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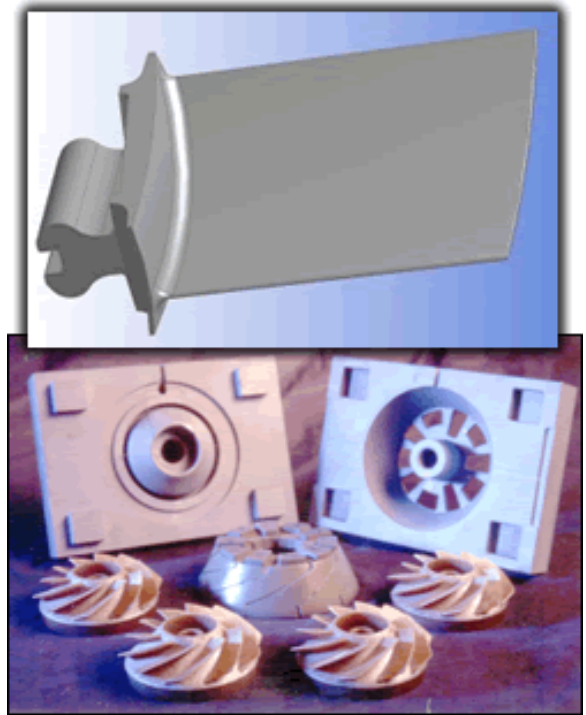
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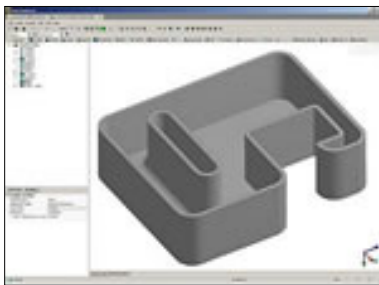
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Leveraging the Advantages of Workbench: DesignModeler

by [Eric Miller](#), PADT

Overview

Over the past several releases, ANSYS Inc. has been rolling out more and more of their Workbench technology. There is already a lot of marketing and technical information available on the various aspects of Workbench, but PADT is still often asked: Why should I use Workbench? or How can Workbench help me? We will attempt to answer these questions with a series of articles about using these new tools to your advantage.



In this third article, we will focus on a Workbench based module that can benefit a large number of users: DesignModeler. In coming issues we will discuss CAD associativity, embedding APDL, post-processing with report writing, and using Workbench hand-in-hand with ANSYS Classic. If you need some basic information on the Workbench, or information on how to access it, please review the first article in this

series.

Modern Solid Modeling for ANSYS

The first step in almost every FE analysis is the definition of the geometry to be analyzed. Most users find that the built in geometry modeling in ANSYS PREP7 is one of the biggest productivity advantages of using ANSYS. When the plans were made for a more modern pre/post processor, the development team made sure that there was an effort to also provide a modern geometry modeling tool that was aimed at the analysis user. There have been several name changes along the way, but with version 7.1, ANSYS Inc. is delivering a very powerful and useful geometry tool in what is now called *DesignModeler*.

This is not a CAD program, but a module built with Workbench technology that gives analysts feature-based parametric solid modeling tools that are associative to the rest of Workbench and that also produces an ANSYS *.anf file (this is the format used by

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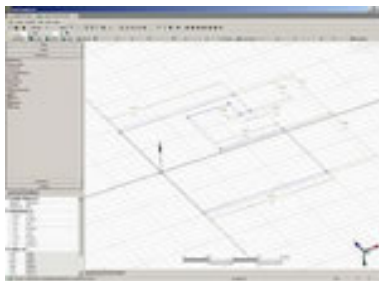
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PREP7). PADT has just started to really exercise this tool and we have been pleasantly surprised by how robust and useful the 7.1 release is. If you are an experienced CAD user, it may take you a while to get your head around the user interface and the way the geometry history works, but this is because things have been adjusted from standard CAD approaches to paradigms that are better suited for building and modifying analysis models.

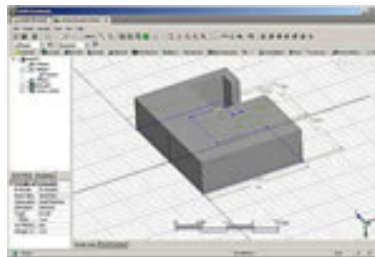
Goodbye Bottom-Up Boolean; Hello Feature-Based Modeling

If you are a die-hard PREP7 geometry person, you have learned how to build things from the bottom up: keypoints to lines to areas to volumes. You have also learned how to do more complex geometry by creating things bottom-up and then using Boolean operations like add, glue, and subtract. DesignModeler is much faster and easier to model in because it has replaced that approach with the widely used concept of creating a parametric 2D sketch that is then used to add a feature to your model. The order in which you create these features and how they relate to each other is automatically stored in the database.

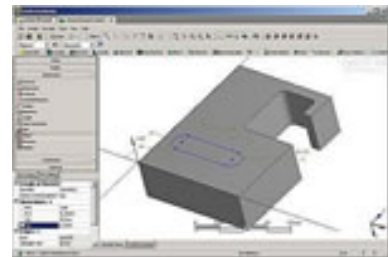
What this means is that you no longer need to build elaborate APDL scripts for parametric geometry models. No more trying to figure out what the number is of a volume created by a Boolean operation! Once created and stored, all the user needs to do to modify the geometry is change dimension values and update. As a simple example, Figure 1 outlines the steps to create a simple part.



Step 1. Sketch profile.



Step 2. Extrude profile.



Step 3. Sketch & remove slot.

