the ANSYS p-element capability. An acceleration load analysis was conducted on this model of a fan.

ANSYS Power Capabilities

At ANSYS Revision 5.2, the user will enjoy the benefits of several new "power" capabilities that complement the ANSYS PowerSolver: PowerGraphics, PowerOptimization, and PowerParallel.

ANSYS PowerGraphics gives the user significant speed improvements in the plotting of ANSYS geometry and results. Speed improvements of several orders of magnitude have been documented with this new feature. For example, displaying geometry, two displacements, and two stress plots on a 52,931-element model meshed with SOLID92 tetrahedrons takes 5 minutes 11 seconds at ANSYS Revision 5.1. The same displays with Revision 5.2 PowerGraphics take only 39 seconds, almost 10 times faster. These speed improvements come from storing the geometry as an object in memory rather than repeatedly reading in the file data.

ANSYS PowerOptimization gives the user a new suite of design optimization tools. These tools include first-order and factorial approaches to design optimization. The advantage of these new tools is the ability to do design sensitivity studies using derivative information, such as gradients of dependent variables with respect to the design variables.

The third "power" feature is the ANSYS PowerParallel capability. ANSYS again leads all design analysis software vendors in porting parallel-processing versions of the software to major

multi-processing hardware platforms, including those offered by Cray Research, Inc.; Silicon Graphics, Inc.; CONVEX Computer Corp.; Sun Microsystems, Inc.; and Digital Equipment Corp.

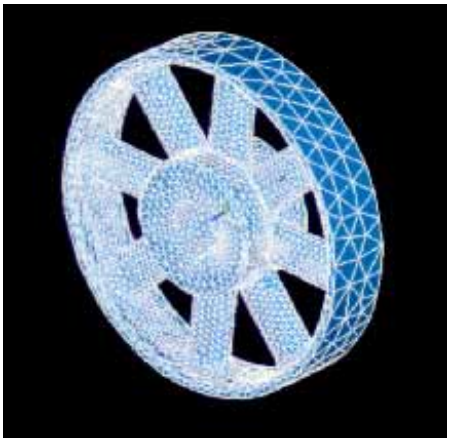
Parallel processing provides additional speed improvements to the already fast solutions achievable with the ANSYS PowerSolver. For example, a benchmark run on a Cray C916 supercomputer on a 100,116-element problem with 145,116 active degrees of freedom (meshed with SOLID72 elements) solved with the PowerSolver in 35 minutes 7 seconds. The same problem solved with four processors computing in parallel solved in 27 minutes 28 seconds, a time savings of 21.8 percent.

New 2-D and 3-D Meshers

The new 2-D quad/tri surface mesher at ANSYS 5.2, gives users control over the interior element size. Users can now influence the size of the interior elements which often results in fewer elements and faster meshing. For instance, in-house tests show that a model meshed with the earlier surface mesher required 1,782 elements. With the new mesher the same model only needed 952 elements (Figure 2). The savings in elements results from the new mesher's ability to efficiently transition from small to large elements.

The new 3-D tetrahedron mesher contains extensive model checking stages, both before and after meshing, to provide reliable mesh generation. In the preparation stage, the new facets checking feature ensures that the boundary triangular facets make sense, and notifies users before meshing when a mesh cannot be made or when problems are anticipated. The new mesher will also create higher mesh quality with the addition of the post-mesh improvement stage. This stage repositions nodes, as well as inserts and deletes elements as needed, to improve the overall mesh quality.

Overall meshing procedures have been simplified and accelerated. Now, very complex models are meshed directly, instead of meshing individual pieces and assembling them. Figure 3 shows a complex wheel design meshed using the new 3-D mesher.



Solid modeling enhancements at Revision 5.2 will include 3-D extrusion. The existing area mesh can be used, eliminating the extra step of meshing the surface volume with area elements prior to extruding the area into a 3-D meshed volume. Drag operations can now be performed on drag paths that are not perfectly orthogonal to the drag entities. The working plane can now be used as a cutting plane, slicing a model into two or more pieces.

IGES Transfer

ANSYS analysis of a model created on a CAD system must follow the IGES data transfer procedure codes. We are working to provide seamless bi-directional model transfer. At Revision 5.2, closed surface splitting for B-spline and surface revolution has been added. Boolean operations have also been improved within IGES. ANSYS now has the capability to make those Boolean adjustments automatically, saving the user time.

New to FLOTRAN

FLOTRAN,® computational fluid dynamics (CFD) software, is offered as a stand-alone product or as an add-on to the ANSYS program containing several new features.

Multiple species transport will greatly increase the realm of fluid dynamics problems possible in FLOTRAN. With this new capability users can monitor the transport of a mixture consisting of up to six different fluids, each of which may have distinct properties. This allows the mixing characteristics of different geometric designs to be evaluated for fluids with widely varying diffusion coefficients. For FLOTRAN, this capability signifies the first step in the design of a

chemical reaction flow capability. Figure 4 shows how three fluid streams, oxygen, nitrogen, and hydrogen, combine to form a mixture. This plot shows the streamline pattern of flow for the mixture, as well as the mass concentration contours for each of the three gases.

A new fan modeling capability in FLOTRAN allows the user to simulate the effects of a cooling fan or pump in a flow field. The simulation can occur in a completely enclosed area like the flow inside a refrigerator, or in a completely open area, like the flow that is passed over the cooling system of a refrigerator and exhausted.

Within Revision 5.2, the ANSYS user can couple magnetic Lorentz forces and Joule heating with their fluid flow analysis terms. A turbulence wall treatment of viscosity and thermal conductivity is also available at 5.2.

Users can now specify density, thermal conductivity, and viscosity in tabular form. Density can be specified as a function of pressure only, where previously it was a combination of pressure and temperature or just temperature. The ability to restart a FLOTRAN analysis from any results set is also new. Users will also have the option of creating a CFD restart file, which minimizes restart time for large models.

Graphical User Interface (GUI)

The Windows-like GUI introduced at Revision 5.1 has enhancements at Revision 5.2. A complete HELP command makes a triumphant return and is better than ever.

The new results picker (data probe) capability offers users quick results on an analyzed model. The picker can show results at any point of the model.

Also available is the capability to see the results on a model at any given plane within the model analyzed. This capability, known as Q-Slice (topological) display, can be beneficial when doing fluid analysis, allowing the user to slice their model at any given plane to see flow results.

New ANSYS/Emag Program

ANSYS/Emag is a stand-alone program at Revision 5.2. Improvements include a new interactive circuit builder, pre- and postprocessing enhancements, and a simplified solution process for static analysis. ANSYS/Emag is also a premium add-on product to the ANSYS program. For more information on the Emag program, see the Product Overview article (page 10).

ANSYS Derived Products

ANSYS/LinearPlus and ANSYS/Thermal are stand-alone products, with some of the same powerful features as the ANSYS program. The new 5.2 versions of these products are supported on Intel® WindowsNT™, Digital™

And in many cases, the commercial software that is deployed for design and analysis may not completely meet the unique needs of specialized industries.

Many companies often expend significant resources to develop customized in-house programs to perform specific functions. Maintenance of these programs, as well as creating and maintaining efficient, easy-to-use graphical interfaces, can be tedious and costly. Many of these in-house codes end up "on the shelf" after their initial implementation because of associated issues such as a lack of training, documentation, updating, and maintenance.

ANSYS, Inc. is focusing on the common request to tailor the ANSYS program per individual requirements through the initiation of the Program Customization Service. ANSYS development resources now available address the customized programming and analysis needs of our customers.

