... within Epsilon

Twin Cities
ANSYS® User Meeting

January 2013

Workbench Update

... within Epsilon

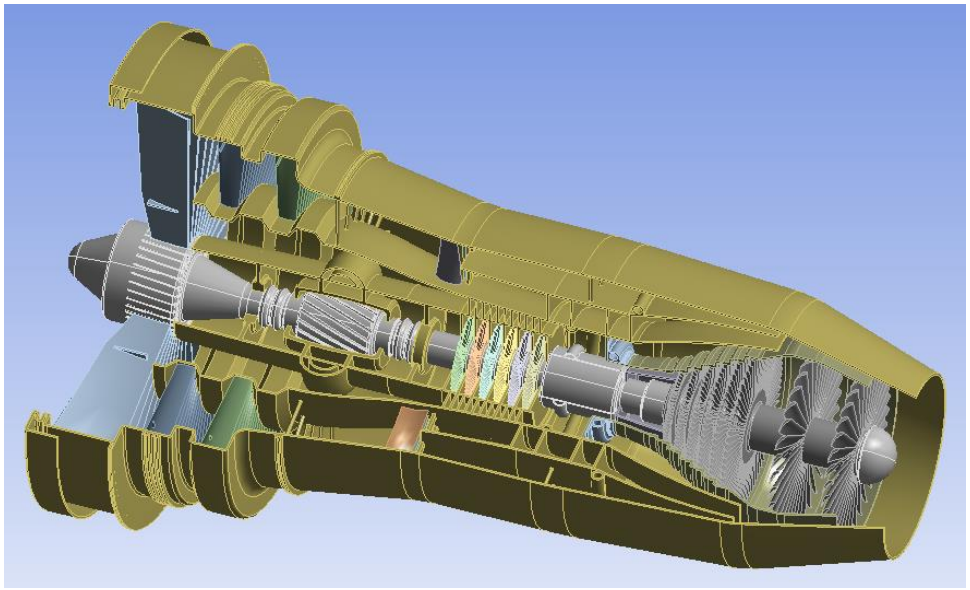
Agenda

1. Speed Improvements
2. Usability Improvements
3. New Features

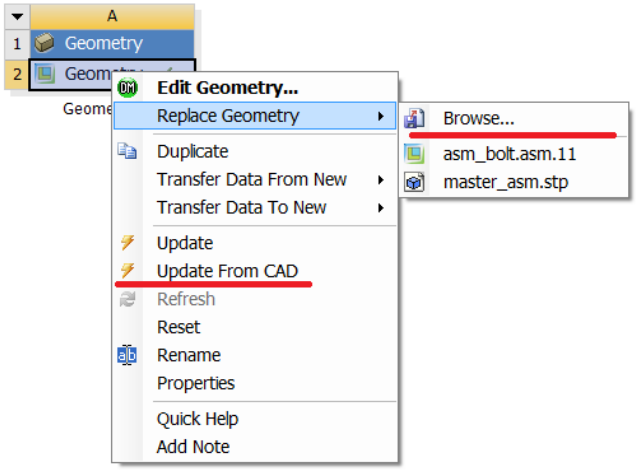
Speed Improvement

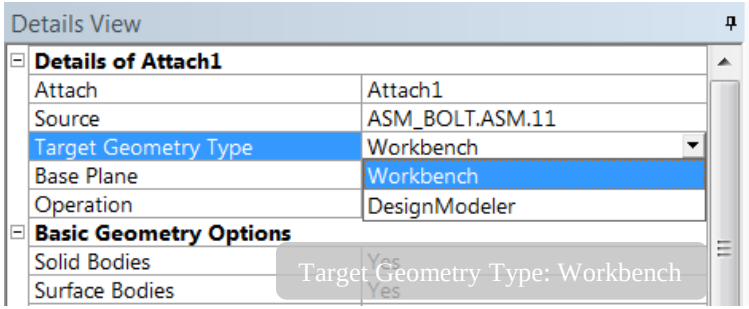
Import Into DM 10x Faster

- Large model reading time reduced
- Smarter handling of databases
  - Reloads only modified parts
  - Associatively linked models show biggest improvements
- Improve performance for geometry import and modeling
  - Faster and more robust processing of IGES and STEP formats



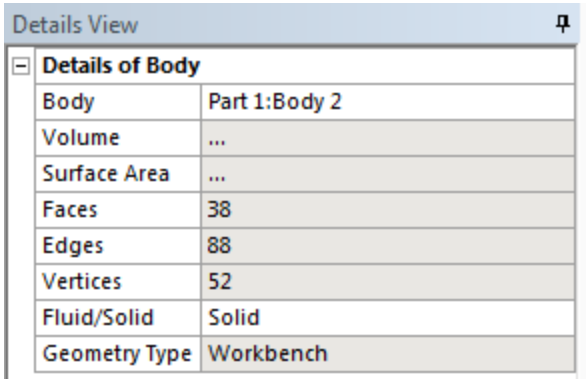
Import Time in 14.0	Import Time in 14.5 (WB geometry type)
15 Minutes	2 Minutes

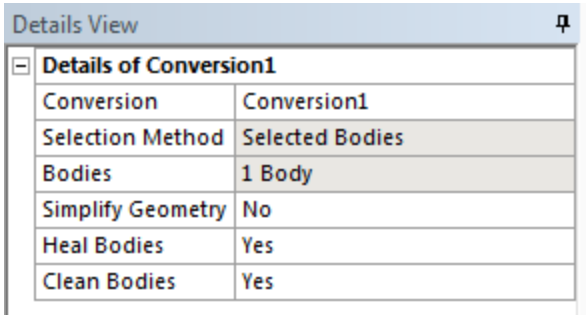




DM Can Leave Things B-rep

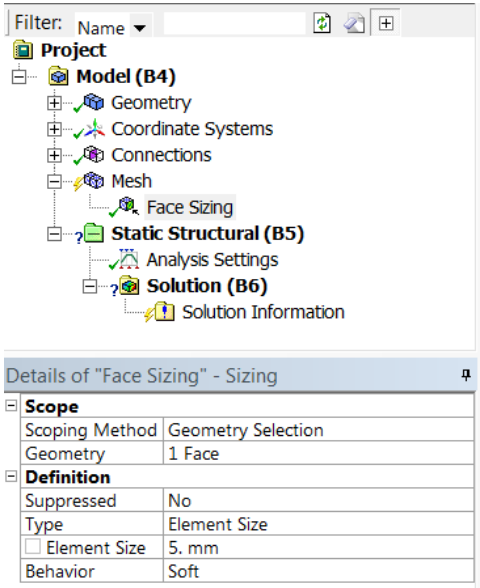
- Avoids time-consuming conversion
- Must be converted to Parasolid (.x_t) for some operations
- User can selectively control mixture of B-Rep and Parasolid
- Some operations (e.g., Shared Topology) automatically convert bodies as needed





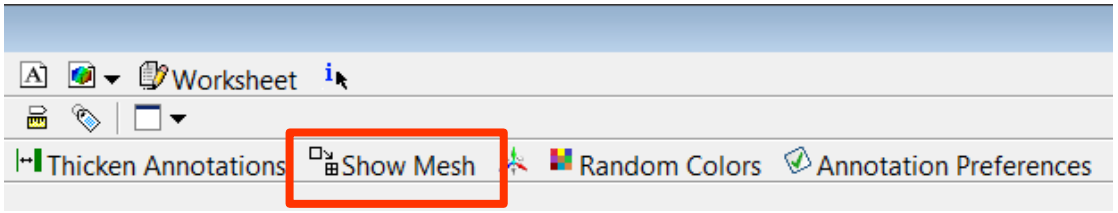
Mesh Sizing

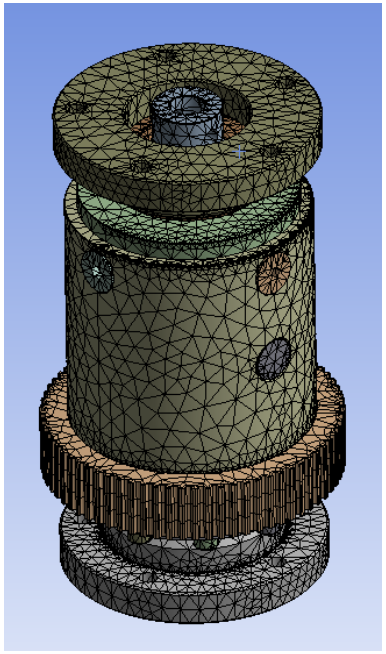
- Can work with mesh size controls without displaying mesh

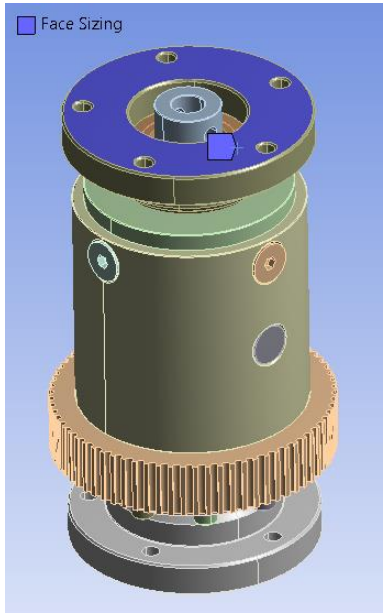


Details of "Face Sizing" - Sizing

Scope	
Scoping Method	Geometry Selection
Geometry	1 Face
Definition	
Suppressed	No
Type	Element Size
Element Size	5. mm
Behavior	Soft

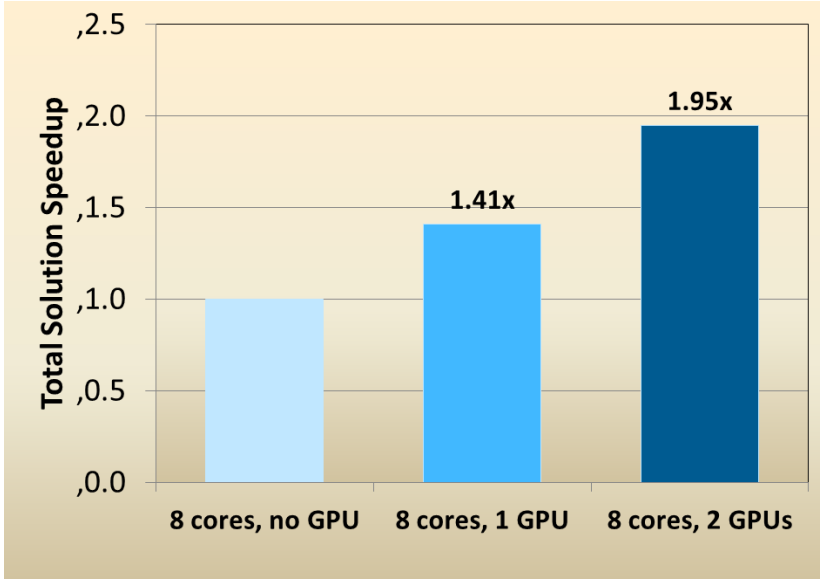






Support for multiple GPUs

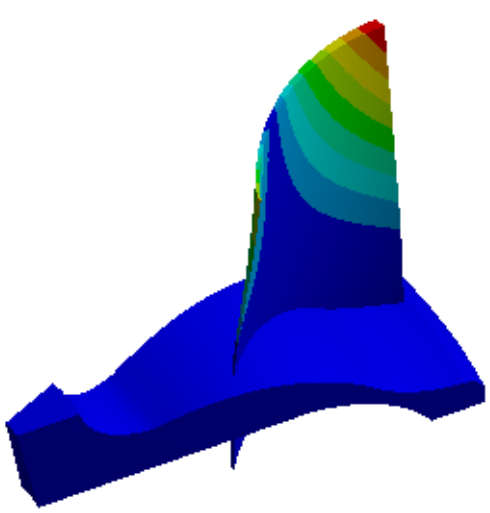
- Multiple GPU's on one box is now supported
- Distributed only for Sparse solver – SMP or DMP for PCG/JCG



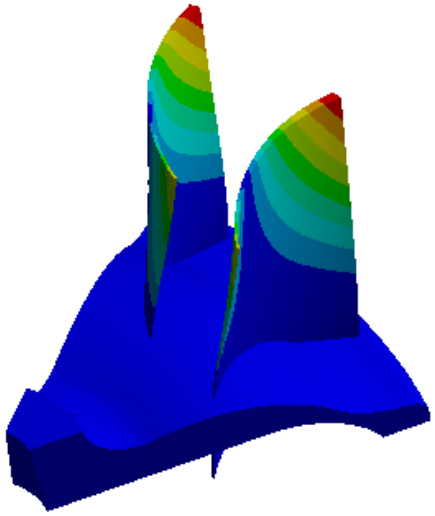
2.1M DOF, Nonlinear Static Analysis, From ANSYS Inc.