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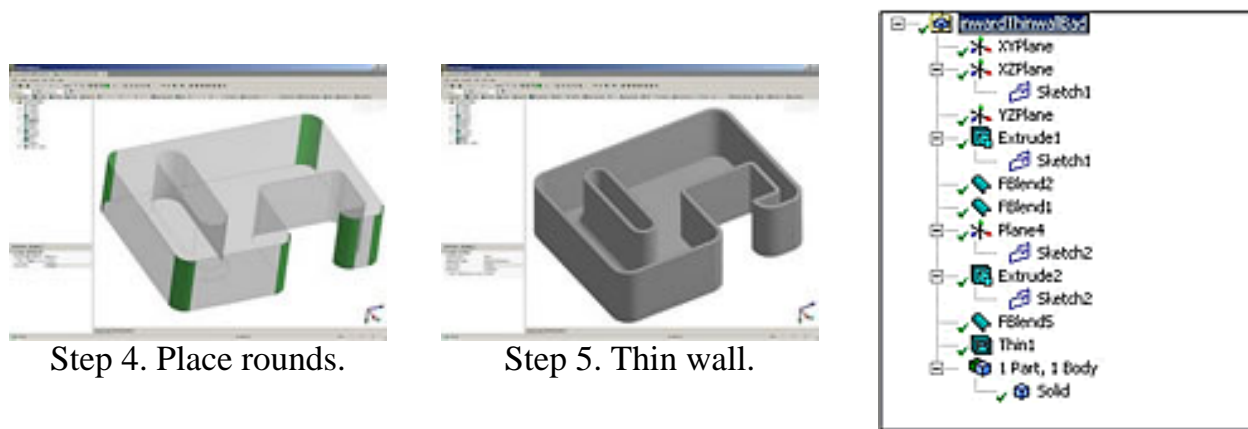


Figure 1.

Tools for the Analyst

The software contains a long a powerful list of features that include:

- Associative attachment of CAD models
- Built in auto-save
- Blend, chamfer
- 2D sketching
- Face delete (defeature)
- Beam modeling
- Entity naming (components)
- Parameter math
- Bidirectional associativity to Workbench
- Multi-part/body modeling
- Import of IGES, DXF, Parasolid, ACIS
- Extrude, revolve, sweep, loft, thinwall
- Plane creation
- Boolean
- Point creation
- Surface creation
- Beam cross section tools
- Parameters
- Output to ANSYS ANF, Parasolids, and IGES
- Body merging (VGLUE)

This is a short list and there is not enough space to describe each feature. However, it is important to point out some of the features that are designed specifically for the analyst. Two of the most significant of these features are the ability to attach parametric CAD geometry from another system and defeaturing.

Although the tool is very capable of creating geometry from scratch, a more common usage is to take CAD geometry and modify it. Figure 2 shows geometry imported directly from Solid Edge that is then defeatured. As the image shows, it is relatively easy to remove fillets and holes with the Face Delete command. You simply insert it into your tree, select the faces you want to remove, and the program will not only remove them,

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but it will attempt to fill the hole created by their removal. The nice thing is that it is parametric back to the original CAD file so if you update that geometry, you don't need to re-do your defeaturing.

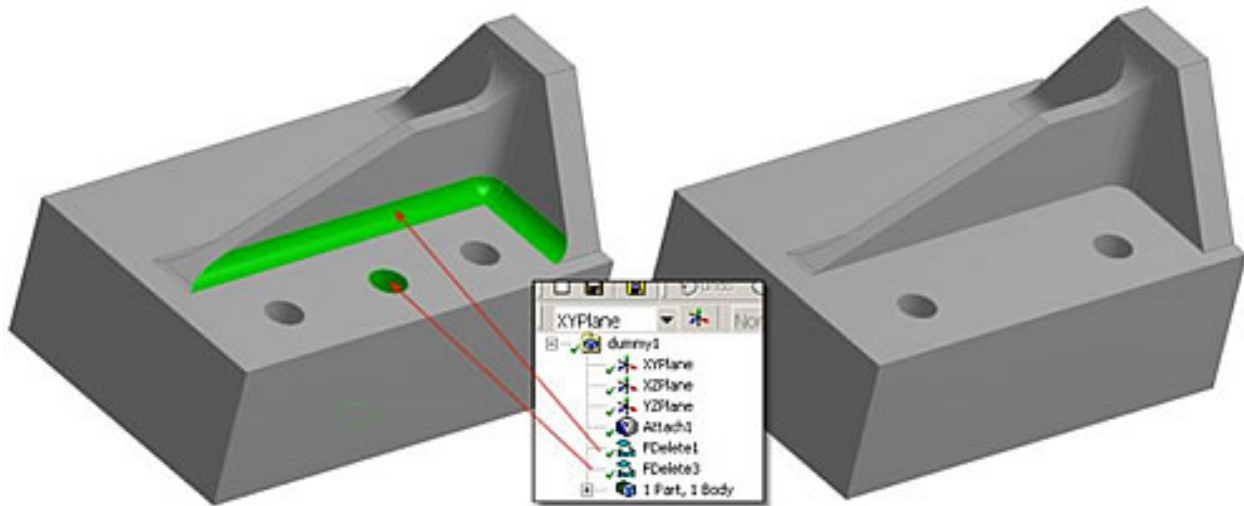


Figure 2.

The geometry creation capability is not just for making new geometry from scratch. It also allows you to add geometry to your model. So, regardless of where the geometry started life, as you use analysis to modify your design, you cannot only delete features, you can also add them. Figure 3 shows a simple tab with a hole in it that was added to our base part that came from Solid Edge.