Using the ANSYS program as the base platform for modeling, analysis, and results evaluation, this service offers specialized programming for customer-specific applications that can be directly integrated within the ANSYS program.

In June, Customer Services launched the customized programming effort by signing a letter of intent to develop a CADDS®/ANSYS interface. As one of our first major Program Customization Service engagements, this customer-driven project created interest in the CADDS/ANSYS interface tool, and development efforts have been initiated for a new ANSYS/CVFEA™ product.

The development process of this software breaks down into three phases. In the first phase (CADDS/ANSYS Geometry Transfer), CADDS geometry will be directly read by the interface and an ANSYS solid model will be created. Because the interface will create an ANSYS solid model, the user will have access to the full suite of ANSYS capabilities to analyze the CADDS parts. In Phase II (CADDS/ANSYS Optimization), the interface will transfer not only geometry but also parameters. Transfer of parameters will be available in both directions (CADDS to ANSYS; ANSYS to CADDS) to allow optimization. Parametric updates will be handled by CADDS and all preprocessing, solution, and postprocessing functions will be done in ANSYS.

Phases I & II of this effort will require the user to have both CADDS and ANSYS. In Phase III (ANSYS/CVFEA) an ANSYS subset will be completely integrated into CADDS. Plans call for support of CADDS icons, commands using the verb-noun-modifier syntax, and macros. ANSYS/CVFEA will function inside CADDS and will have its own solving capabilities.

Customer Services has also begun work on interface products for Unigraphics® (UG). The development of these products will follow a similar phased approach. Phase I will provide a clean, one-way geometry transfer from Unigraphics to full ANSYS. Phase II will provide parameter optimization by allowing bi-directional transfer of parameters between the two packages. Finally, Phase III will integrate a subset of ANSYS into Unigraphics using UG menus. (Please note that Phases I & II will require the user to have ANSYS and UG). In all phases an ANSYS solid model will be created. All preprocessing will be done by ANSYS, and the parametric updates will be handled by UG.

Designer Series Update:

Products on the Move

"Collaborative engineering," "teamwork," and "cross-functional" are all terms that are becoming commonplace in the engineer's vernacular, but if the tools available to them are not supportive of these ideals, then the usefulness of the tools becomes almost nonexistent. Our mission at ANSYS, Inc. is to provide useful, high-quality Computer Aided Engineering (CAE) solutions to help companies stay competitive in the global marketplace.

With Computer Aided Design (CAD) becoming the driving force behind most new concepts, powerful, yet easy to use analysis capabilities need to be available to the people who need them the most: the design engineers. The best way to reach the design engineers is through the CAD software they use, making analysis possible without them leaving an environment in which they are comfortable. With the Designer Series™, engineers can immediately begin to see how their designs react in real-world situations. Designs can be refined and concepts improved, both helping to propel a company far ahead of its competitors.

ANSYS/AutoFEA™: A Product on the Move

ANSYS/AutoFEA for AutoCAD® Release 13 appeared on the market in April, but demos of the product are being shown all over the world to insure that the far-reaching AutoCAD design community has ample opportunity to see such an exciting product. Before ANSYS/AutoFEA, AutoCAD users never performed analysis with such ease. ANSYS/AutoFEA is fully integrated, eliminating tedious geometry transfers, and leads users step-by-step. With minimal training, users begin validating their designs and realizing benefits almost immediately. Versions of ANSYS/AutoFEA are available for DOS®, Windows®, and Windows NT™, capitalizing on the power and ease of the Windows environment.

Autodesk, makers of AutoCAD, embraced ANSYS/AutoFEA, inviting ANSYS, Inc. to participate in their 10-city North American seminar series held this past June. In fact, ANSYS, Inc. was the only analysis vendor asked to participate. Some of the cities visited by Autodesk were Boston, Dallas, Detroit, Houston, and Philadelphia. ANSYS/AutoFEA is backed by inclusion into the exclusive Mechanical Applications Initiative (MAI) sponsored by Autodesk. ANSYS, Inc. also attended CAD Camp, the Autodesk reseller show, held August 12-15 in San Rafael, California, and ANSYS/AutoFEA was asked to be in the Autodesk booth at AUTOFACT Asia, held July 11-14.

ANSYS/AutoFEA also appeared at the Latin American Conference, June 11-14, in Boca Raton, Florida. The conference brought resellers and developers in the Latin America area together. A seminar series is planned for Latin America, similar to the ones held in North America, and ANSYS, Inc. will be part of this promotional effort.

A 3-D version of ANSYS/AutoFEA, currently in development, is due the end of this year. The 3-D product will expand AutoCAD users' design verification capabilities and provide tighter links with the Windows environment. This makes sharing of ANSYS/AutoFEA data easier between all Windows-based applications.

The Only Choice for Pro/ENGINEER®

The recent Parametric Technology Corporation (PTC)/Rasna merger caused a stir in the CAE industry, but had relatively little effect on the ANSYS/ProFEA® and ANSYS/ProActive™ product lines. PTC has acquired an analysis code, but it will take considerable time and effort to integrate Rasna's Mechanica® within PTC's Pro/ENGINEER to the same level as ANSYS/ProFEA. ANSYS, Inc. is committed to continued development of ANSYS/ProFEA and ANSYS/ProActive. On June 12, Peter Smith, CEO of ANSYS, Inc., and Steven Walske, CEO of PTC, issued a joint letter to all ANSYS Support Distributors (ASDs), ANSYS, and PTC customers. Below is an excerpt:

"ANSYS will continue to expand its product offerings that work with Pro/ENGINEER. ANSYS/ProFEA is clearly an excellent simulation and optimization product, and we intend to maintain this leadership role.

ANSYS/ProFEA and the ANSYS-Pro/ENGINEER Interface provide Pro/ENGINEER users access to a broad and sophisticated mechanical simulation technology. ANSYS/ProActive is the latest offering, adding mechanism and motion studies. ANSYS is also research-ing new ways to improve high-end validation using Pro/ENGINEER design data. Many of the world's leading companies, including AT&T, Boeing, Siemens, and Motorola, helped to define and continue to support the ANSYS approach with Pro/ENGINEER and look to ANSYS for ongoing development."

"ANSYS will continue to expand its product offerings that work with Pro/ENGINEER. ANSYS/ProFEA is clearly an excellent simulation and optimization product, and we intend to maintain this leadership role."

The next release of ANSYS/ProFEA, slated for September, will feature distributed optimization, improved convergence for nonlinear simulation, and coupled modal/stress optimization with multiple load cases. Also, in July, ANSYS/ProFEA was released on the Windows NT platform. Now, the Pro/ENGINEER community can use the power of ANSYS/ProFEA simulation and optimization technology while leveraging the features of Windows NT.

A Grass Root Effort

In 1993, two engineers at the Allen-Bradley Company discovered ANSYS/ProFEA, and immediately saw the product's corporate-wide benefits. Allen-Bradley, a subsidiary of Rockwell International, is a leading manufacturer of factory automation products that include programmable logic controllers, operator interface panels, variable frequency electric motor drives, motor starters, and contactors. Prior to 1991, engineers at Allen-Bradley had been trying to achieve integration of analysis into their design process, but never fully achieved this goal until the implementation of ANSYS/ProFEA. Allen-Bradley had been long-time users of ANSYS, and even hired an analyst dedicated solely to ANSYS, but demand was quickly overwhelming.