Partial Cyclic Xpansion Possible

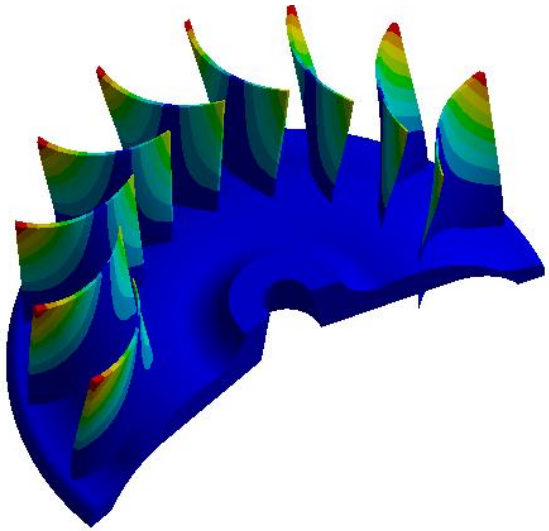
- Now can specify number of sectors to expand
- Minimized computation/graphics delay



One Sector



Two Sectors



Nine Sector

Result Files

- Random vibration doesn't keep multiple modal result copies
- Stores element results in single precision
  - Nodal results are still double
- Result files can be 50% smaller
  - Principal stresses are no longer stored, they are calculated on the fly
  - Lots of little changes in the way things are written

Other Speed Related

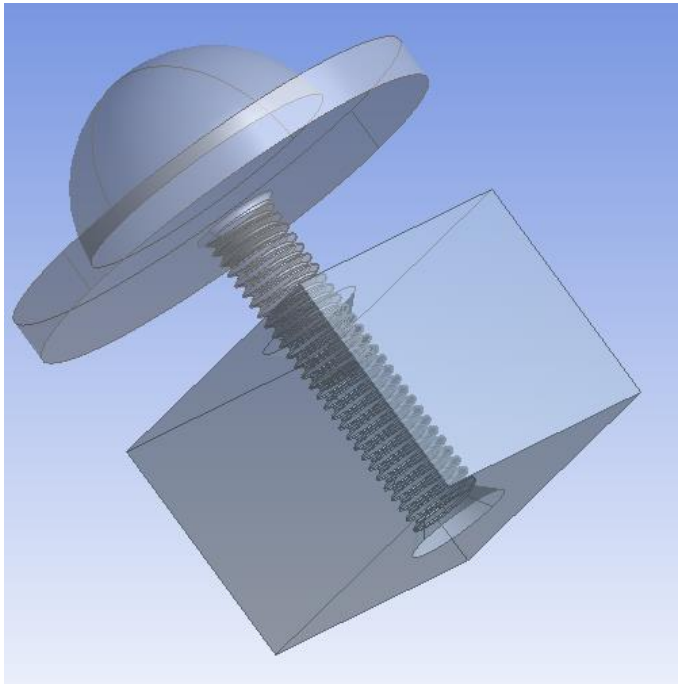
- Animation Performance Improved
  - Typical speedup is about a factor of two
- Slice Planes
  - Slice plane creation is faster
  - By default dynamic section plane is disabled, since it is slow for big models
  - User can turn it on for dynamic plane editing
- Point-cloud Mapping is faster
- Post-processing of results for very large models
  - can be 2x to 5x faster. (like 100 million nodes)

Usability Improvements

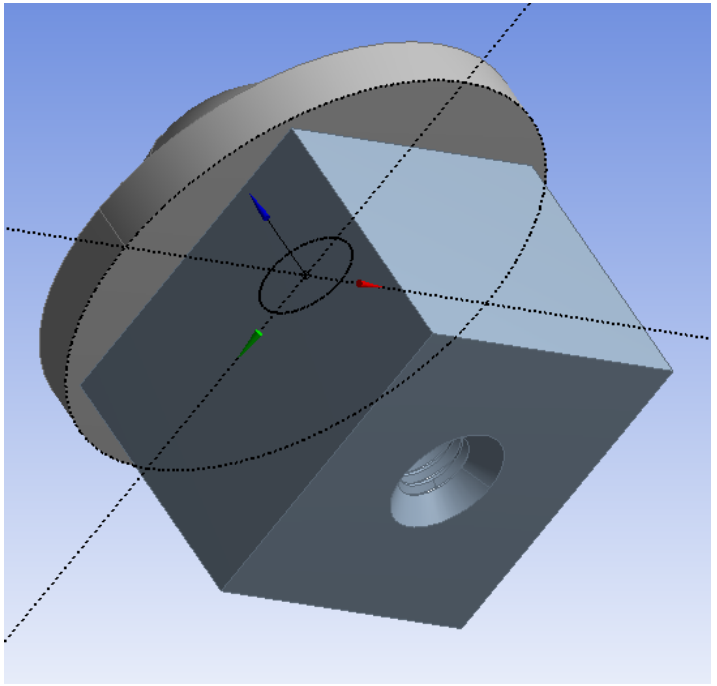
... within Epsilon

Parts Alignment in DM

- Aligning Imported/Attached Bodies By Plane, Direction or Vertices.



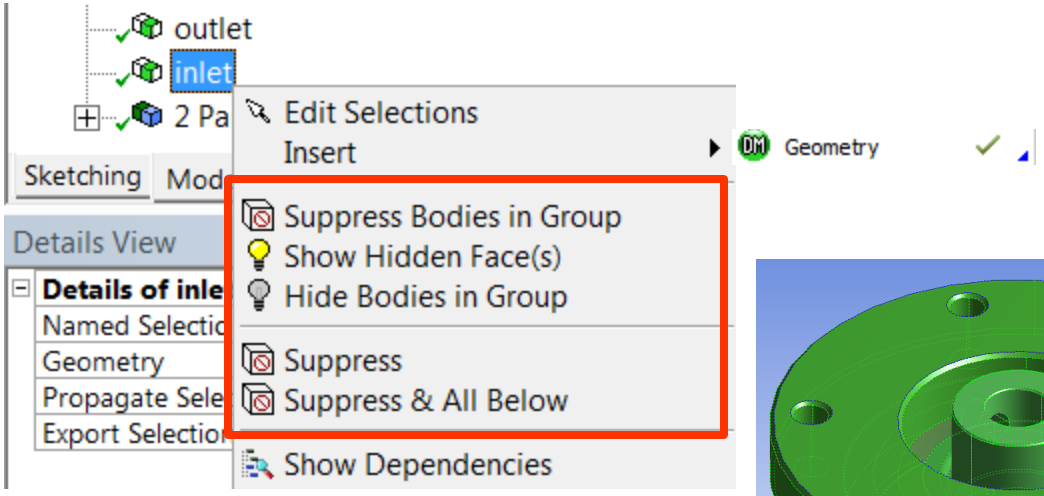
Two imported bodies that do not align properly



Move one body using Body Operation's.

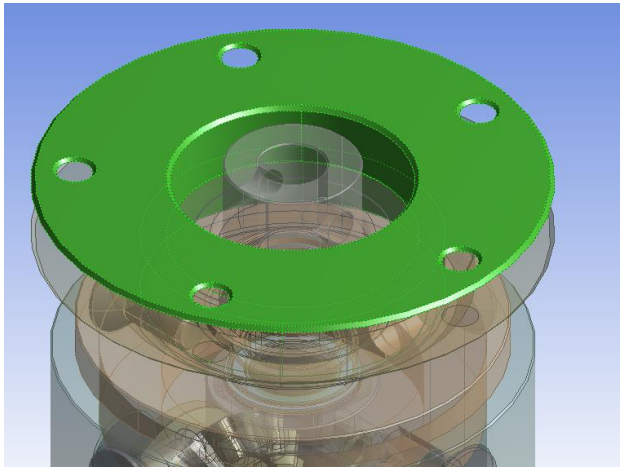
DM Selection Easy

- Improved visualization and suppression for Named Selections (NS)

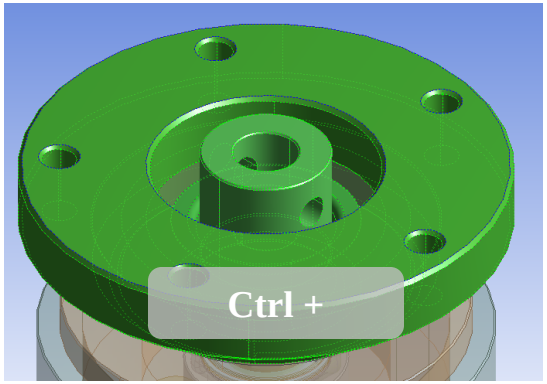


Can be used for multiple NS at one time

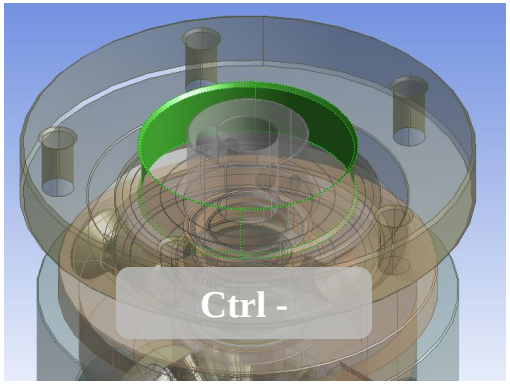
- Shrink/Expand selection set



Original selection



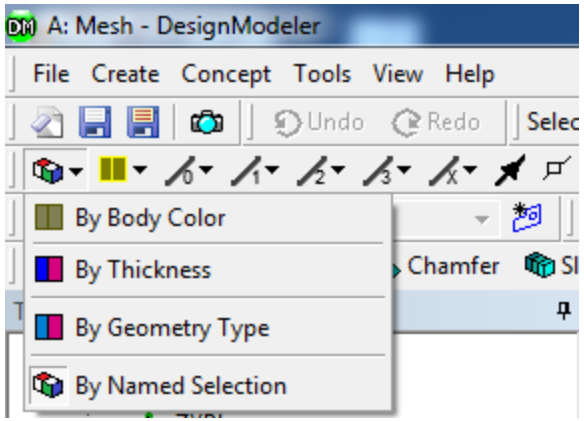
Expand

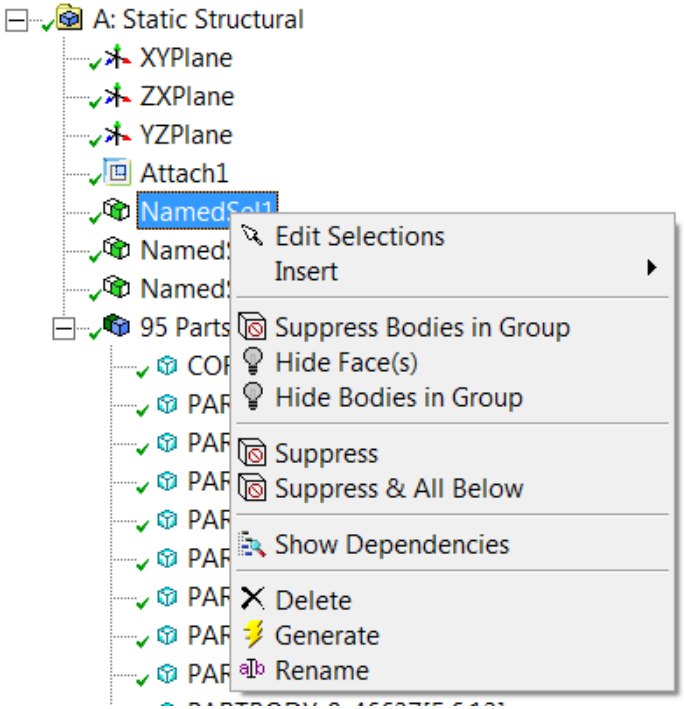


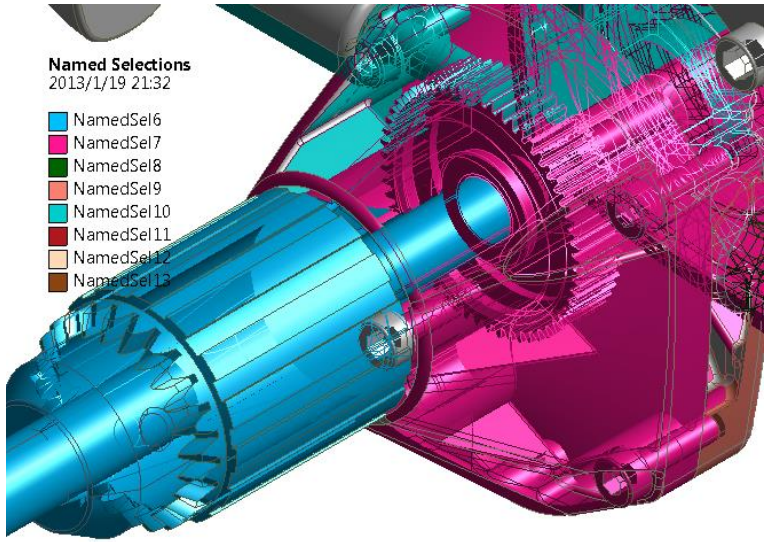
Shrink

DM Grouping Control

- Legend with color assignment to named selection
  - *Seems can't applied to Body set, be good for face and edge set.*
- Part Grouping Changes In DM







v14- DesignModeler Hotkeys

- Hotkeys are active whenever the Graphics Window, tree outline, sketching toolboxes, or Details View are in focus
- For example:
  - F5: Generate
  - F7: Zoom to Fit
  - Ctrl+ B: Selection Filter: Bodies
  - Ctrl+ +: Expand Face Selection

Spaceclaim Enhancements

- Transfer of named selections
- Better persistence during geometry update
- Performance improvements for large parts and drawings
- Recognition and editing of standard holes
- New set of 2D and 3D curve repair tools
- Sheet metal enhancements