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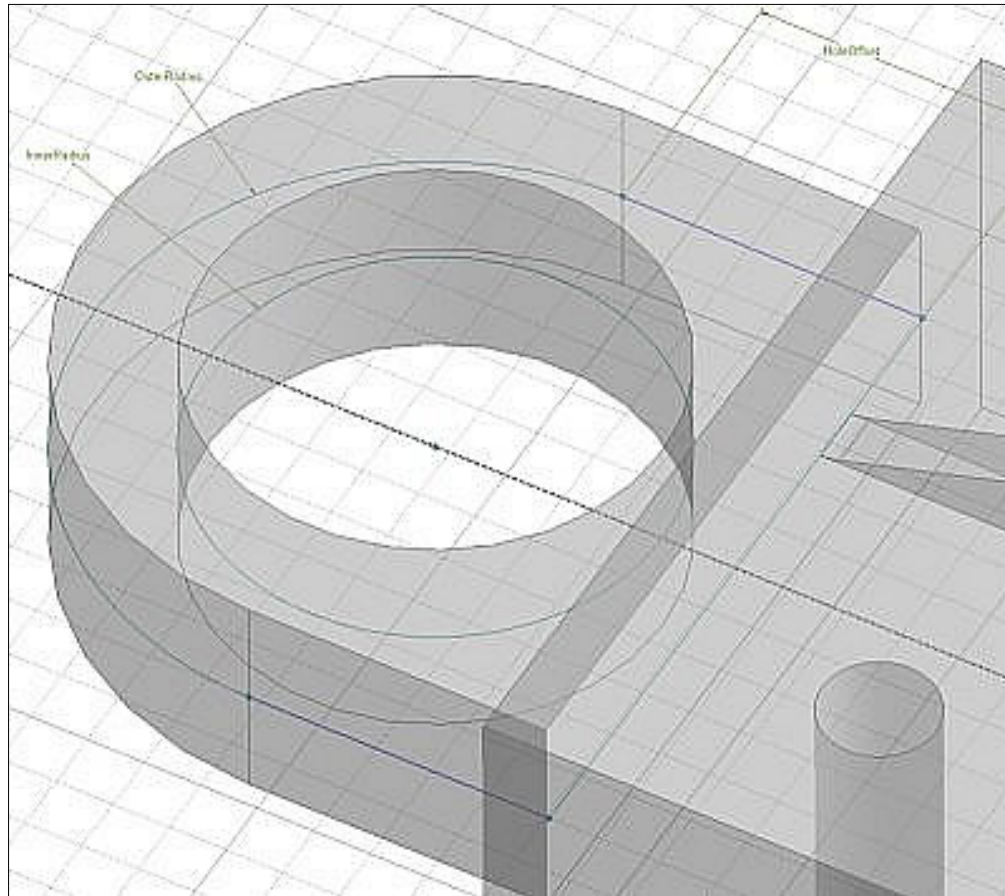


Figure 3.

Another key capability that analysts need is the ability to cut up the geometry. You can do this with planes or surfaces. Figure 4 shows the simple demonstration part sliced up to enable hex meshing. You can also use this capability to split up your geometry for symmetry or cyclo-symmetry. The process is pretty simple.

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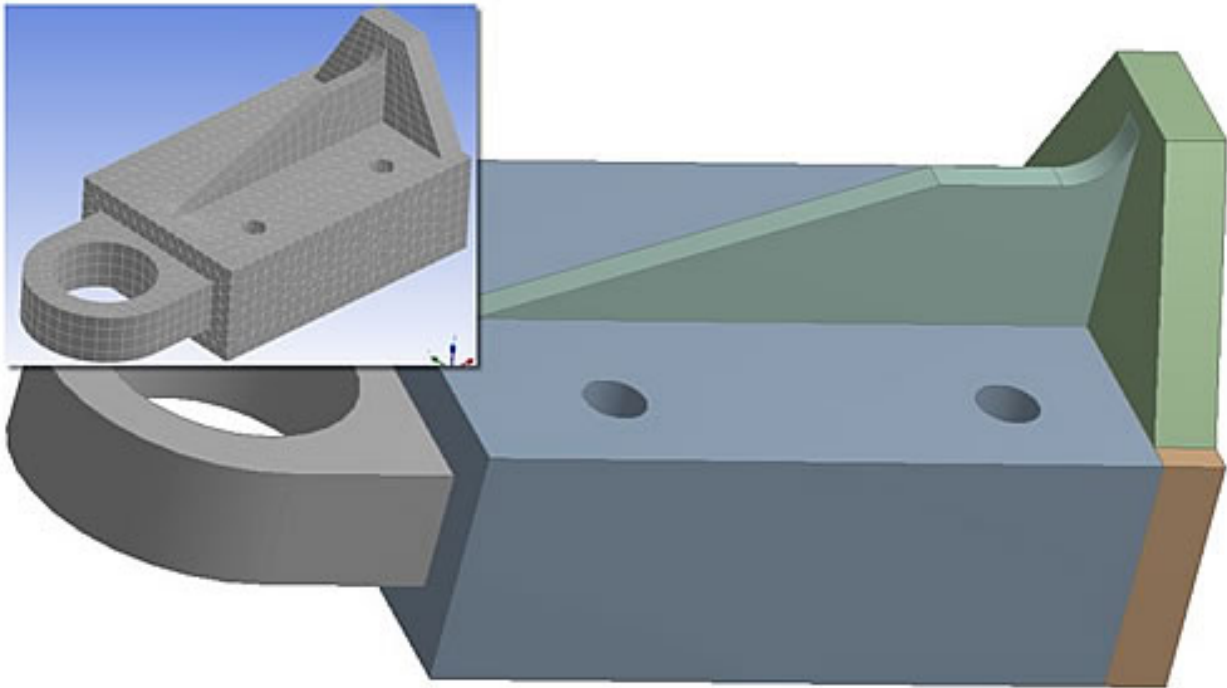


Figure 4.

You create an extrusion that with Operation = Cut Material, Thin/Surface = Yes, and with thicknesses set to 0. This gives you separate bodies (volumes in PREP7-speak). If you want the bodies to stay unique, for material or meshing reasons, but to share surfaces and therefore share nodes, you just use the Form New Part command to get the same results as a VGLUE in PREP7. PADT has found that this feature works very well, even when you need to make changes to the original CAD model.