Upon acquiring ANSYS/ProFEA, training classes for their design community were provided and the results were outstanding. In six months, 26 design engineers from three facilities were trained, resulting in many of the product design groups having at least one design engineer capable of performing simulation and optimization. More and more Allen-Bradley products are analyzed before creating prototypes, and the design engineers themselves are learning more complex analyses.

Through fully supporting and trusting in the power of ANSYS/ProFEA technology and integration, Allen-Bradley has proven the vital benefits that can be achieved. Allen-Bradley became a more responsive and efficient organization, with designs and concepts being validated before costly prototypes are built. Designers and analysts are creating synergy within the company instead of creating roadblocks to success. Better yet, due to ANSYS/ProFEA, the design engineers' talents are expanding.

The Cream of the Crop

The products in the Designer Series all represent technological achievement honed by a 25-year history and ISO 9001 certification. The CAD/CAE community can be assured that developers and engineers alike are working to create the best CAE tools for the job. ANSYS, Inc. supports the design engineers, collaborative technology, and all companies that wish to achieve excellence through simulation and optimization software. ■

by Howard Wood
Marketing Services

Introducing ANSYS/Emag:

The Tool for Electromagnetic Design and Analysis

Electromagnetic field simulation remains an integral part of the ANSYS program. With a greater commitment toward design and simulation, and a wealth of new capabilities, electromagnetics will be offered at ANSYS Revision 5.2 through the ANSYS/Emag product line. This commitment to electromagnetics guarantees customers timely enhancements and productive feature options now and in the future.

ANSYS/Emag will be offered as a premium add-on to the ANSYS program or as a stand-alone product. Used alone, ANSYS/Emag, a totally self-contained product, houses all of the necessary features needed for complete electromagnetic modeling and analysis. Used in conjunction with the full ANSYS program, ANSYS/Emag becomes an even more powerful tool, allowing users to perform coupled-field design simulation with mechanical and thermal analysis. A 2-D component Emag product designed for those customers requiring only 2-D analysis is also available.

The release of ANSYS Revision 5.1 ushered in a new era of engineering software ease and speed, and ANSYS/Emag has benefited from this change. The new release uses the same graphical user interface as the full ANSYS program, which allows for greater ease of use and customization for individual preferences. ANSYS/Emag is also being released for the first time as a stand-alone product on workstations. Previously, ANSYS/Emag was only available on personal computers. Let us now take a closer look at the distinguishing features of ANSYS/Emag and how it can be used for productive design and simulation.

Industry's Most Flexible Modeling and Simulation Tool

ANSYS/Emag leads the electromagnetic software industry with full parametric modeling and is the only electromagnetic product offering design optimization capabilities. The parametric modeling feature allows for complete parameterization of geometry, loading, and boundary conditions which offers flexibility and ease in studying design alterations. With the ANSYS APDL language and custom macro file capability, the parametric modeling feature allows the user to reach new heights by permitting custom development of pre- and postprocessing tools to streamline customer productivity. Complete simulation models can be reduced to a few macro calls that provide for highly tailored and customized operations. No other electromagnetic field simulation package in the industry compares to ANSYS/Emag in flexibility and responsiveness to design alterations and reanalysis.

The design optimization capability lets users choose from a wide variety of design variables such as geometry variables (air-gap width, tooth geometry, pole configurations), coil constants (turns, fill factor, etc.), loading (current, voltage), and material properties, to mention a few. After prescribing design variables and constraints on these variables, ANSYS/Emag automatically solves for a prescribed objective such as minimizing cost, weight, or solution quantities (such as field uniformity, flux leakage, power loss, eddy currents, and inductance). The design optimization feature is key to gaining a competitive advantage for our customer's products in today's business climate.

Dr. John Jacobs, Director of Engineering for Fisher Electric Motor Technology, Inc., makers of alternators and traction motors for electric and hybrid vehicles, leveraged the parametric modeling and macro customization features for fast and easy computer prototyping. Jacobs was able to achieve his desired results without having to build physical prototypes. He states, "When I started looking for a system to assist us in our needs, there were a number of products available to me, each claiming to do the job. But ANSYS allowed us to examine complex electromagnetic

models of our innovations on rotating electromagnetic devices without having to expend the time and expense to build a laboratory model. It saved us considerable time and money."

Jacobs also took advantage of the open programming architecture, utilizing a series of electric machine macros created by ANSYS, Inc. These macros streamlined the parametric modeling of the rotor and stator models and automated the analysis process, which allowed for quick turnaround on jobs.

World Class Circuit-Coupled Field Simulation

The upcoming release of ANSYS/Emag boasts the industry's most comprehensive fully integrated circuit-coupling capability. Finite element modeling of electromagnetic devices historically relied upon limiting the case of current as the supplied loading for coils and solid (massive) conductors. However, most electromagnetic devices are driven by known voltage loads, or fed by electric circuits containing many circuit components. ANSYS, Inc. spent two years developing a comprehensive set of circuit simulation features designed to integrate with electromagnetic field simulation, providing both voltage-fed conductor and circuit-fed conductor options that greatly enhance the system modeling of electromagnetic devices.

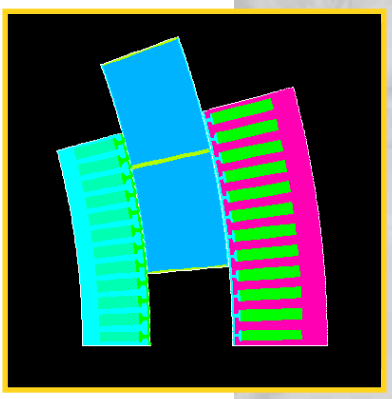
Circuit components offered include resistor, capacitor, inductor, mutual inductor, independent current source, independent voltage source, and several controlled voltage and current sources. Additionally, three circuit components offered hook directly into the modeled coil or massive conductor region of an electromagnetic model, allowing for circuit-fed simulation in 2-D and 3-D for both stranded and massive conductors.

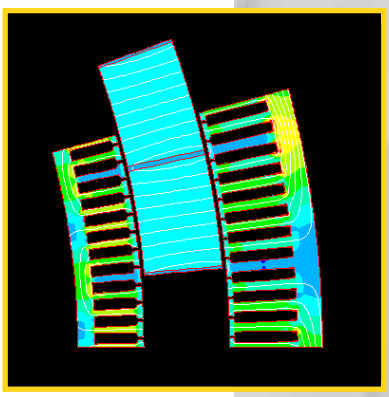
The circuit-coupling opens up a wealth of electromagnetic device simulation opportunities previously unavailable. For solenoid actuators, full transient analysis of voltage or circuit-fed solenoids exists to obtain rise-time and decay-time constants. Coil current and coil inductance can be measured as a function of time as well. Additional transient postprocessing tools, incorporated in ANSYS/Emag, simplify and automate summary reports and plots for forces, energy, power loss, current, and inductance as a function of time. For solenoid actuators, the transient postprocessing procedure reduces to a single "push button" operation.

The circuit-simulation and circuit-coupling feature enhances the use of ANSYS/Emag for design and simulation of rotating electric machines. For example, stator and rotor slot windings can now be completely "wired" together to model phasor voltage loading of the machine through delta or wye connections. Squirrel cage rotor bars and end plates can now be connected through resistors and inductors to accurately account for end effects. The circuit-coupling can take advantage of symmetry modeling in the finite element domain and thus keep modeling to a minimum. This feature

The following descriptions reveal some of the powerful capabilities of the ANSYS/Emag program and demonstrate how this technology can be applied to real-world situations, making modeling and design verification a powerful tool for engineers.