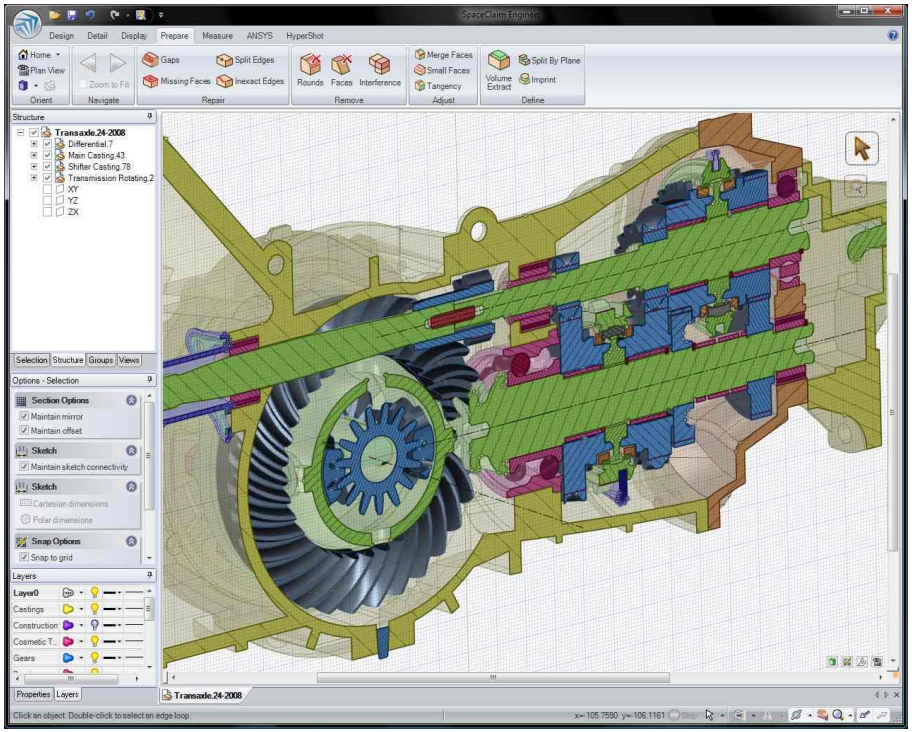
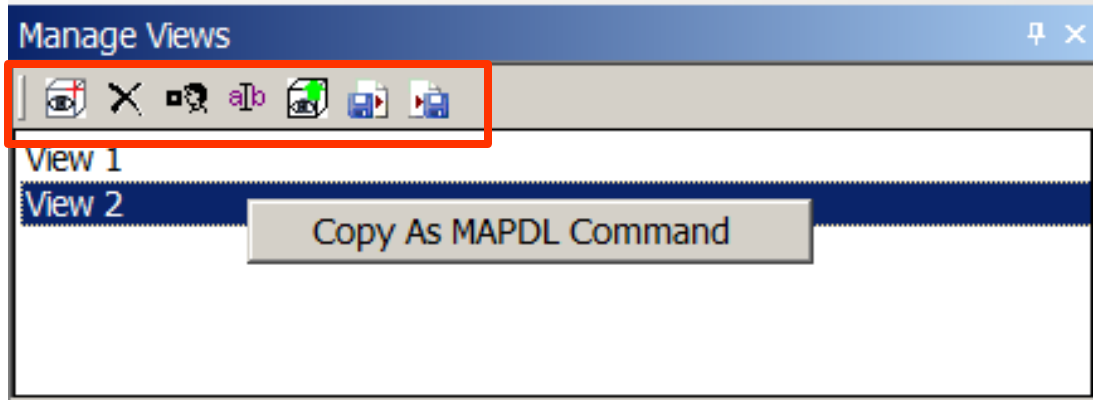
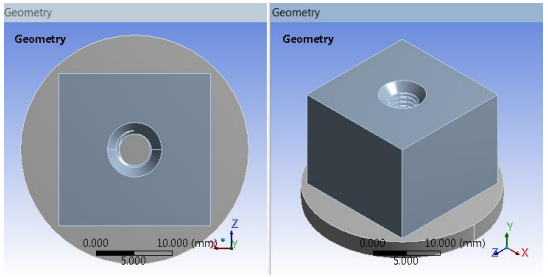