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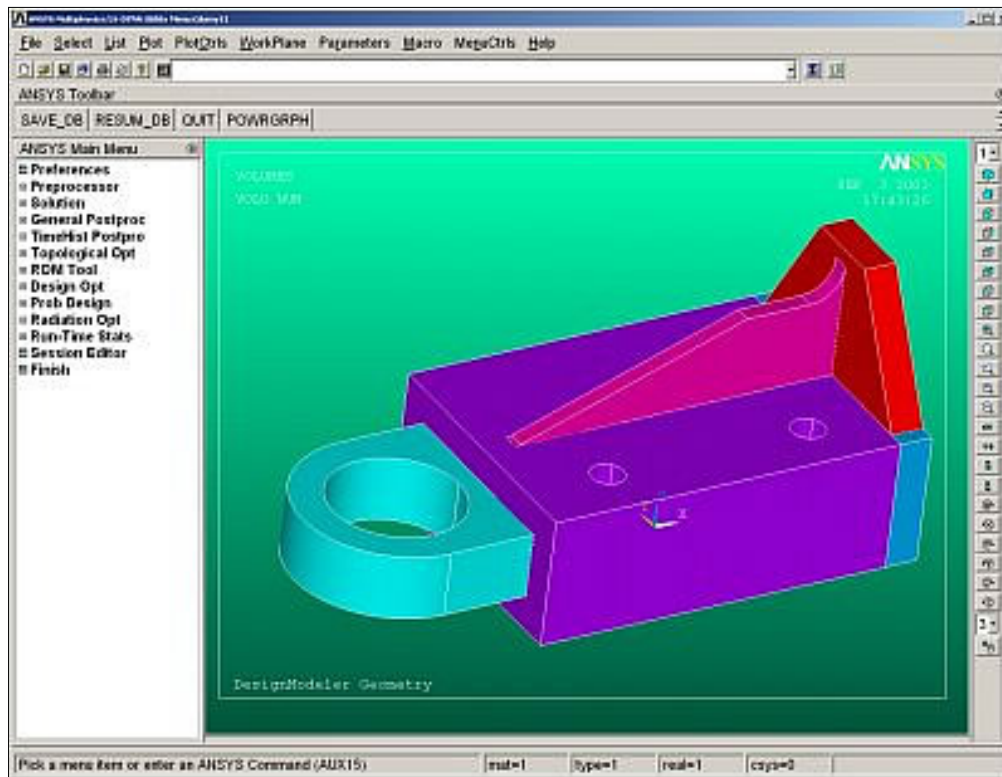


Figure 5.

Probably the most important capabilities in this tool for the experienced ANSYS user is output to PREP7 geometry format (*.anf) and named names selections (components). By combining these two, PADT has been able to set up relatively complex geometry such as the turbine engine blade shown at the beginning of this article.

Conclusion

There is so much more in DesignModeler that the only way to really get a feel for it is to use it on your parts. Many of us who are long time PREP7 users will struggle at first to adopt the new paradigm, but after awhile you will discover that it is a lot easier and less cumbersome, while still keeping the parametric capabilities that we have come to count on. If you don't have a copy of DesignModeler, give your local salesperson a call and ask for a demo key. We have found it to be a major step forward for solid modeling in support of ANSYS, and we think you will as well.

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ANSYS 7.1 GUI Enhancements Taking Advantage of Tcl

by [Jeff True Strain](#), ANSYS Supporter and User

The recent utilization of Tcl/TK for the ANSYS GUI has enabled developers to provide enhancements that were not possible with the older GUI. This article will examine some of them.

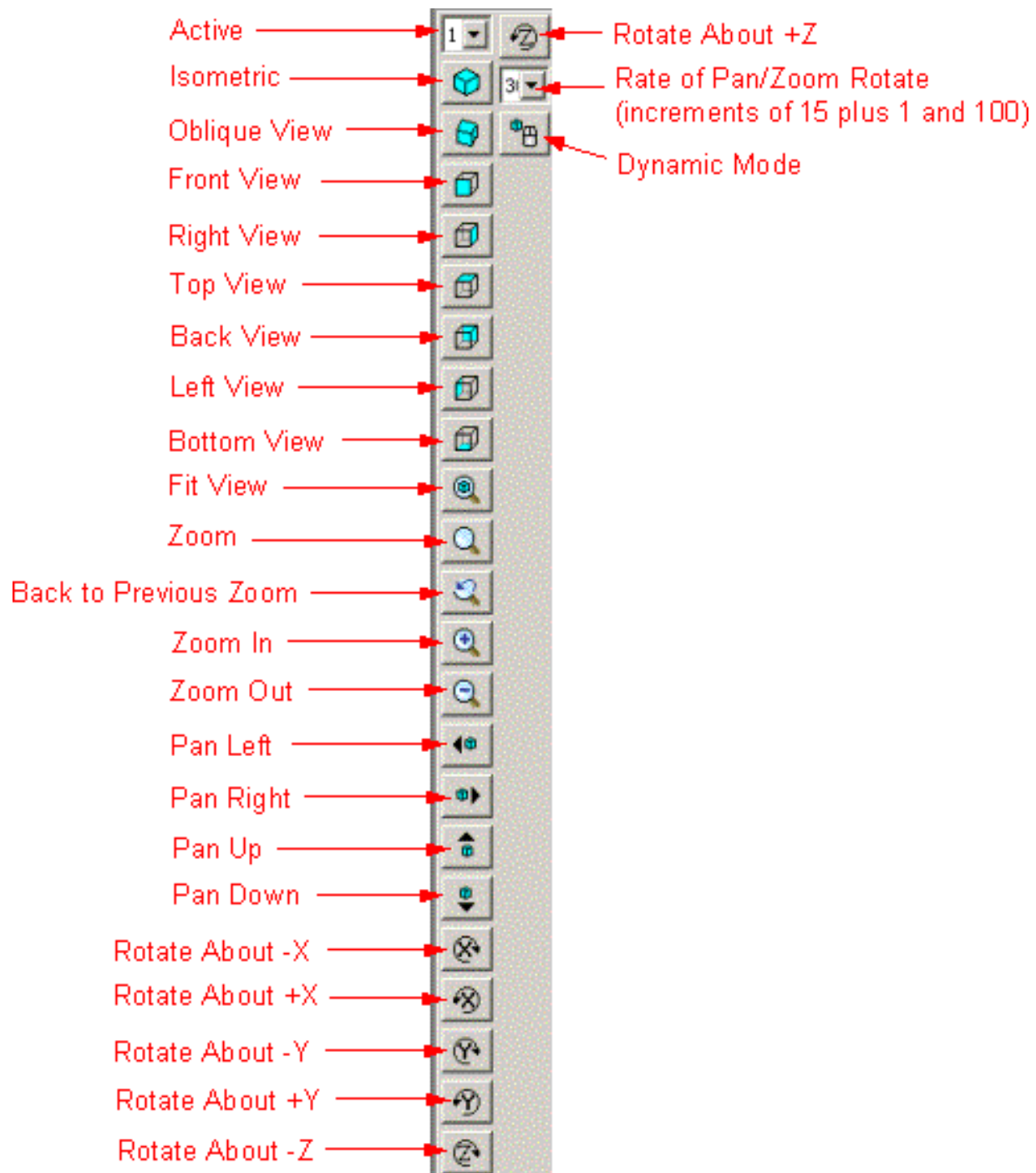
View Toolbar

The most evident change to the GUI in the 7.1 release is the View Toolbar just to the right of the graphics window. This is a slightly simplified version of the Pan/Zoom/Rotate dialog box, which is still available. The toolbar and its functions are shown in Figure 1.