Fisher Traction Motor

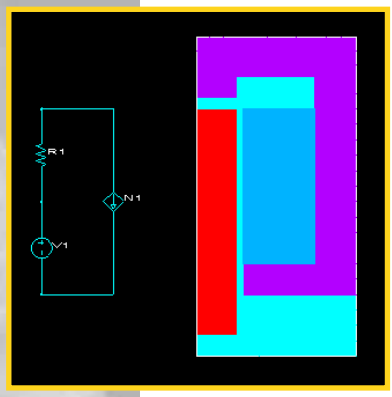


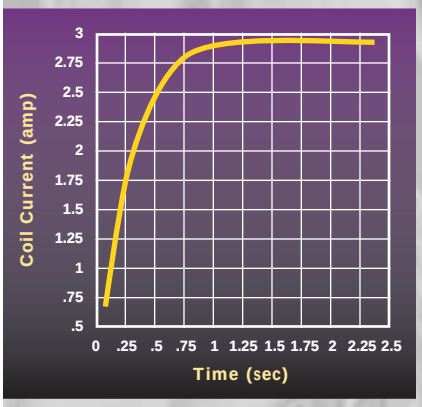


Shown here is a Fisher Technology model of a 50 KW, 240V Traction Motor for use in an electric vehicle. The model represents a single pole of a 36 pole machine. The machine contains both inside and outside stators as well as a permanent magnet rotor. The analysis is performed at different rotor angles. The ANSYS constraint equation interface feature allows for meshing the stator and rotor side air-gap regions independently, allowing for movement of the rotor to any desired position for analysis without re-meshing. Illustrated are flux density levels with flux lines superimposed on the figure.

Circuit-fed Solenoid Actuator

Shown here is a solenoid actuator model with an electric circuit. The electric circuit contains a voltage source (V1), an external resistor (R1), and a stranded coil source (N1). The stranded coil source hooks directly into the modeled coil region (dark-blue) in the finite element model to simulate the coil resistance and inductance. A step voltage load to the solenoid produced the coil current response over time as shown in the figure.





allows for complete circuit modeling of the machine while requiring only a symmetry pole model for electromagnetic field simulation.

The circuit-coupling feature also serves the power transformer industry needs for accurately simulating the circuit wiring of the primary and secondary windings. For example, the circuit coupling with the electromagnetic field allows for accurate calculation of induced currents in the closed loop formed by the parallel winding conductors. Additionally, circuit coupling allows for modeling of both open circuit conditions and load conditions on the secondary.

Coupled-Field Analysis that Can't be Beat

Today's design environment calls upon engineers to perform extraordinary design and analysis tasks on devices. Sometimes these tasks take engineers out of their comfort level. Often times a mechanical engineer must simulate an electromagnetic field, or an electrical engineer must predict temperature rise in the windings of a transformer or machine. As the industry moves to more complete system simulation, engineers from all disciplines need the resources to provide coupled-field simulation. The ANSYS family of products minimizes the learning curve and software requirements to perform such coupled-field simulation. ANSYS/Emag integrates directly with ANSYS for coupled-field simulation requiring thermal or structural analysis. Heating loads from harmonic or transient electromagnetic field simulation of transformers or machines, for example, are directly available for heat transfer analysis. Similarly, Lorentz forces in conductors, as well as Maxwell surface forces, are available for direct structural coupling.

With advanced large-deflection structural coupling features, engineers can perform complete circuit-fed solenoid actuator analysis with armature motion within a single analysis simulation. Similarly, with temperature-dependent material property characterization, engineers can perform electro-heating and induction heating simulations. With endless coupling options and opportunities, the aggressive engineer mastering these simulation options will most certainly enhance his or her position in the engineering community.

Productivity and Postprocessing Tool Enhancements

At ANSYS Revision 5.2, strides have been made to increase productivity by providing additional preprocessing, solution, and postprocessing capabilities. Solving static electromagnetic field problems in the past often required tedious load step preparation prior to solution. But now, users can solve any static magnetic field problem with a single control panel that requires only the selection of the formulation option to process.

Applying force boundary conditions for Virtual Work and Maxwell stress tensor methods have also been tedious work, but now the user is required to only group the elements of the device into an element component and prescribe that component for force calculations. The program automatically applies the boundary

conditions and calculates the forces. In the postprocessor, the user merely selects the component and forces are automatically tabulated and summarized.

Accurate linear and nonlinear energy calculations are now available for static, harmonic, and transient analysis, and a tabular report summarizes the stored energy by material. Energy density is calculated and stored in the Element Table for displaying. An error measure assesses regions in a model where mesh refinement may be required. The error measure calculates the relative error between a continuous field solution across element boundaries and the discontinuous field predicted by the elements. The calculation, valid for multiple material models, provides a tabular summary of the error norm measure in terms of field variables. The error norm values are displayed in the Element Table.

Current flow in 2-D models is now readily calculated in the postprocessor and can be used to check input current loads as well as induced eddy currents and total current flow. Transient postprocessing of calculated quantities, including forces, current flow, inductance, energy, and power loss, is now a mouse-click operation. A tabular summary is prepared that lists the results as a function of time. Display plots automatically provide a graphical summary of the results data that can be viewed by the DISPLAY program.

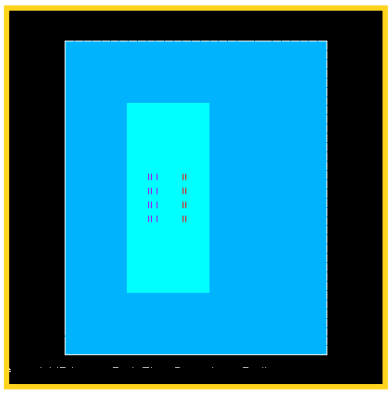
ANSYS/Emag is Your Choice for Electromagnetic Design Simulation

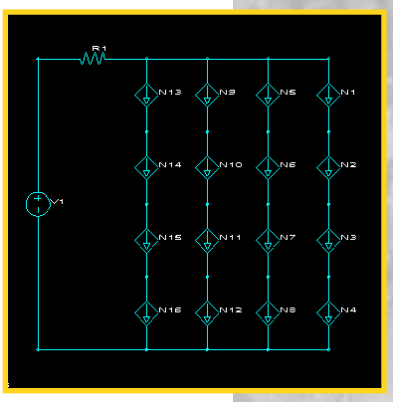
In a crowded marketplace with many electromagnetic codes to choose from, ANSYS/Emag is one of the few that can offer true world-wide distribution, training, and support with our global network of ANSYS Support Distributors (ASDs). Existing customers of the full ANSYS program receive continued use of electromagnetics, free of charge, with Revision 5.2. For more information on the ANSYS/Emag product line and licensing needs, contact your local ASD.