Fig From SPACECLAIM Corp

Graphical Views Manage

- Manage and save multiple view settings
- Export as Mechanical APDL Commands or .xml file






```
!Length unit for the following data is MM
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/VIEW, 1, 0 ,0 ,-1
/ANG, 1, 1.47877933334711E-06
/DIST, 1, 18.287874050795
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Export as APDL

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<LocY>10.9930147969639</LocY>
<LocZ>25.9662326636785</LocZ>
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<FocY>9.53809489591562</FocY>
<FocZ>14.249412162781</FocZ>
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<ViewY>.164060629061232</ViewY>
<ViewZ>.489499126439434</ViewZ>
<RotAngle>-168.698140352666</RotAngle>
<ZoomDistance>20.6715083033882</ZoomDistance>
</ModelView>
<ModelView Name="Front">
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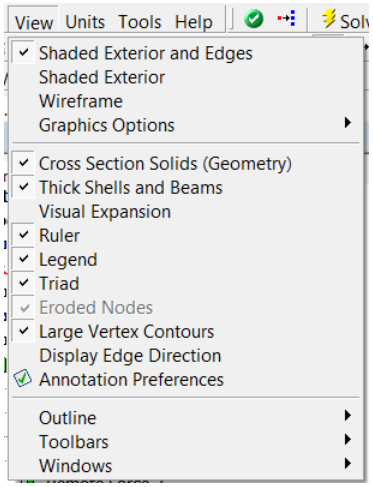
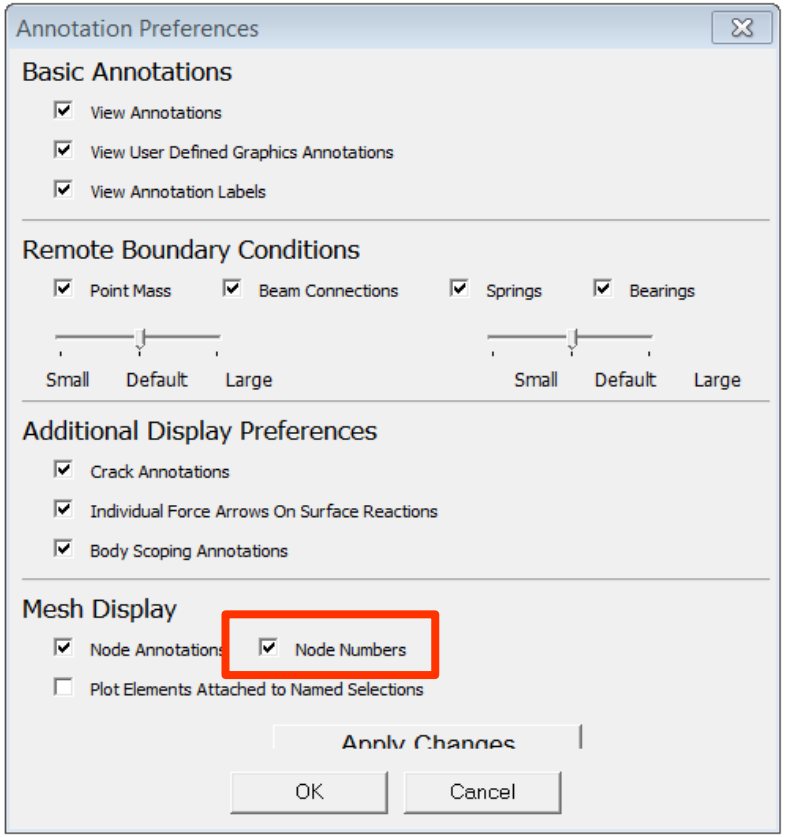
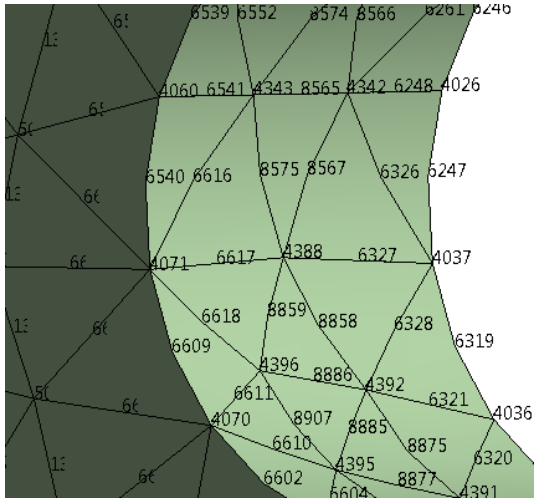
Export as ,.xml file

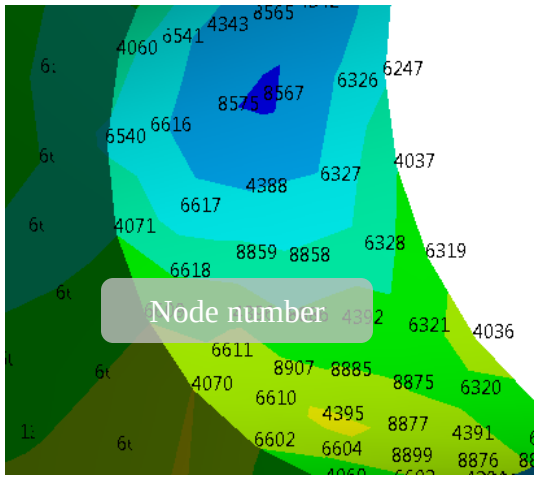
Annotations Control

- Some items updated
- Added display node number option



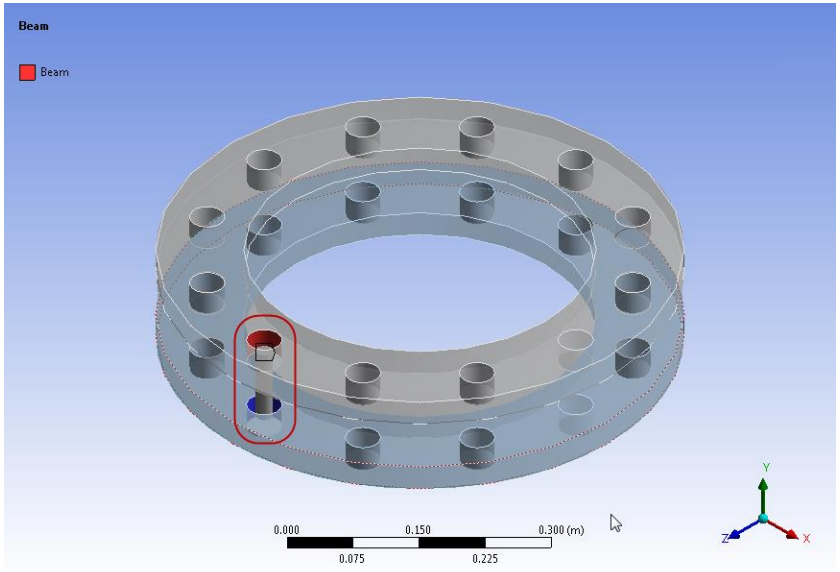






Pattern Generation Of Tree Items

- Object Generator to make one or more copies of a template object
  - any tree object that supports the “Duplicate” function can be used as a template.



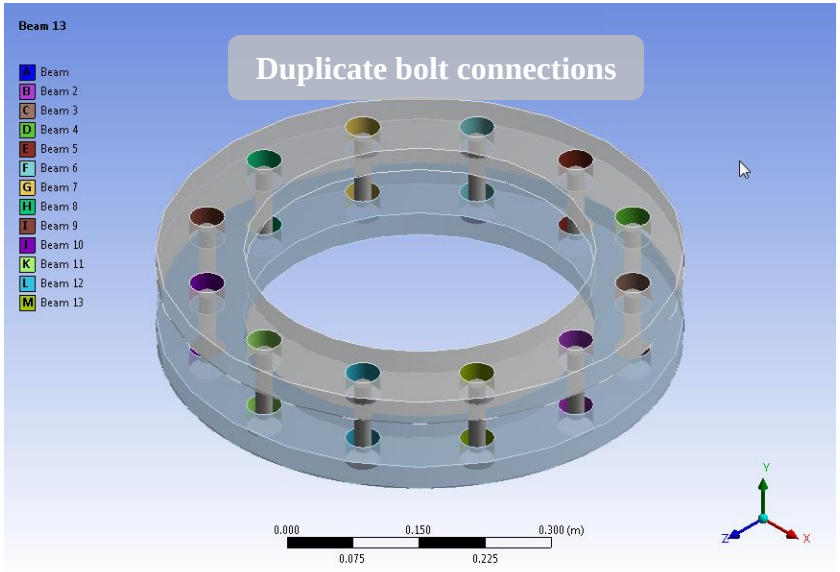
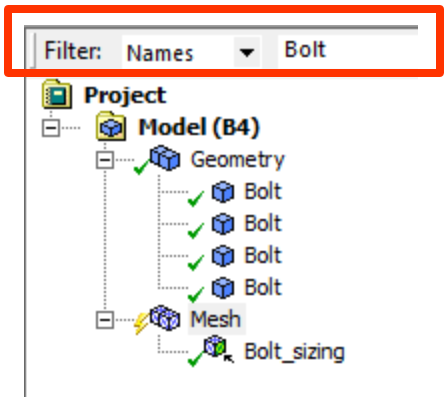


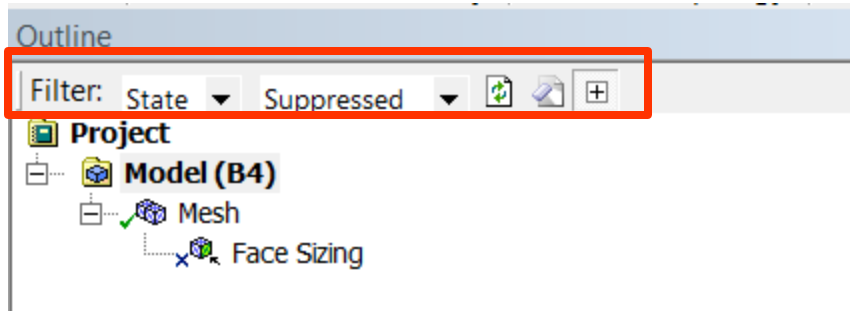
Fig From ANSYS Inc, 2012

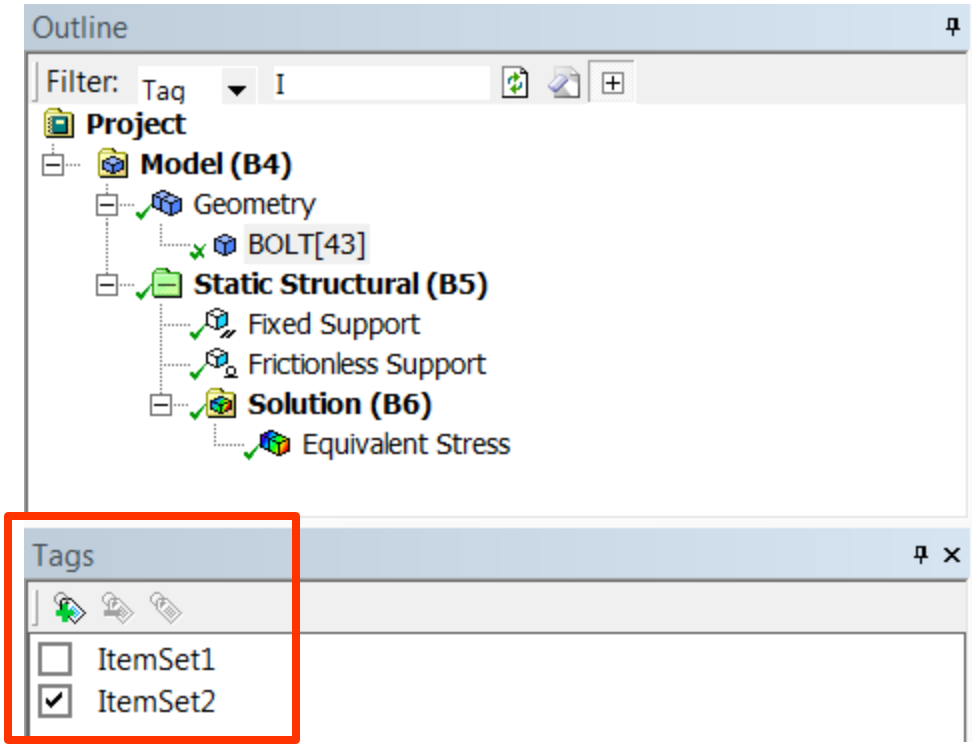
Filtering Tree Items

Filtering of Objects in Tree Outline. Filters include:

- Name:
- Tag
- Type
- State
  - All, Not suppressed, Suppressed, Underdefined, Not licensed

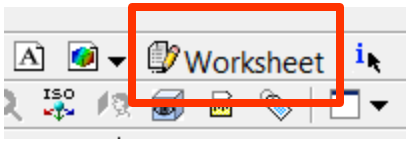






Contact Tool: Connection Matrix

- Summarizes joint/contact information
- Exportable as a txt file



Hide Preferences | Refresh

- [x] Contact Information
- [ ] Joint DOF Checker
- [ ] Joint Information
- [x] Connection Matrix
  - [x] Show Upper Diagonal
  - [x] Show Diagonal Marker
  - [ ] Show Unconnected Bodies
  - [ ] Show Suppressed Objects
  - [ ] Bundle Connections

Control Connection Types

- [x] Contact
- [ ] Spot Weld
- [ ] Joint
- [x] Spring
- [x] Beam

Connection Matrix

	PRT0003[40]	PRT0002[45]	PRT0004[56]	PRT0005[59]
PRT0003[40]	----			
PRT0002[45]	Contact Region	----		