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One thing I noticed while writing this article is that, on the rotate buttons, the button descriptions do not match the button graphics. The right-hand-rule takes precedence in this case; I checked.

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Right-Click in Graphics Window

Right-clicking on the graphics window provides a shortcut to many functions, such as viewing, graphics, and window options, as well as working plane adjustments. These menu picks are highlighted in Figure 2.

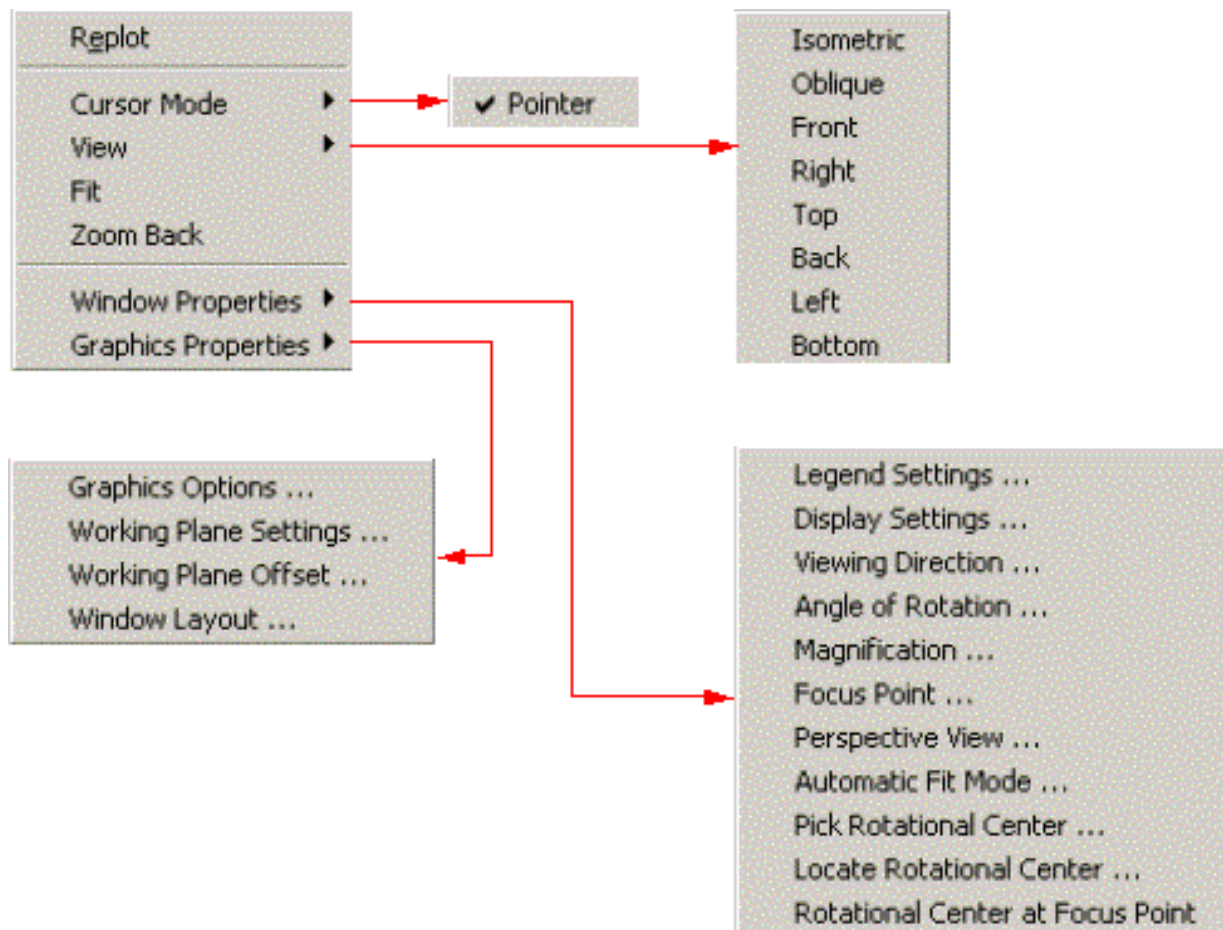


Figure 2. Graphics window menu shortcuts

A few of the more important, but less self-explanatory items include:

- *Automatic Fit Mode under Window Properties.* Oftentimes, when animating large deflections, ANSYS will autoscale each frame to fit the model in its deflected configuration for each timestep. Automatic Fit Mode allows you to turn that off.
- *Window Layout under Graphics Properties.* This allows you to split the graphics area into two, three, or four windows.
- *Graphics Options under Graphics Properties.* This brings up a dialog window to control the legend, logo, and triad displays.

Right-clicking, holding, and dragging in the graphics area will enable box zooming.

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Mouse Wheel

Placing the cursor in the graphics window and rolling your mouse wheel will zoom in and out on the model.

Font Controls

This is found under Utility Menu > MenuCtrls > Font Selection and provides controls for the font style and size for various text displays in the GUI as shown in Figure 3.