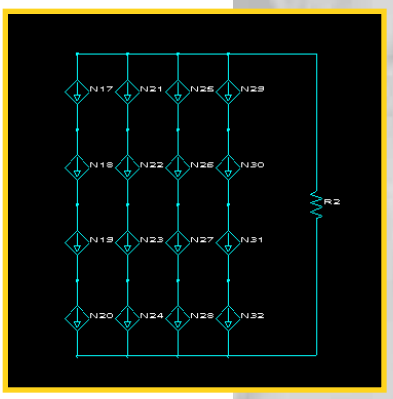
The ANSYS program has always been praised for its broad-based capabilities, but it is time for field-simulation features such as electromagnetics to have their time in the spotlight. A wealth of features such as comprehensive circuit-coupling, parametric modeling, design optimization, attractive licensing, and world-wide training and support all make ANSYS/Emag a distinguished offering in the world of electromagnetic field simulation. ■

by Dale Ostergaard, Product Manager
Electromagnetics

Howard Wood, Marketing Services







Circuit-Coupled Transformer

Shown here is a two winding transformer. The primary and secondary windings each contain four parallel conductors and four turns in a series connection. The circuit-coupling feature allows for simulating the entire primary and secondary circuit under rated frequency and load. This is useful in calculating the current distribution in the windings which are affected by eddy currents in each conductor as well as current loops formed by the current paths. The primary and secondary circuit models are shown. They include a voltage source (V1) and resistance (R1) on the primary side and a load (R2) on the secondary side. Each winding conductor is represented by a stranded coil source (N1-N32). The stranded coil sources hook directly to the winding conductors in the modeled coil regions. The primary input current, secondary output current, and secondary voltage drop are compared against experimental data as shown in the table below.

Transformer	Measured	Simulation
I (Primary)	280.0	284.8
I (Secondary)	272.0	273.1
V (Secondary)	29.4	29.5

Visualizing Fluid Flow

The subject of fluid dynamics is often avoided by mechanical engineers, but no area of engineering is better known for the pictures it creates. Flow visualization, made popular by the many examples of smoke tunnel testing, has even been incorporated into the current Ford Motor Company's emblem, which uses the dividing streamline over an ellipsoid.

Potential Flow Theory

$\psi = -\frac{\Lambda \sin(\theta)}{r}$	for the doublet
$\psi = Uy$	for the uniform flow
$\psi = Ur\left(1 - \frac{\Lambda}{Ur^2}\right)\sin(\theta)$	which gives ψ in polar coordinates

Within the area of fluid dynamics, Van Dykes' *An Album of Fluid Motion* is well known within the fluids community as a compilation of photographs of flow visualization taken from many areas of research. As flow visualization was once the best tool for the fluids researcher, this collection is able to teach a significant amount about fluid flows without the use of equations or even text.

At Engineering Methods Inc. (EMI), an ANSYS Support Distributor, fascination with the pictures collected by Van Dyke and the need for example problems that had straight-forward answers led to the inevitable.

In preparation for teaching FLOTRAN courses at EMI, the class experiments depicted within *An Album of Fluid Motion* were recreated using FLOTRAN.

The first Van Dyke photograph analyzed was of a cylinder in cross flow (Photo 1). The photo, originally taken by Sadatoshi Taneda, showed the flow with the Reynold's number at .16. For this particular case, the experimental study done involved a creeping flow. This flow is of particular interest because the flow field does not have to be determined experimentally. Because of the boundary conditions imposed on the flow and its low speed, the equations of motion can be solved directly.

Another technique to get an exact answer is to use potential flow theory. This assumes incompressible, irrotational, and inviscid fluid. Potential Flow Theory allows the flow field to be built mathematically from the superposition of other flow fields; namely, a doublet at the origin and a uniform flow field (stream functions for each of these are included in the box below). The stream function for the combination of the two can be obtained by adding the stream functions for the two separate parts. The third line in the box represents the stream function for cross-flow past a cylinder.

A FLOTRAN plot showing flow fields and streamlines pertaining to the first analysis of Van Dyke's book is shown in Figure 1. Streamlines indicate the speed and direction of flow. This functional relationship correlates well with the picture from Van Dyke, as well as with the results obtained from FLOTRAN.

The second flow experiment is over a rectangular cavity in the wall. This problem is not one that leads to an analytical solution. The problem was chosen because it is a trivial geometry to model, and the recirculation zones provide interesting results for the beginning user of FLOTRAN (Photo 2). Close inspection of the numerical solution will show some inconsistency with the experimental plot (Figure 2). This can be attributed to the fact that the only information given by Van Dyke is the aspect ratio of the rectangular cavity. The depth of penetration of the main flow would be determined by the Reynold's number. Since the Reynold's number was not known, the match is only approximate.

The third flow is into a C-section with the open side facing the flow

Photo 1 Circular Cylinder Flow (R=.16)

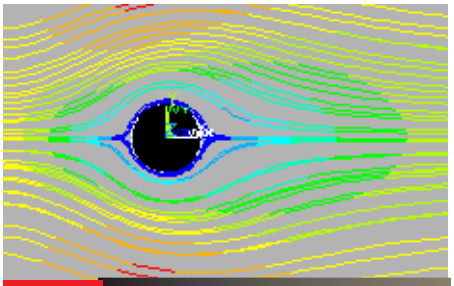


Figure 1 Streamlines Contoured by Velocity

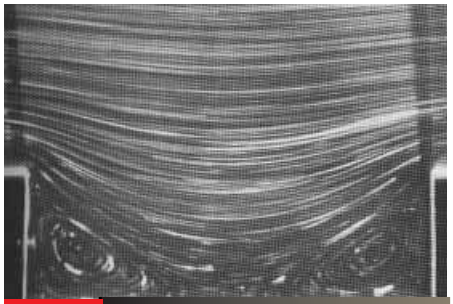


Photo 2 Creeping Flow Over a Cavity

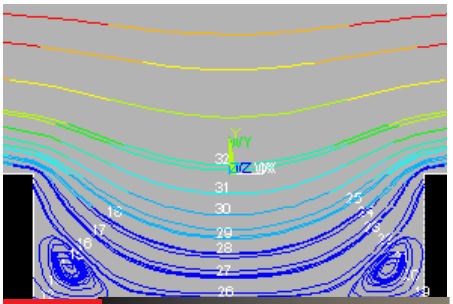


Figure 2 Streamlines Contoured by Velocity

(Photo 3). This problem was chosen because it possessed some difficulties in modeling that are not obvious. The mesh at the C-section cannot have nodes that are used for both the interior and exterior portions of the flow. The physical barrier produces a discontinuity which coincident nodes would not impose. The model used was the same as for the cylinder in cross flow with the inner circle present (Figure 3). In order to establish mesh continuity, the lines at the leading edge of the cylinder were glued to the lines forming the hole in the rectangular flow field, but the lines along the C-section were not glued to insure the discontinuity.

The last analysis run was similar to the first, with the Van Dyke picture once again having a cylinder in cross flow. In this Sadatoshi Taneda photo the Reynold's number was increased to 26 in order to develop recirculation zones behind the cylinder (Photo 4). The FLOTRAN analysis created in the last case was completed with the Reynold's number at 25, but the results were for the most part similar. One difference that can be observed is the length of the separated flow. This difference is most likely due to upstream conditions and surface roughness of the cylinder that occurs in the experimental case and was not modeled in FLOTRAN (Figure 4).