PRT0004[56]	Contact Region 2	Contact Region 5	----	
PRT0005[59]	Contact Region 4		Contact Region 6	----

Export txt file

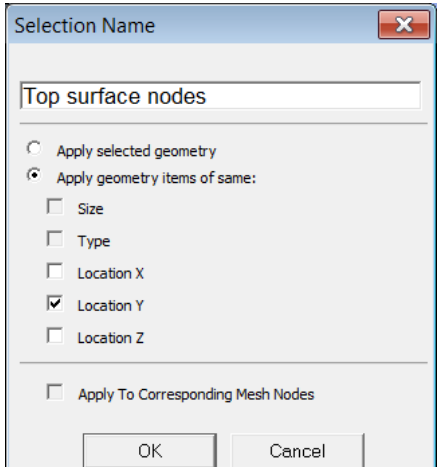
```
1 PRT0003[40]    PRT0002[45]    PRT0004[56]    PRT000
2 PRT0003[40]    ----
3 PRT0002[45]    Contact Region  /  Fixed - PRT0003[40
4 PRT0004[56]    Contact Region 2    Contact Region 5
5 PRT0005[59]    Contact Region 4          Contact Regi
```

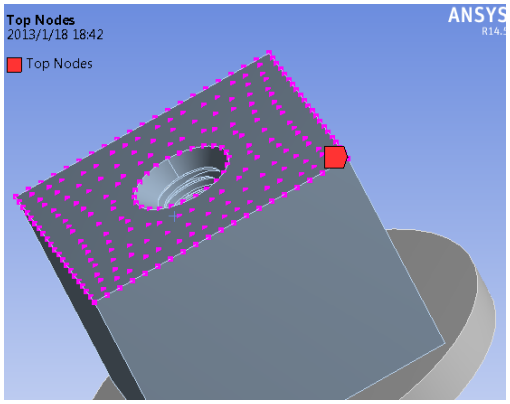
Legend:

Contact | Spot Weld | Joint | Mesh Connection | Spring | Beam | Multiple Connection Types | Suppressed

Named Selections with Location

- Select with a distance from the origin of a selected Coordinated System
- Select Node, face, edge, etc





Generate

	Action	Entity Type	Criterion	Operator	Units	Value	Lower Bound	Upper Bound	Coordinate Sys...
☑	Add	Mesh Node	Location Y	Equal	mm	16.	N/A	N/A	Global Coordin...

Face
Edge
Vertex
Mesh Node

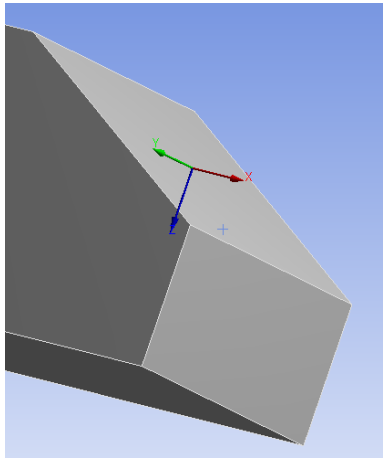
Generate

	Action	Entity Type	Criterion	Operator	Units	Value	Lower Bound	Upper Bound	Coordinate Sys...
☑	Add	Mesh Node	Location Y	Equal	mm	16.	N/A	N/A	Global Coordin...

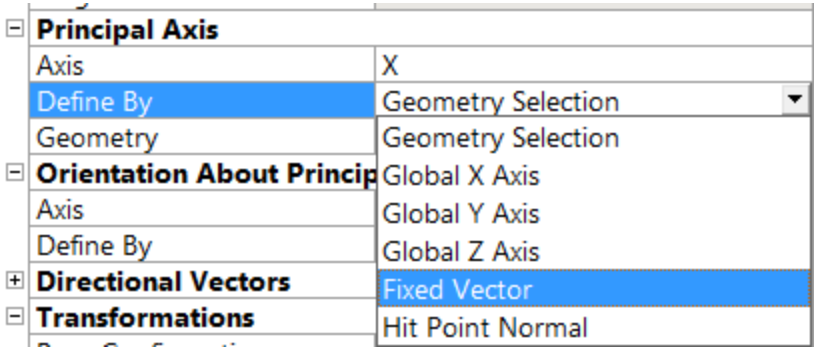
Equal
Not Equal
Less Than
Less Than or Ec

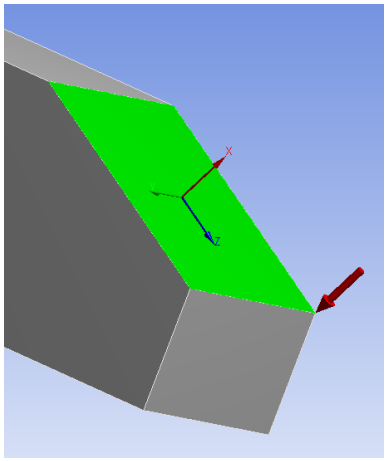
Local Coordinate System

- Create local CS normal to face
- Creating a Coordinate System by Direct Node Selection



Default option

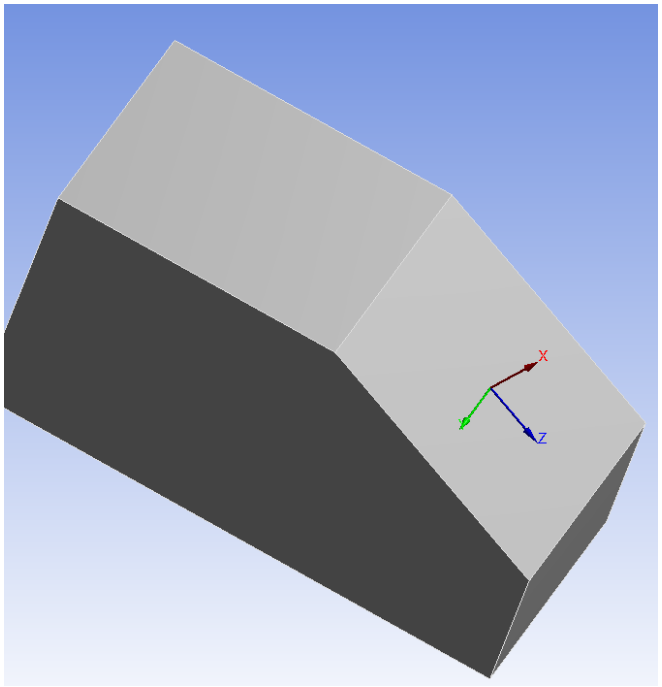


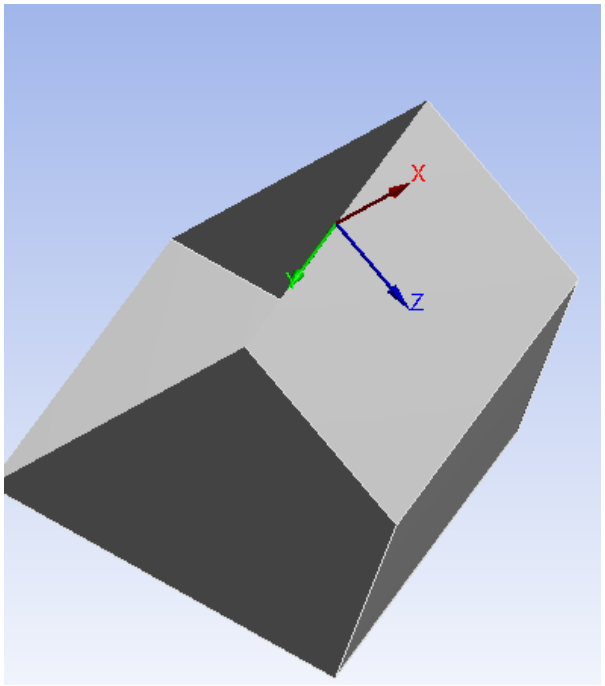


Defined with Fixed Vector

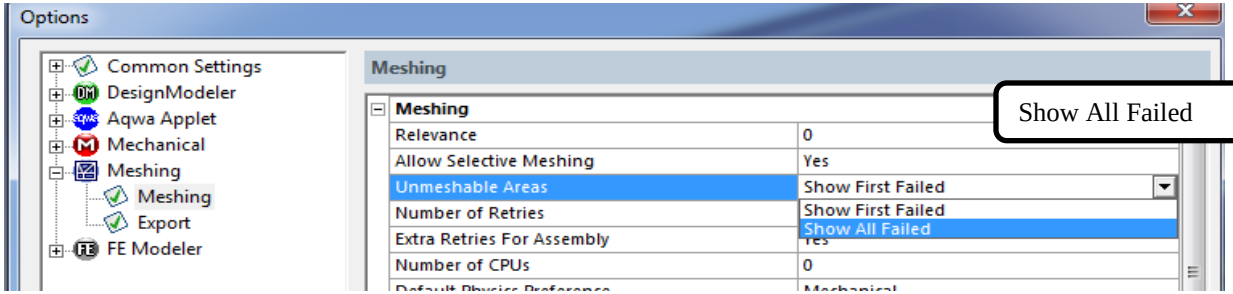
Create Section Plane from CS

- Create section plane from local CS
  - Section plane in the XY plan

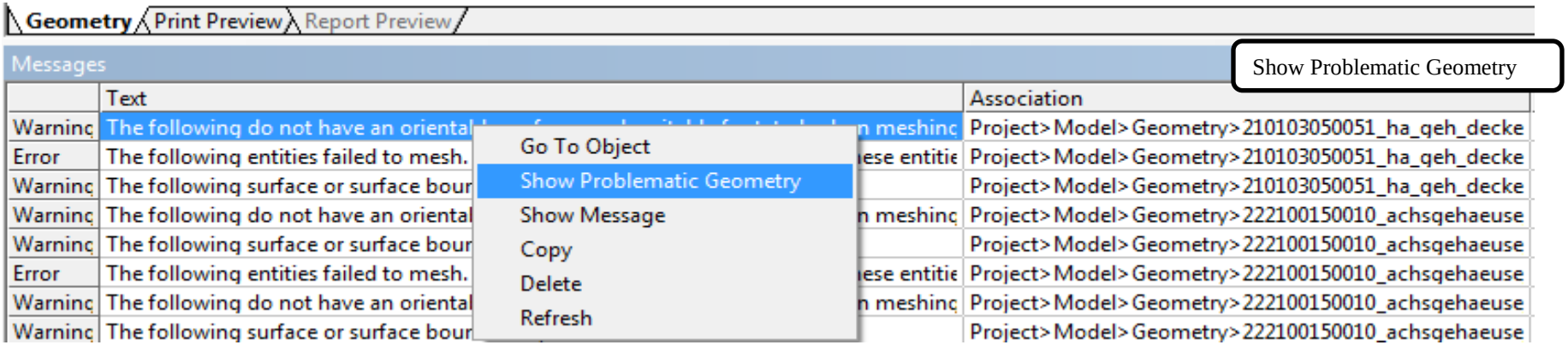




Meshing: Robustness



- "Show All failed" improved in 14.5
  - All failed regions are listed for easier correction
  - Helps indicate if just a few problems or more significant

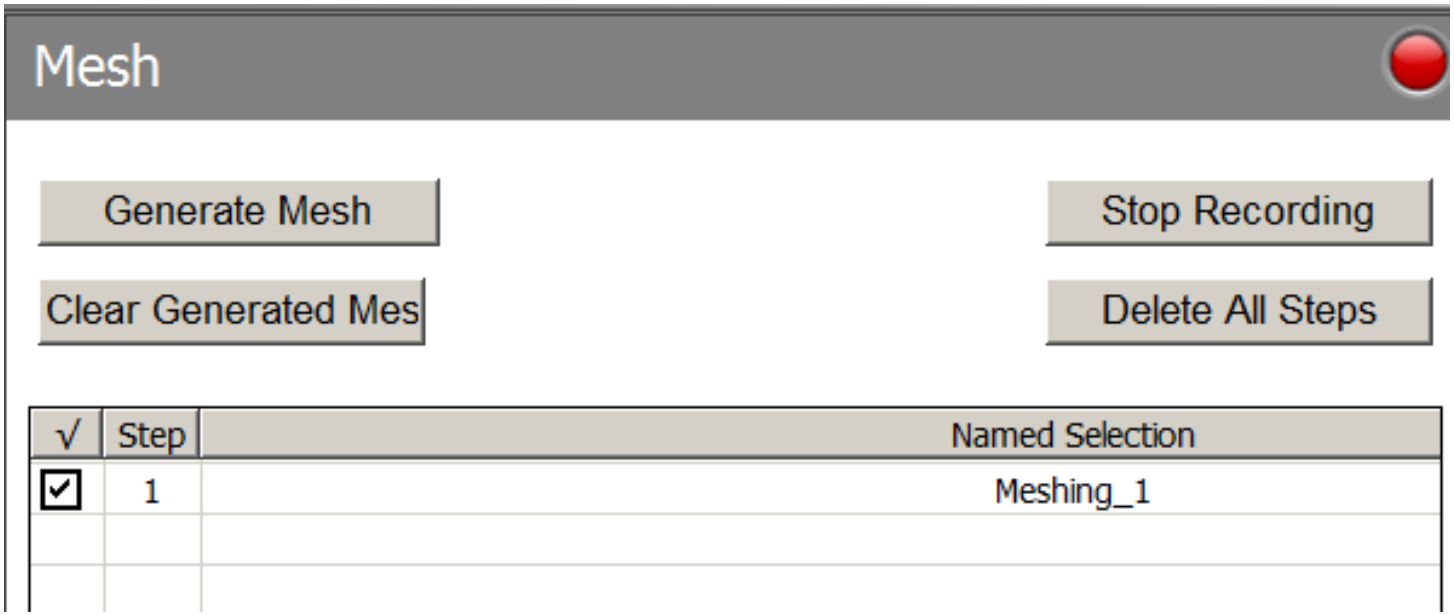


- >1000 meshing defects fixed:
  - In all technology areas, application areas, etc.

Fig From ANSYS Inc, 2012

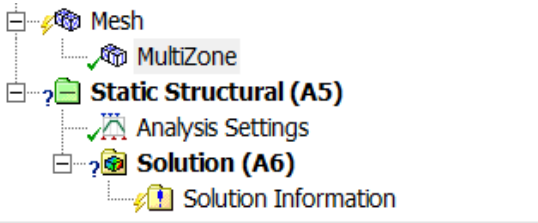
V14 – Selective Meshing

- Worksheet tracks meshing done on individual bodies (repeatability)



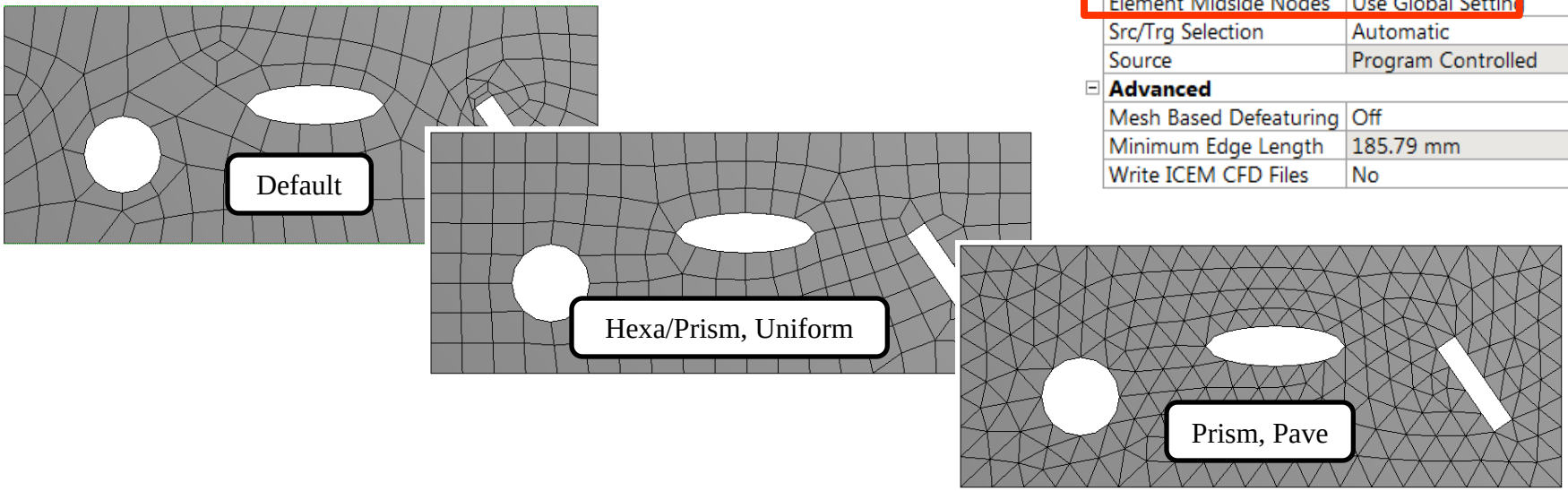
MultiZone Meshing Improvement

- Improved face meshing
  - Surface mesh methods: Program controlled, Pave, Uniform
  - Support for Advanced Size Function
- Improved Imprinting
- Improved Side Face Handling.
- Advanced Size Function.