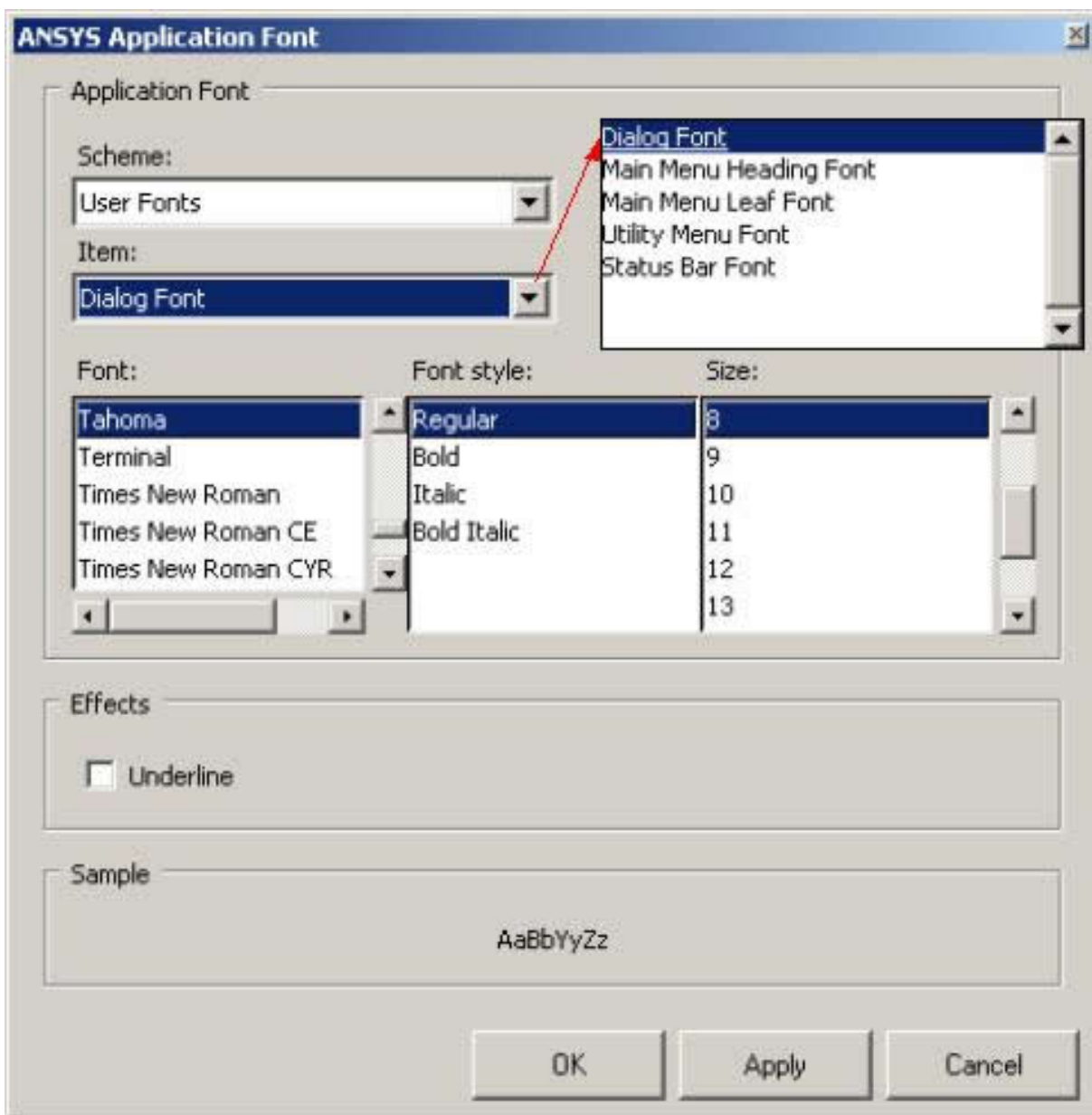


Figure 3. Font selection dialog window.

You can reset the fonts by selecting System Fonts under Scheme, and clicking Apply or OK.

Colors

You can also control colors for various components of the GUI under Utility Menu > MenuCtrls > Color Selection as shown in Figure 4.