The time spent developing this set of example problems has led to a set of FLOTRAN solutions for flows which are of varying difficulty to model and for which the solutions are well documented. The correlation between the experimental results and FLOTRAN solutions are not a rigorous proof in the validity of the code, but can serve as a confidence-building tool for both the ability of the user and the capability of the code. ■

by Renard G. Tubergen
Director of Engineering Services
Engineering Methods, Inc.
West Lafayette, IN

Photo 3 Flow Around a Semicircular Arc

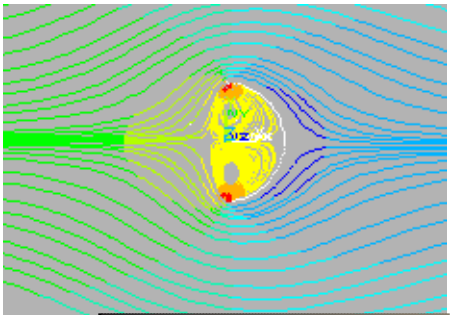


Figure 3 Flow Traces Contoured by Pressure

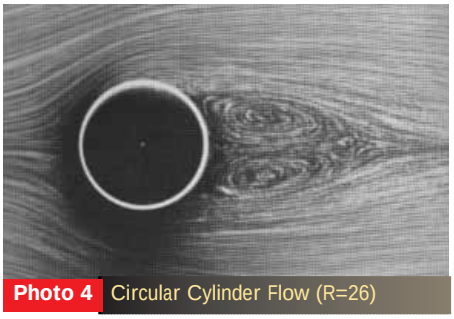


Photo 4 Circular Cylinder Flow (R=26)

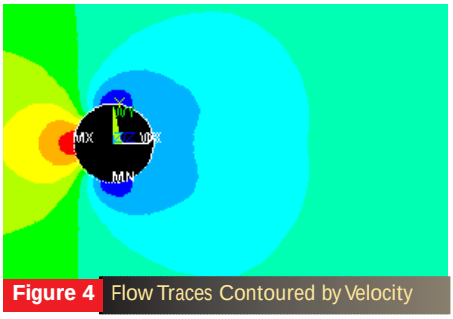
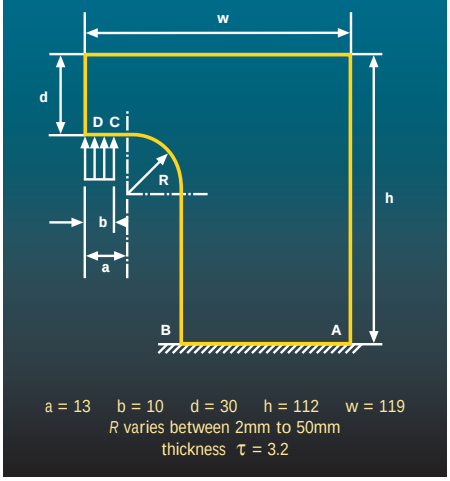


Figure 4 Flow Traces Contoured by Velocity

Where Textbook Results are not Available, ANSYS has the Solution

When a fillet is employed to smooth out transition in geometry, the popular belief is the larger the fillet radius, the smaller the stress concentration factor. This is further supported by monographs on stress concentration factors

Figure 1
Latch Geometry



such as Peterson's *Stress Concentration Design Factors*.

Well, that is not the case for a latch component of a heavy-duty wool bale press. A wool bale press is often required to work continuously with the compressing load fluctuating cyclically. This demands optimum design in the latch components required to resist the compressing load in order to prolong their fatigue service life.

While stress concentration factors for a number of cases have been extensively listed[1], that of the simple latch is not available. Using a photoelastic model with an initially small fillet radius and by taking increasingly larger fillet radii, the same model can be reused to investigate how the changing fillet radius would affect the stress concentration, but this approach is costly and time consuming. It was decided to use ANSYS to model the latch component.

Procedure

Modeling the latch component: The geometry of the latch is shown in Figure 1. Only the fillet radius R is subject to change, other dimensions are fixed as given. The latch is restrained on face AB and uniformly loaded on face CD.

The model was generated by bottom-up solid modeling with keypoints defined by parametric methods. This allowed easy changing of fillet radius, which is of prime interest in this case, as well as other parameters if need be.

Stress concentration factor: As the maximum shear stress was found to be on the boundary and the problem is plane stress, the maximum shear stress is half of the maximum principal stress σ_1:

$$\tau_{max} = \sigma_1/2$$

An average shear stress across the tip of the latch was defined as:

$$\tau_{av} = \frac{P}{d \cdot t}$$

where P: resultant force of the uniformly distributed load on face CD (Figure 1).

d: depth of the tip
t: thickness of the latch

The shear stress concentration factor is then defined as:

$$K_\tau = \frac{\tau_{max}}{\tau_{av}}$$

For each value of fillet radius *R*, the maximum value of σ_1 was sought, the position of the most critically stressed region was searched, and value of K_τ computed. A check on the error mapping and listing of forces were also carried out to ensure that the maximum σ_1 obtained was creditable.

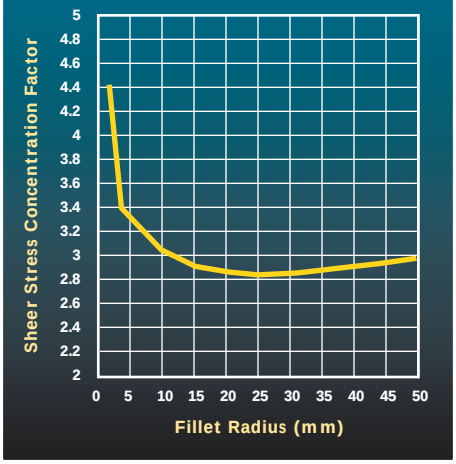
A plot of K_τ versus *R* for *R* from

Figure 2
Result of Finite Element Analysis of Changing Fillet Radius

R (mm)	τ_{max} (M.Pa)	K_τ
2	14.05	4.43
5	10.85	3.42
10	9.65	3.04
15	9.23	2.91
20	9.05	2.85
25	8.98	2.83
30	8.99	2.83
35	9.00	2.84
40	9.10	2.87
45	9.22	2.91
50	9.32	2.94

Figure 2A

Shear Stress Concentration Factor Versus Fillet Radius



2mm to 50mm is shown in Figure 2 and 2A. It was thought that a fillet radius larger than 50mm was not practical. It shows that K_τ is small for the range of R from 25mm to 30mm. Further more refined analyses showed that in fact K_τ **is minimum at R = 26.5mm**.

It is quite clear that a larger fillet radius does not necessarily mean a lower stress concentration factor. In the case of the latch component there is the contributing effect of local stress field on face CD. There are also two factors of short beam effect; stresses due to shear force and bending moment. These factors change in opposite direction as R changes.

Plots showing distribution of maximum stress σ_1 are shown in Figure 3 (R = 26.5mm), and Figure 4 (R = 35mm).

Conclusion

An optimum fillet radius is found for the latch component by finite element modeling. An inspection of Figure 3, indicates that most of the material is hardly stressed at all. Further, optimization using ANSYS will be carried out to minimize the weight of the latch component. ■

Figure 3

R=26.5mm

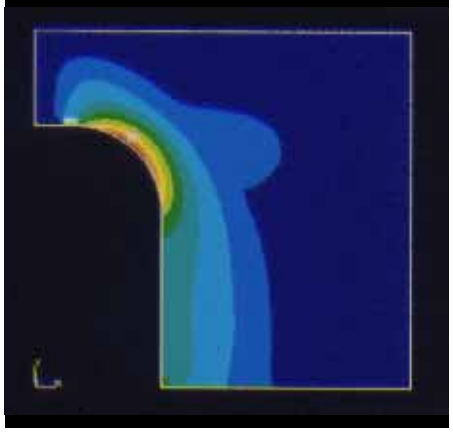
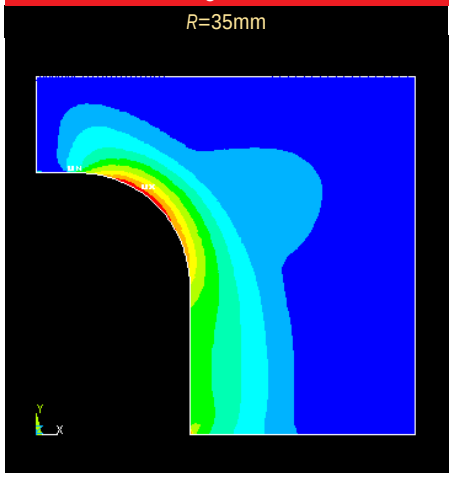