- Behavior option for sizing controls.



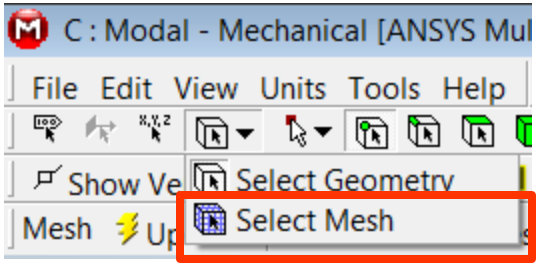
Details of "MultiZone" - Method

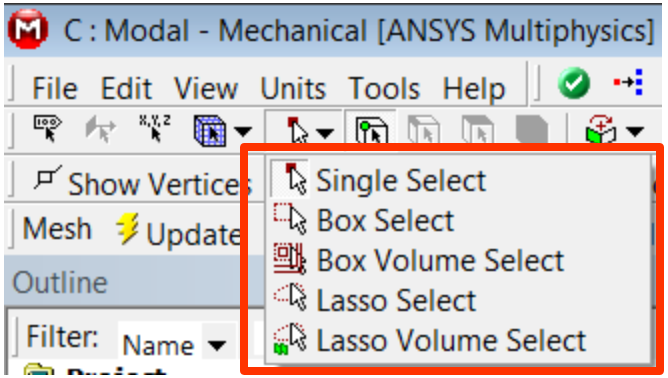
Scope	
Scoping Method	Geometry Selection
Geometry	1 Body
Definition	
Suppressed	No
Method	MultiZone
Mapped Mesh Type	Hexa/Prism
Surface Mesh Method	Uniform
Free Mesh Type	Not Allowed
Element Midside Nodes	Use Global Setting
Src/Trg Selection	Automatic
Source	Program Controlled
Advanced	
Mesh Based Defeaturing	Off
Minimum Edge Length	185.79 mm
Write ICEM CFD Files	No

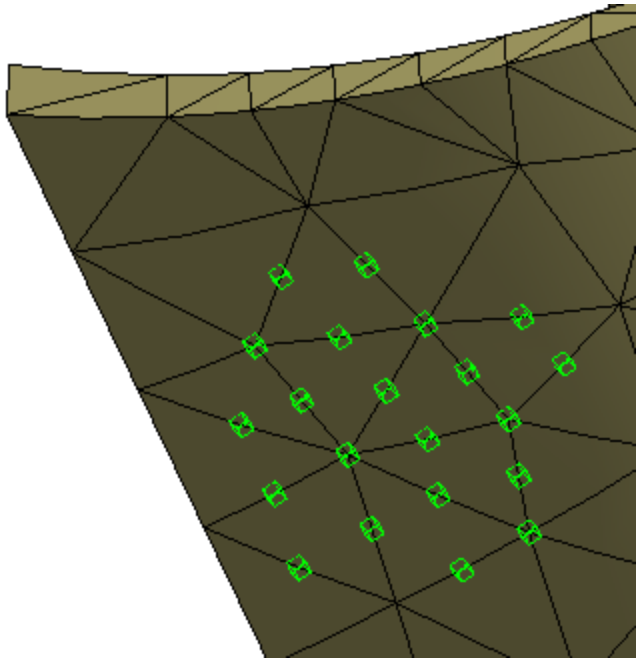


Selection of Nodes

- Able to select mesh
- Different selection options

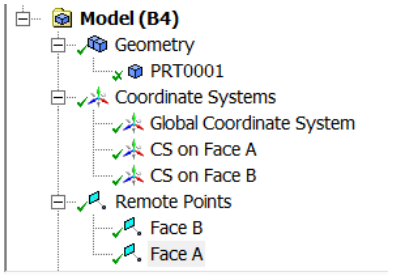






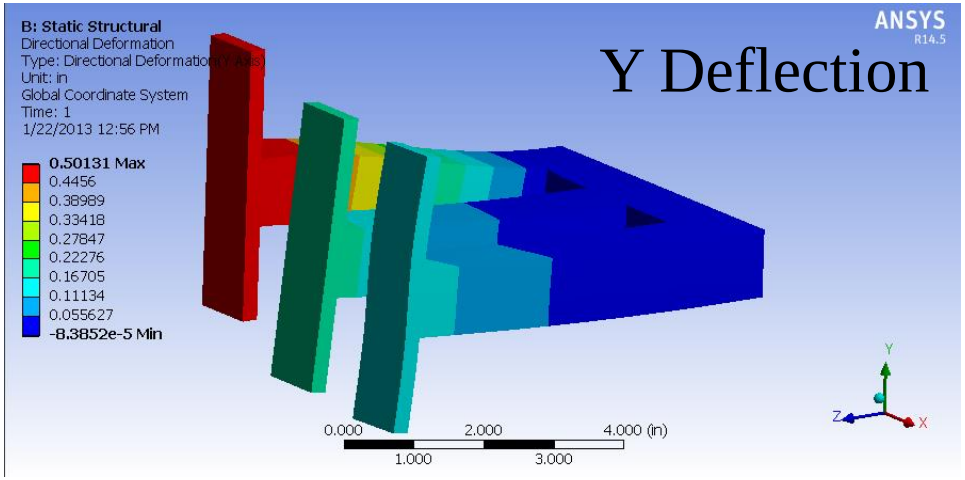
Coupled Remote Bc's

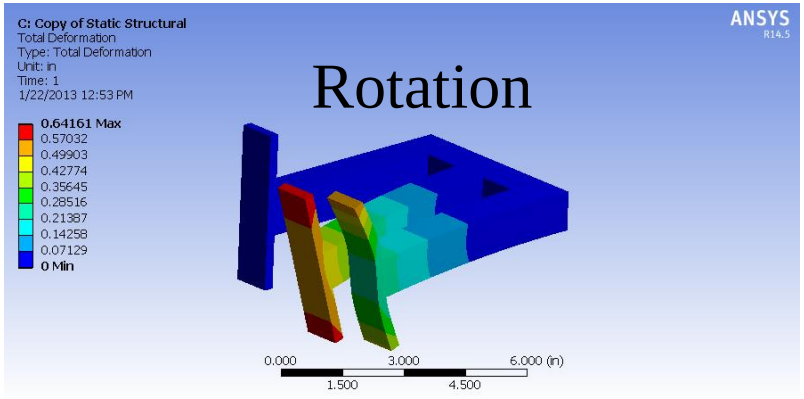
- Previously had Rigid/Deformable
  - Implemented thorugh contact tehcnology
  - Rotation behavior likely is not what you expect .
  - Displacement behavior can also not be what one expects
- Coupled Behavior for a Remote Point.
  - Implements by coupling all nodes together for applied BC direction
  - Rotations ignored/disabled



Details of "Face A"

Scope	
Scoping Method	Geometry Selection
Geometry	1 Face
Coordinate System	CS on Face A
X Coordinate	0. mm
Y Coordinate	30. mm
Z Coordinate	0. mm
Location	Click to Change
Definition	
ID (Beta)	64
Behavior	Coupled
DOF Selection	Program Controlled





Other Items

- Less invalidation of current solution in memory
- Disconnect Job From RSM
- Selective virtual topology and other tools
- Default contact formulation to augmented Lagrange
- All damping available (alpha, beta, total)
- RSM Setup Wizard

New Features

Submodeling in WB

- Saves time
- Support Thermal & Stress analysis
- Supports 2D to 3D

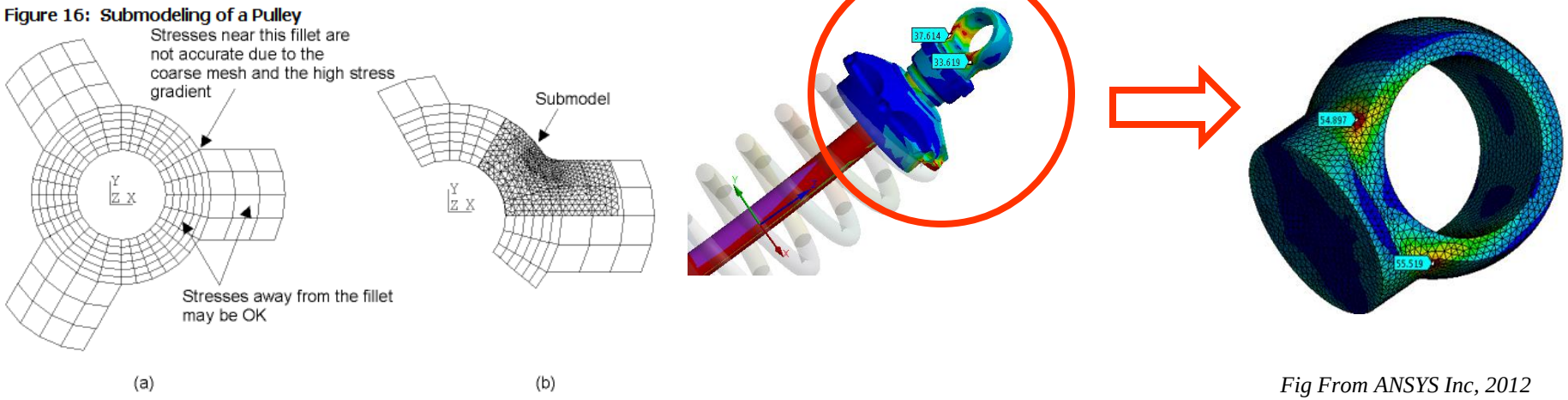
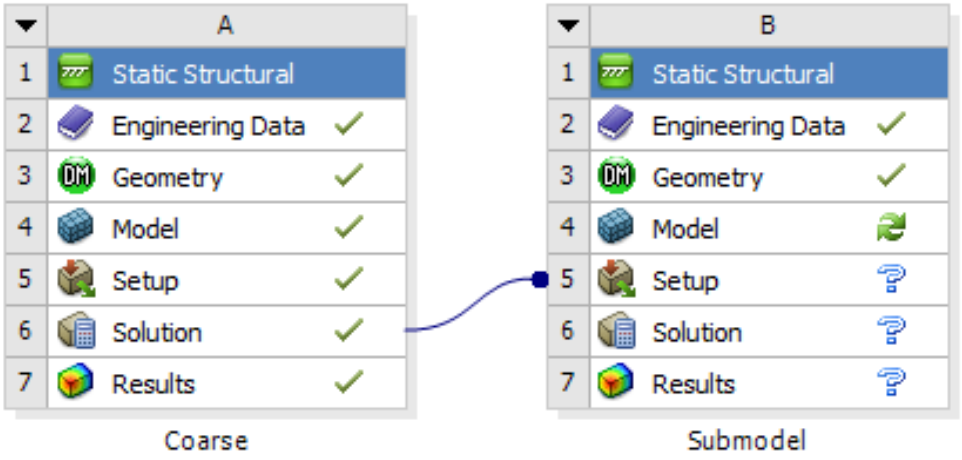
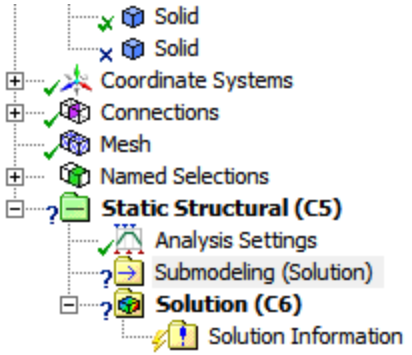


Fig From ANSYS Inc, 2012

Submodeling In WB

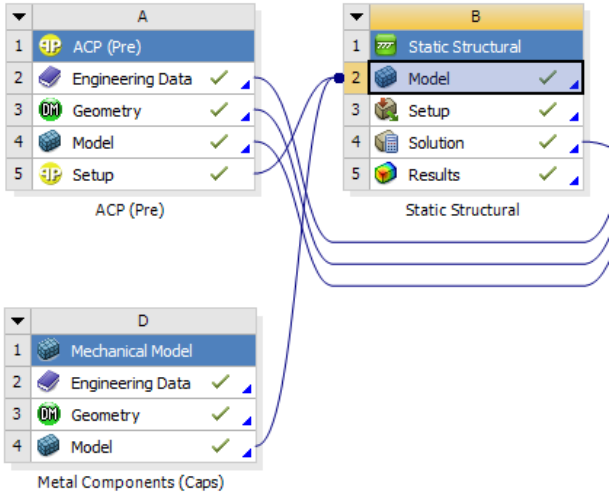
- Make coarse model
- Make submodel, dragging the solution from coarse onto submodel setup

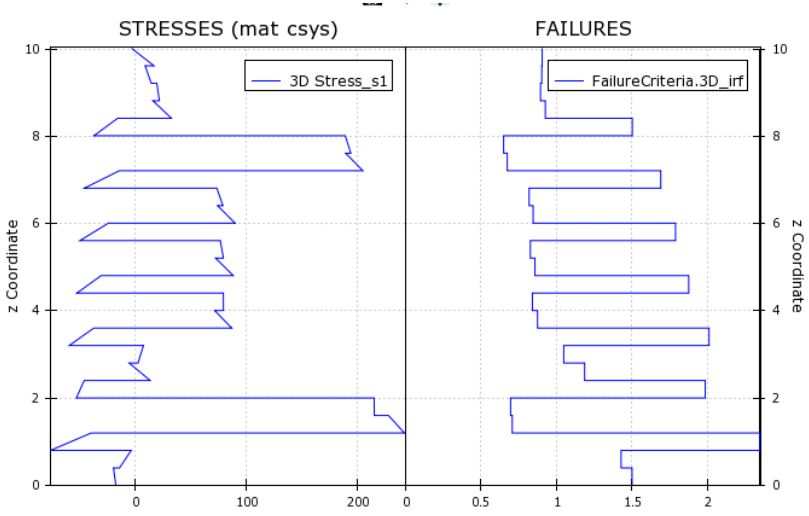




Composites Enhancements

- Can now do solid composites in Mechanical (Was shell only)
- Thick geometry
- Combine composites with non-composites in a single model
- Global and local results are displayed and investigated directly on the 3D model





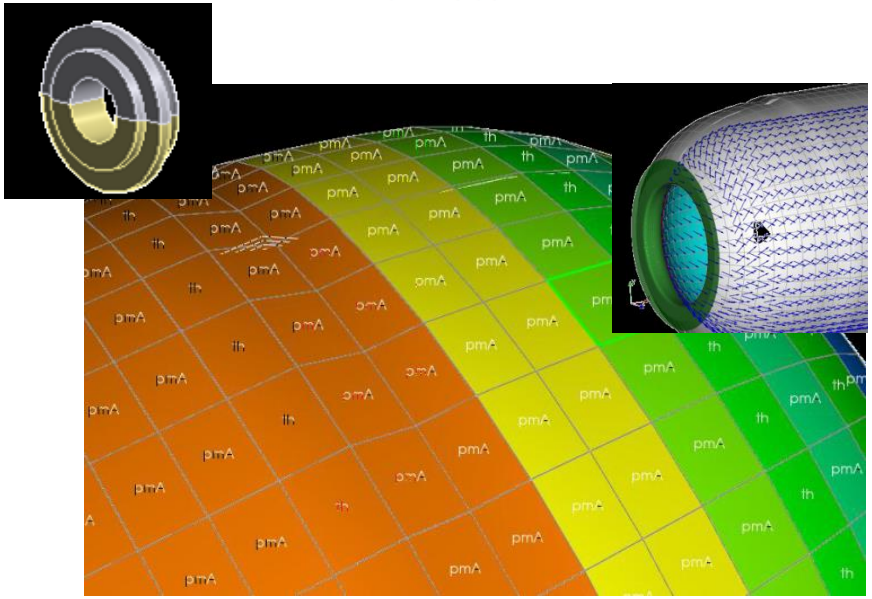


Fig From ANSYS Inc, 2012

ACT for new loads/bcs