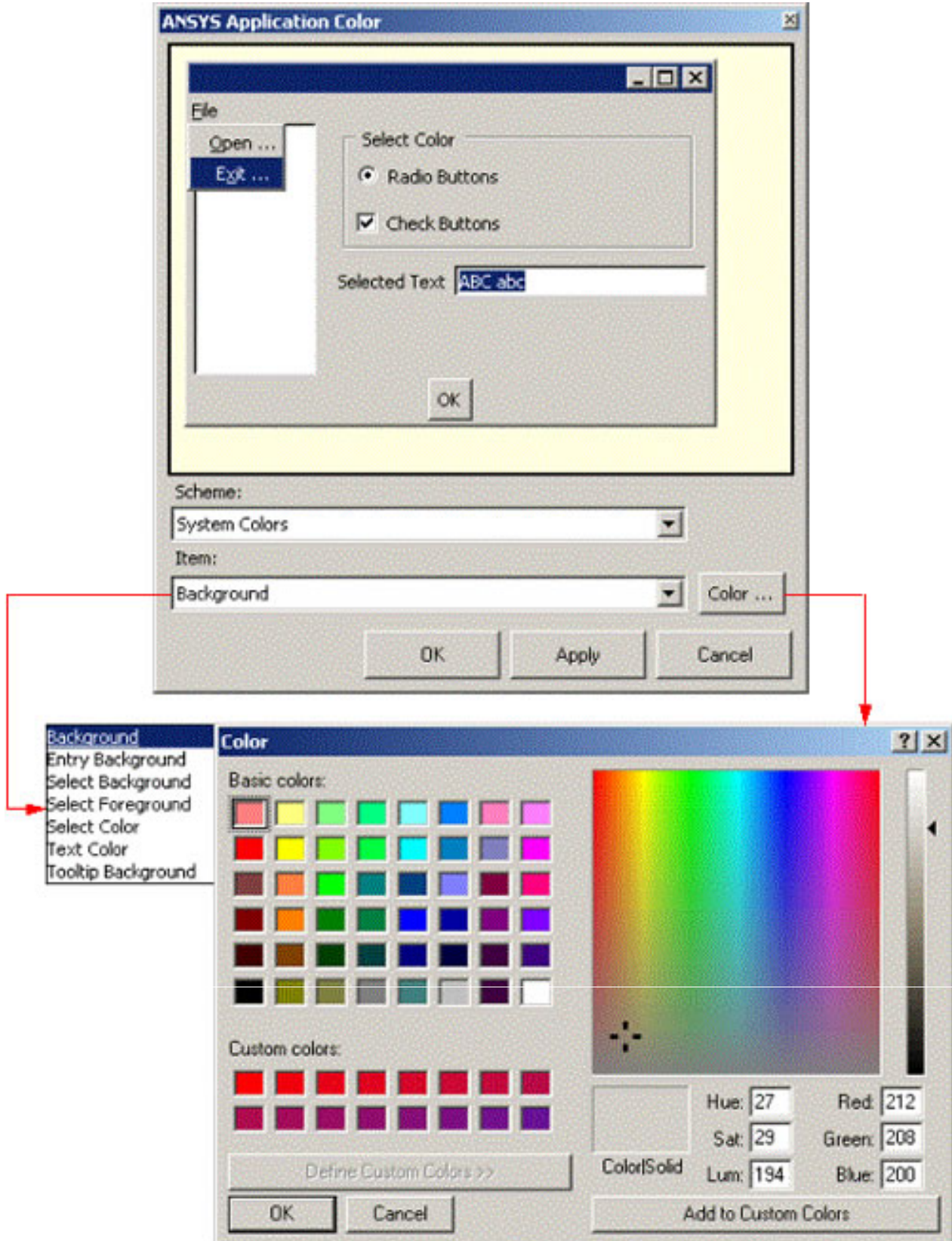


Figure 4. Color selection dialog window.

You can reset the colors by selecting System Colors under Scheme and clicking Apply or OK.

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Detachable Input Window

The last, but certainly not least, enhancement I'll mention is the detachable input window. Clicking on the keyboard icon causes the input window to detach from the rest of the GUI. Once the input window is detached, the stack of previously issued commands becomes visible. This window can then be expanded or contracted by clicking and dragging the edges. To return the input window to its original position in the GUI, click the **x** icon. See Figure 5 for an illustration.

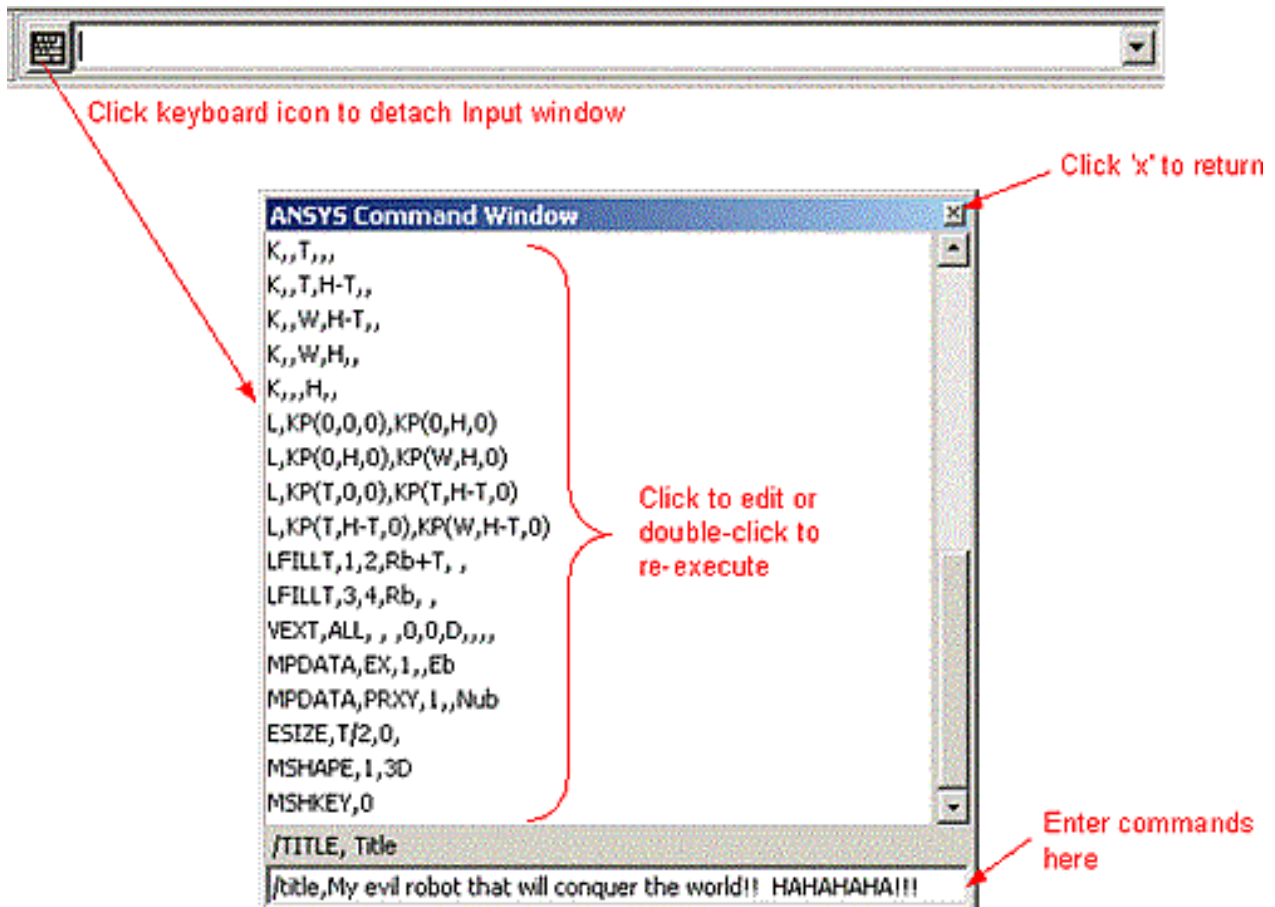


Figure 5. Detachable input window.

As new versions of ANSYS are released, even more GUI enhancements will be included. These will be highlighted in future articles in *The Focus*. It is hoped that these improvements will significantly facilitate your use of ANSYS.

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Epoxy Injection Molds Produce Production-Intent Plastic

The never-ending quest to develop new products faster and more economically is today being compounded by the expectation that prototypes be made from production materials. When final parts will be produced from high-temperature engineering thermoplastics such as Ultem® and Teflon®, the challenge is even greater.



PADT put its rapid prototyping capabilities to a test recently by injection molding production-quality Ultem® fans for installation in fuel cells being tested and installed on operating automobiles.