Figure 4

R=35mm



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1. Peterson, R.E. “Stress Concentration Design Factors”, John Wiley and Sons, (1983).
2. Tranxuan, D. and Boyd, J.T. “Report on Photoelastic Model for Beca Carter Hollings and Ferner Ltd”, Uniservices Report No. 3577, University of Auckland, New Zealand, (Oct. 1990).
3. Pedersen, M.B. and Tranxuan, D. “Fillet Optimization by FEA and Photoelasticity”, Final Year Project Seminars, Mechanical Engineering Department, Victoria University of Technology, Australia, (Dec. 1994).

by Dr. Danh Tranxuan
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Victoria University of Technology
Melbourne, Australia

Mallett Technology:

Teaching Classes for the User

In order for an engineer to make the best use of Computer Aided Engineering software they must first understand the underlying technology. For the past eight years, the University of Maryland has combined efforts with

Attendees of the 1994 Session

Mallett Technology, Inc., in hosting two short courses that have been developed to aid and enhance practicing engineers' skills. Mallett Technology, Inc., the ANSYS Support Distributor (ASD) for the Mid-Atlantic region, regards these courses as particularly valuable to ANSYS and FLOTRAN users.

The first course, *The Integration of Finite Element Analysis into Design Practice*, explains data transfer from CAD systems, guidelines for finite element modeling, and advanced topics in adaptive meshing and optimization. Lecturers involved include Professor Mark Shephard of the Rensselaer Polytechnic Institute, Professor Sunil Saigal of Carnegie Mellon University, and instructors from Mallett Technology as well.

The second course, entitled *Computational Fluid Dynamics Using Finite Element Analysis*, presents basic equations and illustrates how to obtain and interpret fluid responses using modern computational fluid dynamics software. Instructors for this course include Professor Steven Miner of the U.S. Naval Academy, Dr. Richard Schwirian of Westinghouse Nuclear Technology, and Mr. James Smotrel of Babcock and Wilcox Nuclear Technologies.

These three-day courses will be held at the University College Conference Center at the University of Maryland, College Park Campus. *The Integration of Finite Element Analysis into Design Practice* will be held on October 9-11, 1995. *Computational Fluid Dynamics Using Finite Element Analysis* is scheduled for November 13-15, 1995.

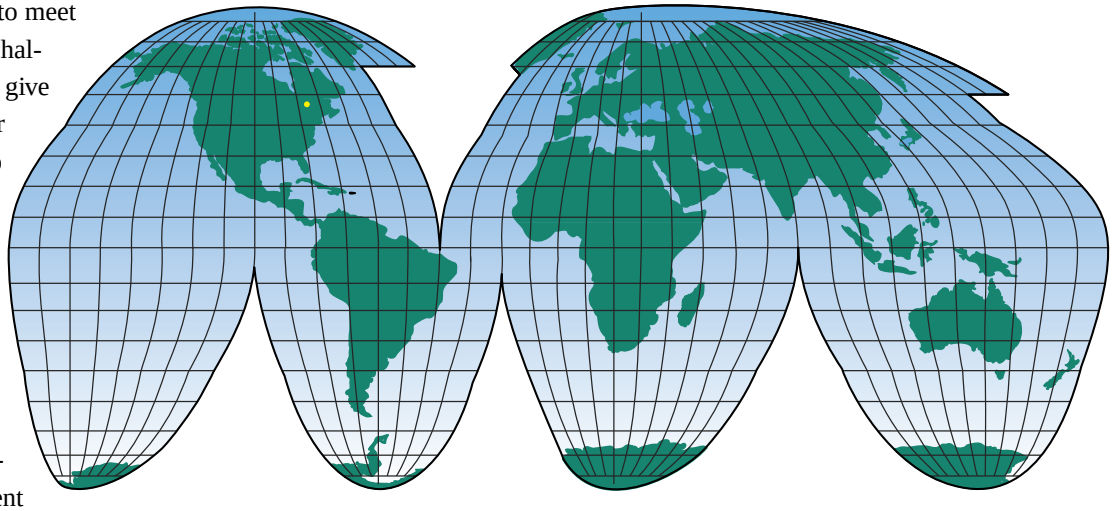
Information regarding arrangements for these courses may be obtained by contacting Mallett Technology at 1(800) 682-6797 or e-mail to (ctb@pitt.mallet.com).

Information regarding content of the courses may be obtained by contacting David Dietrich at (301) 725-0060 or e-mail to (dedii@wdc.mallett.com). ■

by David Dietrich II
Educational Programs
Mallett Technology, Inc., McMurray, PA

Customer Satisfaction Survey Summary

Everyone at ANSYS, Inc. extends their gratitude to all of our users who took the time to complete the 1994 ANSYS Customer Satisfaction Survey. ANSYS, Inc. is committed to constantly improving and providing you with the best innovative products and services to meet your ever-changing engineering challenges. Your input and evaluation give us a tool not only to monitor your present satisfaction, but a basis to judge our future performance.



Every ANSYS Support Coordinator throughout the world received the 1994 survey. In addition to English, the survey was translated into three major languages: French, German, and Japanese. The overall response rate of over 39 percent signifies our users' interest in helping ANSYS, Inc. become the number one supplier of Computer Aided Engineering tools and services worldwide. Ten winners drawn from the list of survey respondents were awarded a free copy of the ANSYS/ED Program.

One very pleasing result from the survey was that the highest ratings were given to ANSYS, Inc.'s and ANSYS Support Distributors' technical support services. In addition, 43 percent of the respondents told us they only request technical support on a monthly basis, followed by 40 percent who request support quarterly. These results reflect the ease of use of ANSYS products, the excellence of ANSYS training courses, and the high quality of ANSYS support, when requested.

Many ANSYS users also use other analysis programs in their work. To take advantage of their experience, we asked that the ANSYS Program be compared to the other programs used within the last year. The ANSYS Program received an overwhelming vote of confidence and was shown as superior to the majority of our competitors' programs. In addition to this outstanding vote of confidence, respondents indicated a strong satisfaction and loyalty in their response to the final question in the survey: "Would you recommend ANSYS products and services to someone else?", **96 percent surveyed said "yes"**.

As part of our commitment to constantly improving our products and services, your evaluation and input are key factors as we strive to satisfy your needs. If you would like to receive a future survey or share your feedback with us, please contact either Elaine Travers at (412) 873-2851 or e-mail to etravers@ ansys.com, or Leo Mezerski at (412) 873-2865 or e-mail to leomezerski@ansys.com. ■

by Elaine Travers
Marketing

Leo Mezerski
Corporate Sales Programs

Call for Papers:

Seventh International ANSYS Conference and Exhibition 1996

ANSYS, Inc. seeks abstracts for its Seventh International Conference and Exhibition. The conference will be held from May 20 through May 22, 1996 at the Pittsburgh Hilton and Towers, Pittsburgh, Pennsylvania. The theme of the conference is *"The Future of Simulation Tools: Computer Aided Engineering (CAE) in the 21st Century"*.

ANSYS users are invited to submit papers for the Seventh International ANSYS Conference and Exhibition. Submitting an abstract allows you the possible opportunity to lead a discussion that examines techniques, applications, and strategies in your area of expertise.