- Application Customization Toolkit (ACT) based on Python and XML scripting
- Toolkit for performing customization within ANSYS Mechanical
- Similar with Mobile phone app develop process
- ANSYS will host a library for user uploads

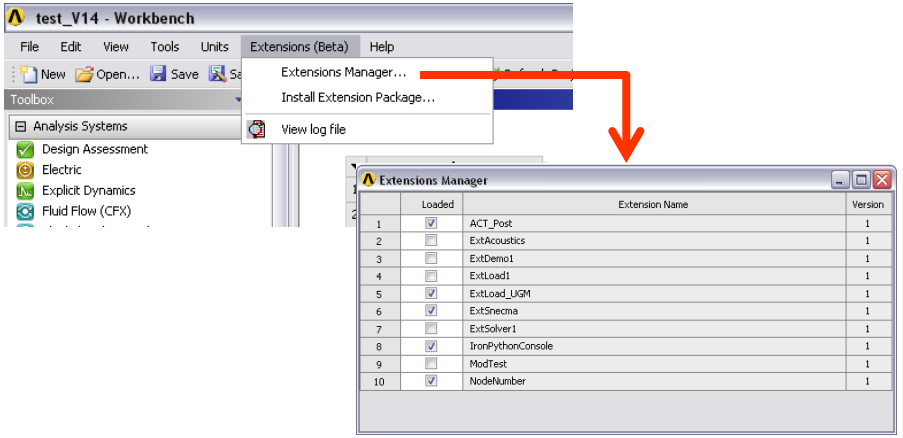
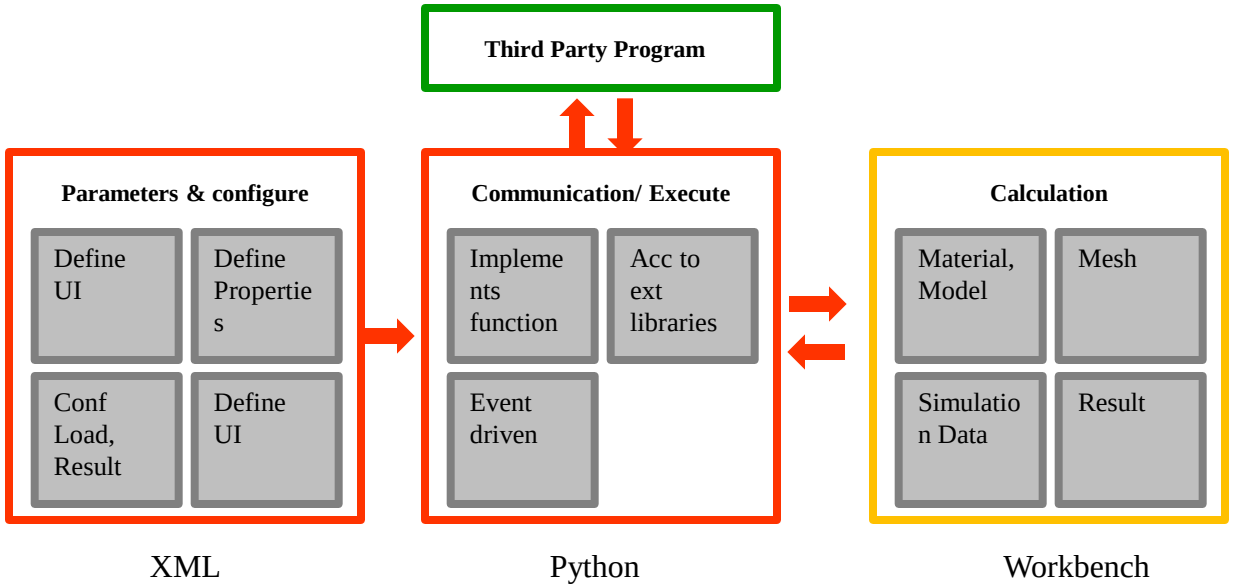
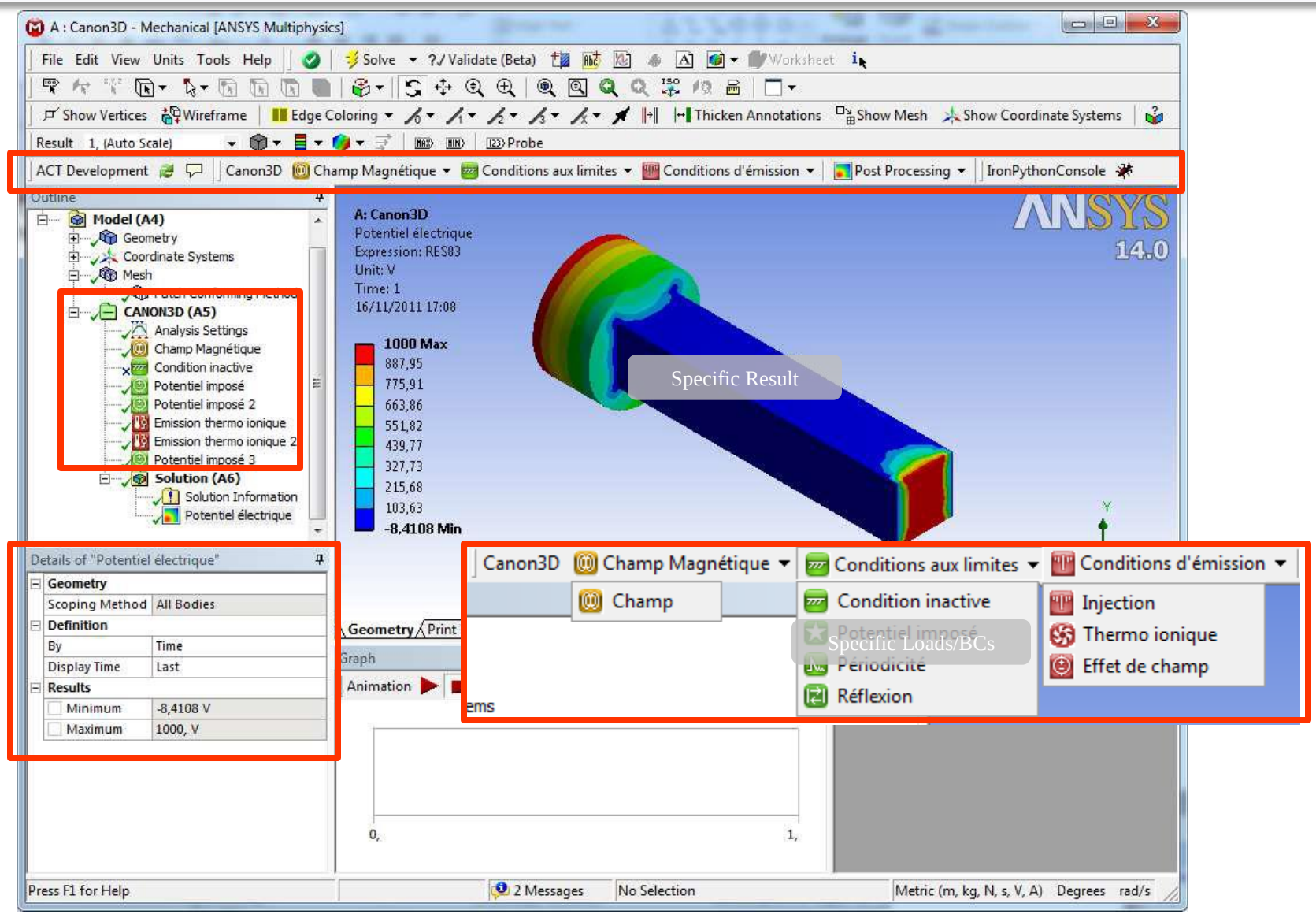


Fig From ANSYS Inc, 2012



ACT for new loads/bcs



Contact and Connection Enhancements

- **Penetration Tolerance.** For a Formulation setting of Program Controlled or Augmented Lagrange, you can now specify a Penetration Tolerance for a Contact Region.
- **Force Frictional sliding** supported
- **No separation** is now supported for rigid body modeling
- **Radial Gap Stop.** A new type of joint stop, radial gap stop.
  - Think of a cylinder in a cylinder with a gap and the inner cylinder and translate and tilt
- **Nonlinear stiffness** for rigid body analysis for springs and bushings

Advanced	
Formulation	Program Controlled
Detection Method	Program Controlled
Penetration Tolerance	Value
Penetration Tolerance Value	0. mm
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled

Definition	
Type	Bonded
Scope Mode	
Behavior	
Trim Contact	
Trim Tolerance	
Suppressed	
Advanced	
Formulation	Program Controlled
Detection Method	Program Controlled
Penetration Tolerance	Program Controlled
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled

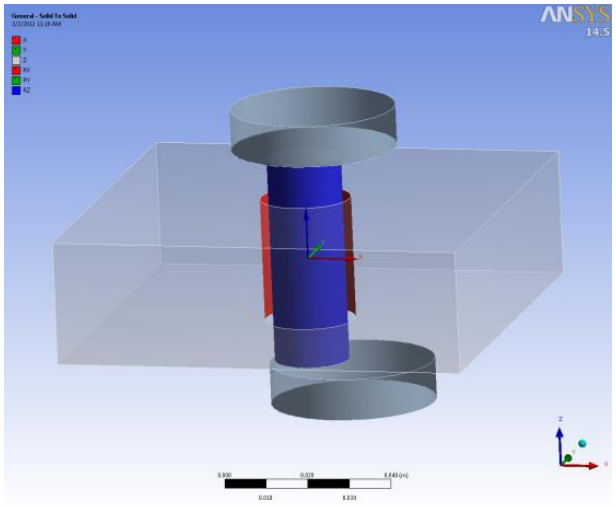
Bonded
No Separation
Frictionless
Rough
Frictional
Forced Frictional Sliding

Radial gap stop as Contact

- Efficient modeling of small clearance between shaft and bearings are available for spherical, general and bushing joint and do not require full contact modeling

Details of "General - Solid To Solid"

Definition	
Connection Type	Body-Body
Type	General
Suppressed	No
Translation X	Free
Translation Y	Free
Translation Z	Fixed
Rotations	Free All
Reference	
Scoping Method	Geometry Selection
Scope	1 Face
Body	Solid
Coordinate System	Reference Coordinate System
Mobile	
Scoping Method	Geometry Selection
Scope	1 Face
Body	Solid
Initial Position	Unchanged
Stops	
Radial Gap	Stop
Inner Diameter	1.8e-002 m
Outer Diameter	2.2e-002 m
Height	3.e-002 m
Restitution	0.5



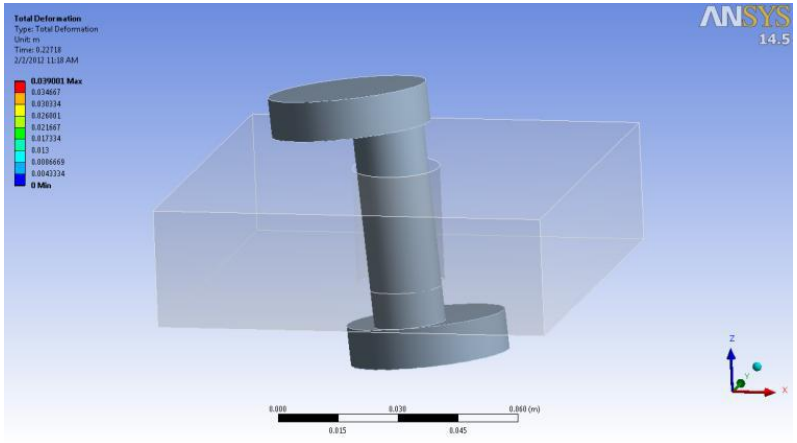
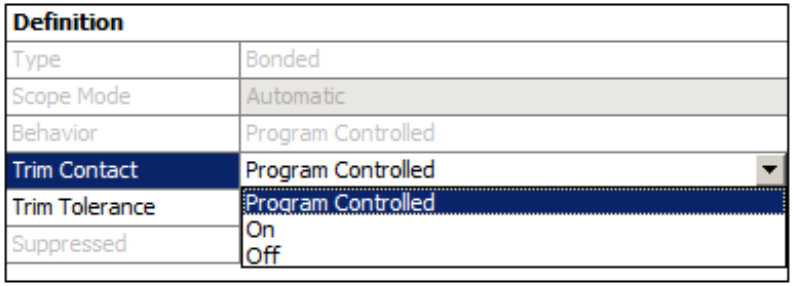


Fig From ANSYS Inc, 2012

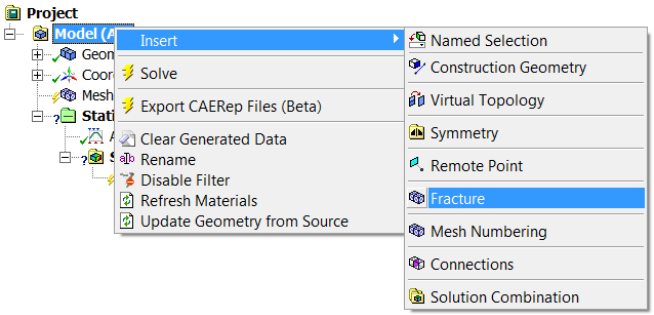
Contact Enhancements