Two Weeks for Turbine Fan in Production Material

For the fuel cell project, PADT was asked to mold 50 to 70 functional, multi-finned blowers. The company's engineers developed the design according to customer specifications, producing a fan-like blade that produced high air flow at low pressure. When virtual simulation tests indicated that the design satisfied the performance criteria for the part, a SL master was built. The model was then used to confirm PADT's FEA analysis, verifying that the 3D solid blower had the same air flow characteristics as the virtual part.

The SL master performed as expected and technicians began building an epoxy injection mold. According to Mark Schanze, Molding Technologies Manager at PADT, "Once we had the SL master, it took us about two weeks to build the epoxy tooling and mold 25 parts for initial testing. Developing the tools was the most difficult task because of the multiple fins on the part."

Tool Production

Moldmakers started by fabricating mold forms that would be used in casting the 10 blower fins by packing epoxy putty under each blade on the SL model. Each section was allowed to cure for five minutes before being demolded and then sequentially numbered. When all mold forms were complete, edges were machined smooth. An aluminum box

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was assembled around the fully released SL master and epoxy putty mold forms. Epoxy was then poured around the pattern so that it was completely encapsulated. The epoxy was then placed in a pressure chamber and allowed to cure to a rigid state, about 18 hours.

Next, the cured mold half was removed from the mold box and registration shapes were machined into the parting surface with a mill. The first half was then thoroughly released and set back into the box. Epoxy was mixed and poured over the SL master, forms, and epoxy half and allowed to cure overnight. The time needed to set up the master, make the two mold halves, and build the inserts was about 40 hours.

Part Processing

To prepare for injecting Ultem® parts, the two mold halves were installed on steel jackets. Mold inserts were then put in place and the complete tools were put in the injection press. To warm the mold and optimize its durability, technicians started by making a series of short shots, slowly bringing the epoxy tool up to the desired 180°F to 200°F (83°C to 93°C) surface temperature. At this point, part production began using the fastest possible cycle time to ensure a relatively constant, warm mold temperature. At the outset of the project, engineers had planned to incorporate heating cartridges in the tools to control mold temperature. However, this would have added time and expense to the tool production. Ultimately, the decision was made to simply cast the tool from aluminum-filled epoxy.

With the filled epoxy, we get some thermal conductivity in the tool. This allows us to inject resin until it skins and then pressurize and pack the plastic in until the part is complete. Using this technique, we reduce shrinkage and ensure high quality parts, Schanze explains.

The same procedure is used for molding parts from other engineering thermoplastics such as Teflon®. Working with the aluminum-filled epoxy, we re able to quickly cast injection molds for complex parts and make from 100 to 1,000 quality thermoplastic parts for prototyping as well as low-volume and initial part production, Schanze concludes.

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Figure 1. Mold forms were built for each fan rib using epoxy putty.



Figure 2. The two mold halves are pictured here with the even numbered mold inserts cast.



Figure 3. A series of short shots was used to warm the mold until it was ready to produce the Ultem® fan blades.



Figure 4. Pictured here, Ultem® blower parts with the RenCast epoxy inserts and mold halves in the center and background.

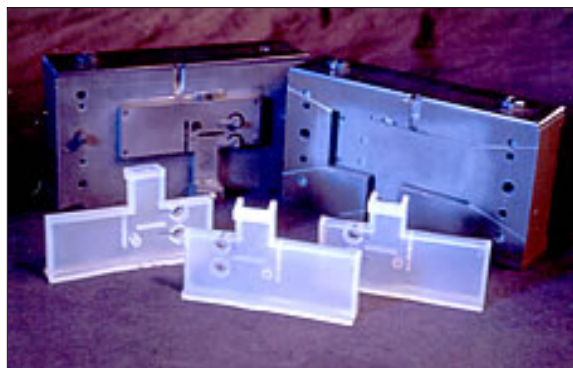


Figure 5. Teflon® is among the thermoplastics PADT shoots in cast epoxy injection molds.



Figure 6. A large epoxy tool used to produce ABS parts. Cooling lines were used to help with thick section sink.

Ultem® is a registered trademark of GE Plastics; Teflon® is a registered trademark of DuPont.

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Upcoming Training at PADT

A complete schedule of the training courses for the next three months is shown below. [Learn more](#) about how the **Training Services** offered by PADT can save you time and money. Or, feel free to drop an e-mail to our training coordinator, [Ted Harris](#)!

Month	Start	End	Course	Description	Location
Sep '03	9/15	9/18	802	Advanced APDL and Customization	Irvine, CA
	9/22	9/23	104	ANSYS Workbench Simulation - Intro	Tempe, AZ
	9/24	9/26	201	Basic Structural Nonlinearities	Irvine, CA
	9/29	9/30	501	ANSYS/LS-DYNA	Tempe, AZ
	9/29	9/30	701	Design Optimization & Probabilistic Design	Tempe, AZ
Oct '03	10/2	10/3	100	Engineering with Finite Element Analysis	Tempe, AZ
	10/6	10/8	101	Introduction to ANSYS, Part I	Irvine, CA
	10/23	10/24	203	Dynamics	Irvine, CA
	10/27	10/29	902	Multiphysics Simulation for MEMS	Tempe, AZ
Nov '03	11/3	11/5	101	Introduction to ANSYS, Part I	Tempe, AZ
	11/6	11/7	301	Heat Transfer	Irvine, CA
	11/12	11/14	401	Introduction to Electromagnetics	Irvine, CA
	11/17	11/18	102	Introduction to ANSYS, Part II	Tempe, AZ
Dec '03	12/3	12/5	101	Introduction to ANSYS, Part I	Irvine, CA

Whether it s one of our regularly-scheduled classes at our training facility, or a customized class tailored to your specifications and location, you can be assured that the training you receive will have immediate, positive results on your capabilities in design, analysis, and product and process improvement.



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The Focus is a periodic electronic publication published by PADT, aimed at the general ANSYS user. The goal of the feature articles is to inform users of the capabilities ANSYS offers and to provide useful tips and hints on using these products more effectively. *The Focus* may be freely redistributed in its entirety. For administrative questions, please contact [Rod Scholl](#) at PADT.

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