Suggested Paper Topics

"The Future of Simulation Tools: CAE in the 21st Century", describes the focus. ANSYS, Inc. welcomes abstracts covering all aspects of design and analysis. What we are looking for are papers that push analysis to its limits. Users who have problems that take the ANSYS program to the extreme are of most interest. Also, a separate session will be held for papers showing how analysis has improved your company's bottom line.

Some suggested paper topics are included, but feel free to write about new technologies not listed. ANSYS, Inc. takes interest in analyses that furnish intuitive, intelligent solutions to engineering problems.

Suggested Topics for the Paper Sessions

- Aerospace
- Electronic Applications
- ANSYS/AutoFEA
- General Applications
- Automotive
- Electromagnetics
- Biomechanics
- Manufacturing Simulation
- CAE Integration
  (*How it improved your bottom line)*
- Nonlinear Analysis
- Nonmetallic Materials
- Composites
- Optimization
- Computational Fluid Dynamics
- ANSYS/ProFEA
- Dynamics
- ANSYS/ProActive

Submitting an Abstract

Please send abstracts to ANSYS, Inc., attention: Bill Bryan. Also, for your convenience, abstracts may be sent via fax transmission (412) 873-3118 or e-mail to williambryan@ansys.com. ■

Deadlines

First Drafts Due:	**September 30, 1995**
Final Papers Due:	**December 31, 1995**
Conference Date:	**May 20-22, 1996**

by Jennifer D'Orazio
Marketing Services

Revision 5.1 Available on AlphaStation

ANSYS Revision 5.1 is now available for Digital Equipment Corporation's AlphaStation™ computer system under the Windows NT™ operating system. The AlphaStation is the fastest system running ANSYS Revision 5.1 in a Microsoft Windows NT environment. Digital's AlphaStation workstations offer impressive floating-point performance and industry-leading 2-D and 3-D graphics. The chart above shows the results of standard benchmarks for ANSYS Revision 5.1 on various AlphaStation models and their timing results generated.

AlphaStation Timing Results (in seconds)
Standard Benchmarks for ANSYS Revision 5.1*

* All configurations are 128MB, 2 Disks, WNT 3.5

	LS1	LS2	LS3	LS4	LS5
AlphaStation 400 4/233					
CPU Time	47	256	790	1824	1962
Elapsed Time	49	273	863	1942	2113
AlphaStation 250 4/266					
CPU Time	33	196	596	1497	1323
Elapsed Time	35	223	680	1655	1541
AlphaStation 600 5/266					
CPU Time	22	138	437	1006	911
Elapsed Time	24	158	502	1118	1050

Currently, the Windows NT version of ANSYS contains only 2-D graphics capabilities, but support for 3-D graphics is planned for future releases.

Windows NT offers manufacturers a new way to achieve increased competitive advantages. The combination of ANSYS, Digital's Alpha RISC processor, and Microsoft's productivity tools opens up even greater advantages for design engineers and manufacturing companies. ■

by Ralph Campanelli
Mechanical CAD Marketing Manager
Digital Equipment Corporation
Marlboro, MA

Julie Lesko
ANSYS Senior Systems Analyst
Systems and Production

The following information represents a partial listing of ANSYS and FLOTRAN seminars and the dates the seminars will be presented. For complete details on the seminars listed below, contact the ANSYS Support Distributor (ASD) shown for that particular seminar. Contact your ASD if you are interested in a seminar not listed here. For seminars held at ANSYS, Inc., contact Terry Serena at (412) 873-2882. Reservations are recommended at least two weeks in advance.

DATE (Week of)	Introduction to ANSYS	Design Optimization	Dynamics	ANSYS Pro/FEA	Heat Transfer	FLOTRAN	Substructures	Solid Modeling	Structural Nonlinearities	Special Topics (See footnotes)
Oct. 2-8	SIL	STR	ING		ITAL			IMAG ANS	ATT CAD	CAD[9] ANS[25]
Oct. 9-15	EMI IMAG AZE MCR ECI ITAL			JAR	STR DEF			EMI DEF	ANS	CAD[7] CAD[6] CAD[14] ANS[3]
Oct. 16-22	STR DRD ING			CEC ECI DRD		ITAL	STR ANS		AET	IMAG[8] CAD[3] CAEA[22] CAEA[23]
Oct. 23-29	IMAG DEF	MTI ITAL				JAR ING		ECI		STR[17] IMAG[8] CAEA[24]
Oct. 30-Nov. 5						ECI		SIL		ANS[3]
Nov. 6-12	MTI STR AET ANS EMI ITAL MCR		AET ANS		MCR			EMI	ECI	IMAG[8] CAD[7] CAD[10] CAD[1] CAD[14] CAD[20]
Nov. 13-19	JAR CEC JLR ECI ATT CAEA	EMI	SIL CAEA		CAD	STR ITAL		IMAG	STR DEF	NIIT[21] ANS[26]
Nov. 20-26	IMAG	ITAL			IMAG STR					IMAG[8] CAD[2] CAD[11] CAD[13] CAD[5] CAD[1] CAD[12]
Nov. 27-Dec. 3	SIL DEF				CAD	ECI CEC			ING	STR[18] CAD[3] ANS[3]
Dec. 4-10	STR ECI ANS EMI DRD			DRD	AZE IMAG ANS			EMI	SIL	STR[19] CAD[7] CAD[9] CAD[14]
Dec. 11-17	ING DEF ITAL			EMI ECI MTI		ITAL CAD ANS	SIL	ING		MTI[4] CAD[7]
Dec. 18-24					ECI					CAD[15] CAD[16]
Dec. 25-31						ECI				

Company Key

ANS ANSYS, Inc.
AET Advanced Engineering Technologies
AZE Anker-Zemer Engineering A/S
ATT AT&T ISTEL
CAD CAD-FEM GmbH
CAEA Computer Aided Engineering Assoc.
CEC Concurrent Engineering Corp.
DEF Defiance/STS/SMC
DRD DRD Corporation
ECI Engineering Cybernetics, Inc.
EMI Engineering Methods, Inc.
IMAG IMAG Industries Inc.
ING INGECIBER S.A.
ITAL Italcae SRL
JAR Jordan, Apostal, Ritter Assoc.
JLR JLR Computer Analysis, Inc.
MCR MCR Associates
MTI Mallett Technology, Inc.
NIIT NIIT Ltd.
SIL Silicon Graphics s.r.o.
STR Structures and Computers Ltd.

Special Topics Key

1 LS-DYNA3D-Metalforming
2 LS-DYNA3D-Airbag Simulation
3 ANSYS Rev. 5.2 or 5.3 Update
4 ANSYS Pro/ENGINEER
5 FLOTRAN-Short Intro
6 Injection Molding with C-Mold
7 FEA with ANSYS/ED short intro
8 ANSYS Presentation
9 ANSYS/FEA with Pro/ENGINEER
10 ANSYS/FEA with Autocad
11 ANSYS Numeric: 1 Basics Analysis
12 ANSYS Numeric: 2 Error Est in FEA
13 ANSYS Numeric: 3 Eq. Solver in FEA
14 ANSYS Basics: 1 Intro ANSYS/FEA
15 ANSYS Basics: 2 Solid Model, Macro Lang., Optimization 1
16 ANSYS Optimization 2, Advanced
17 User Group Meeting
18 Intro to ANSYS/ED 5.0
19 Intro to ANSYS/ED 5.1
20 ANSYS Macro Lang. and User Prog.
21 6th ANSYS User Meeting
22 Finite Element Modeling
23 Random Vibrations
24 Fracture Mechanics
25 Magnetics
26 User-Programmable

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