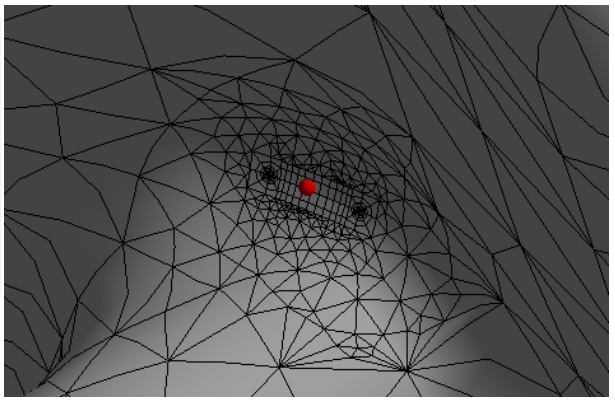
- Trim contact
  - Speeds the solution process by reducing the number of contact elements of each contact pair involved in the analysis.
- Shell thickness contact offset
  - Allows to include or exclude the thickness of a surface body for an analysis involving contact pairs of surface bodies.

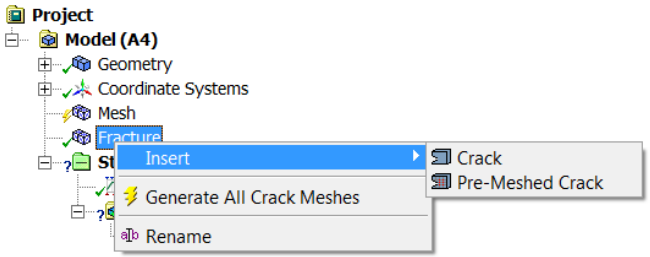


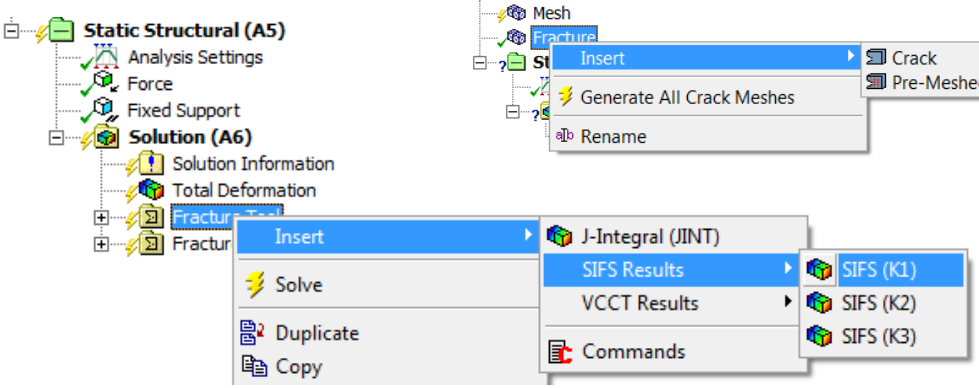
Crack Defined Easily, SIF Plotting

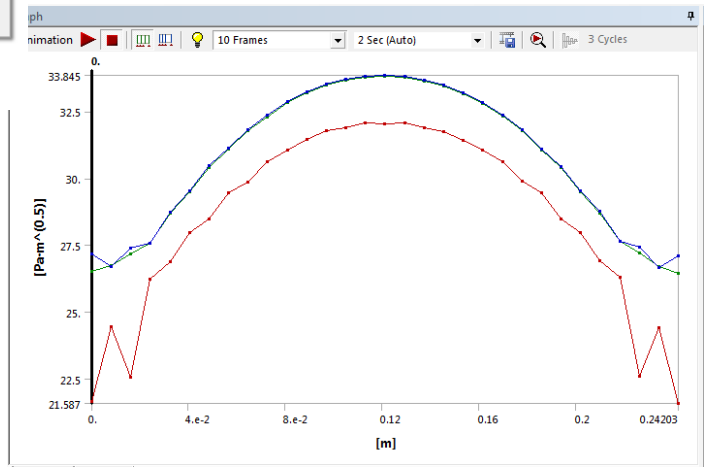
- Easily Defined
  - Insert a Fracture folder in the Tree Outline
- Plot Stress Intensity Factors and Energy release rates











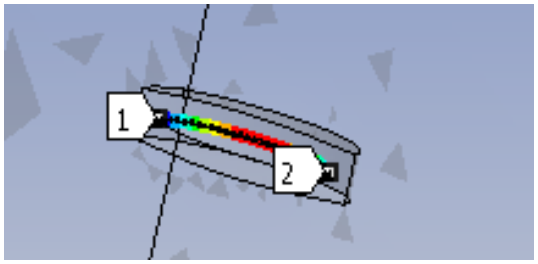
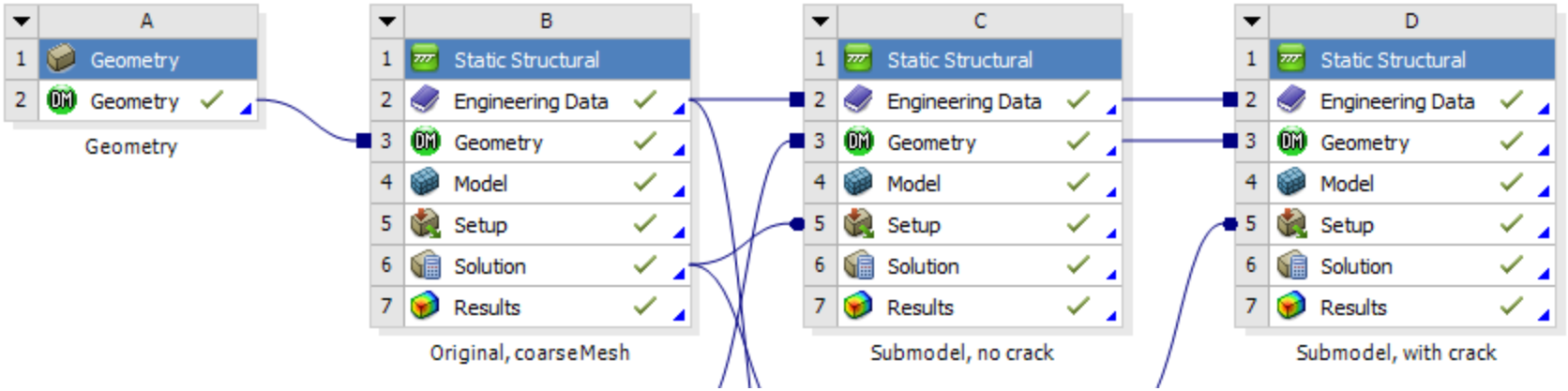
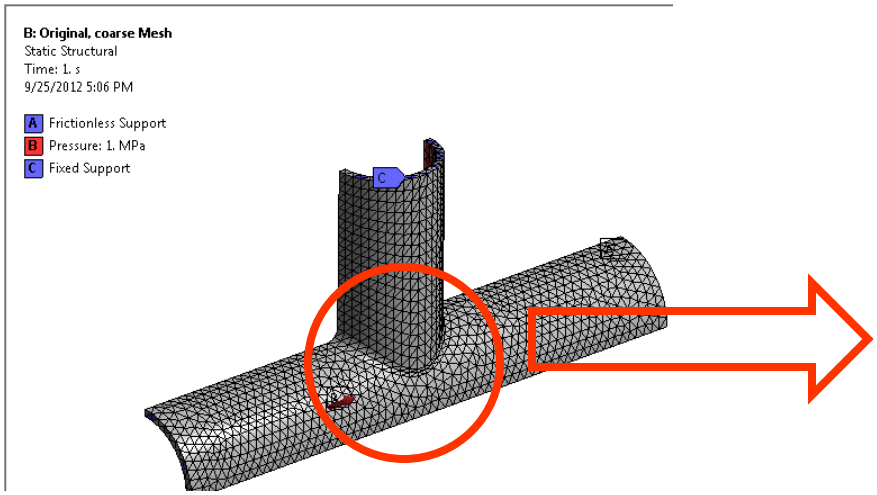


Fig From ANSYS Inc, 2012

Combine Submodeling And Crack Analysis

- A crack can be introduced in a submodel to reduce overall computation time while increasing the local accuracy.





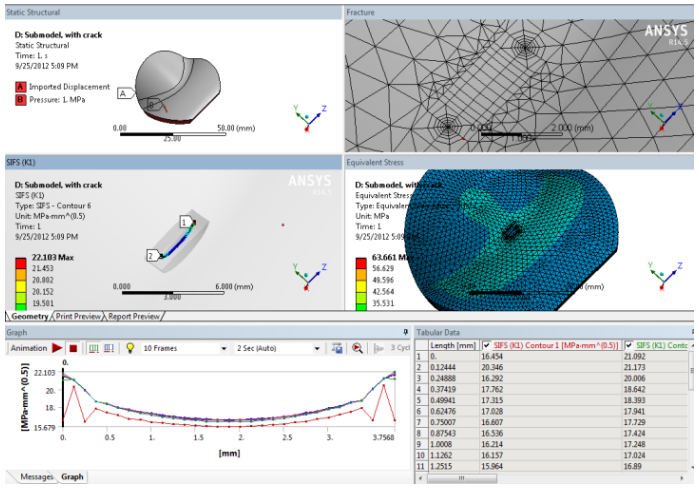
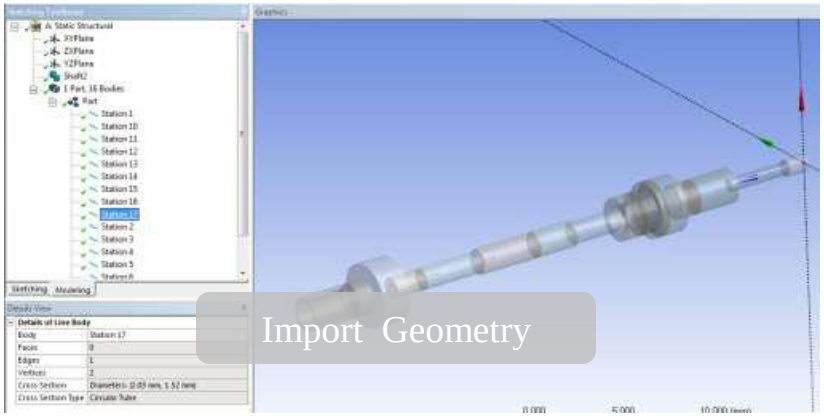


Fig From ANSYS Inc, 2012

v14-Rotordynamics in WB

- Geometries can be imported from a CAD system or imported from a simple text file definition as used in preliminary design
- Rotordynamics analyses require a number of advanced controls:
  - Damping
  - Solver choice
  - Coriolis effect
- Get Campbell Diagrams



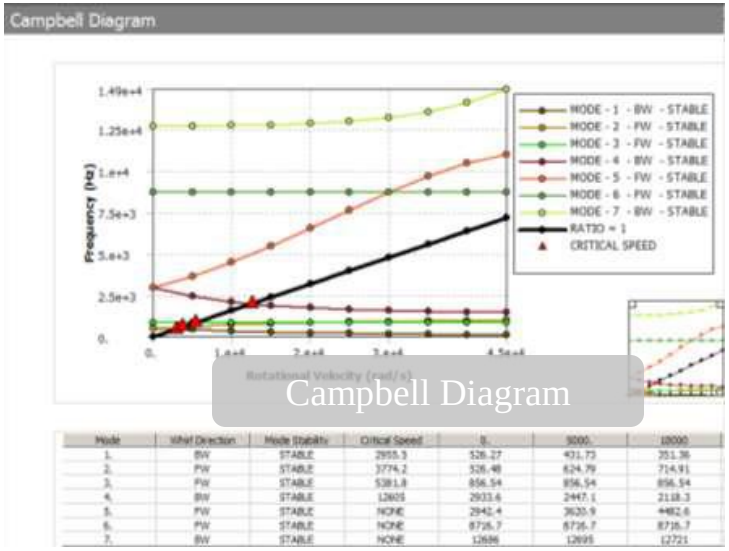
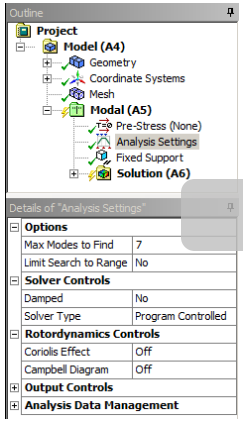
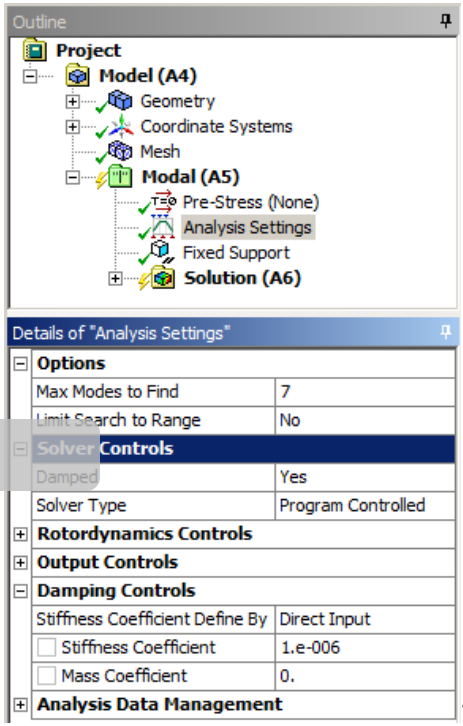


Fig From ANSYS Inc, 2012

Rotordynamics Controls	
Coriolis Effect	On
Campbell Diagram	Off
Output Controls	
Damping Controls	
Analysis Data Management	



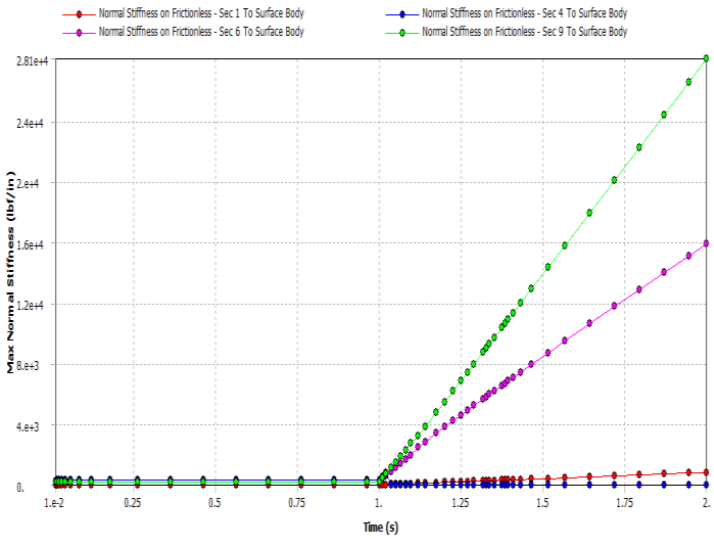


Analysis Setting

FKN As Variable Of Time, pressure, Etc.

... within Epsilon

- FKN, CNOF, TCC etc can be defined as function of time, temperature, pressure, gap/penetration etc.



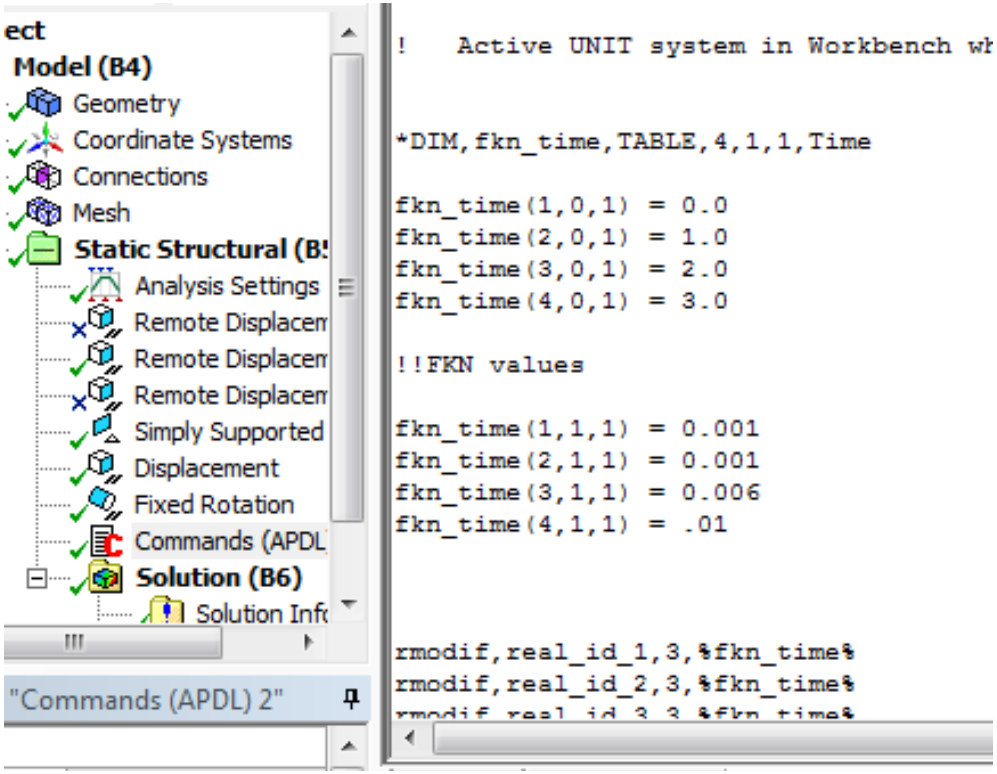
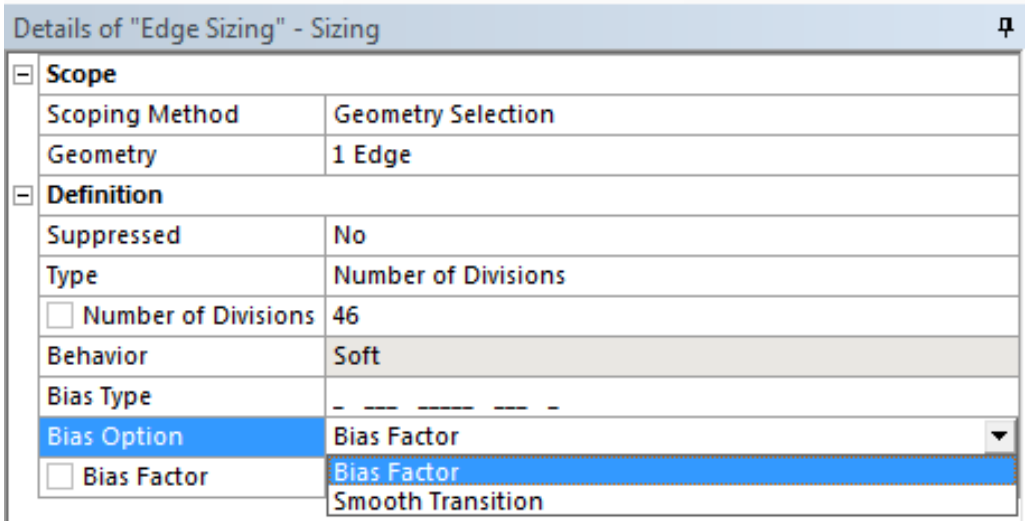
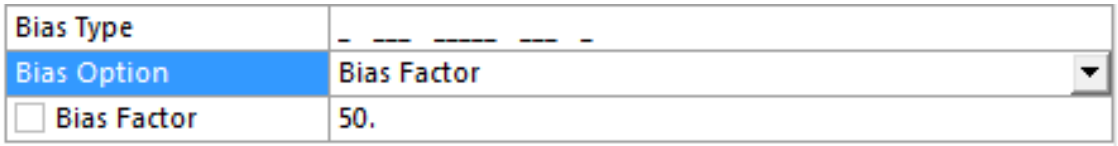


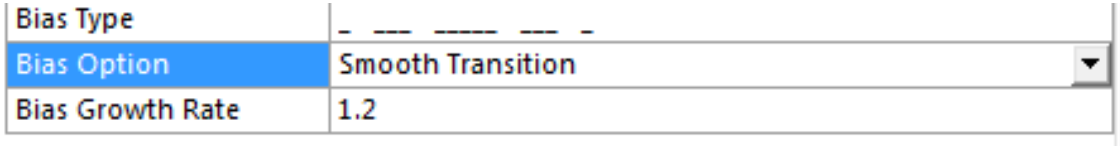
Fig From ANSYS Inc, 2012

Local Size Control Enhancements

- New Bias:
- Bias Factor:
  - Same as in past
  - Max/Min edge length
- Smooth Transition:
  - Bias Growth Rate
  - Bias Growth Rate = Bias Factor ^ (1/(n-1))

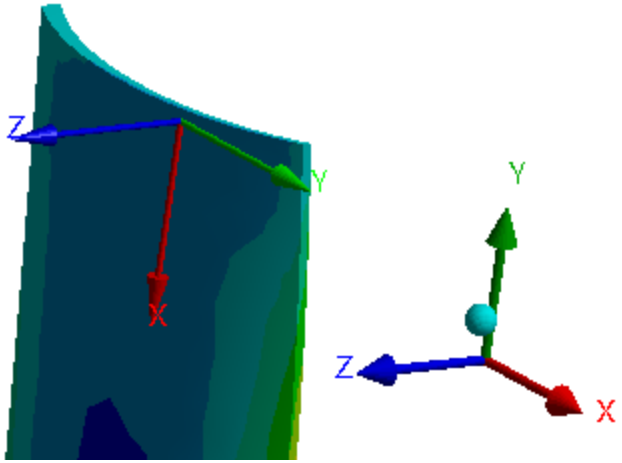




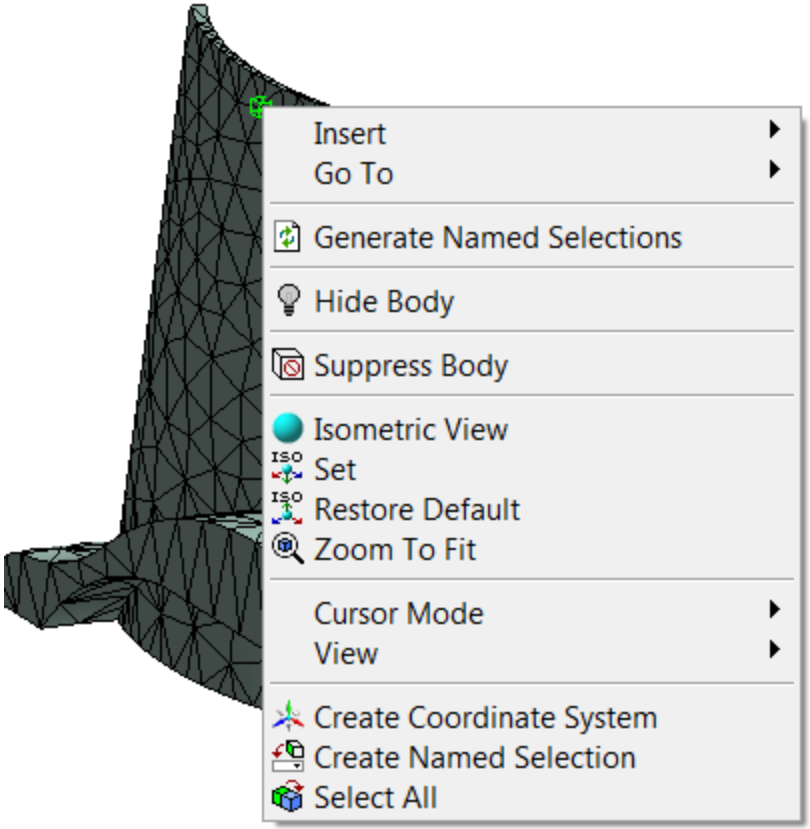


Make Cs By Picking Nodes

- Define local CS by node.
- Get result with user defined CS. Such as principal stresses.



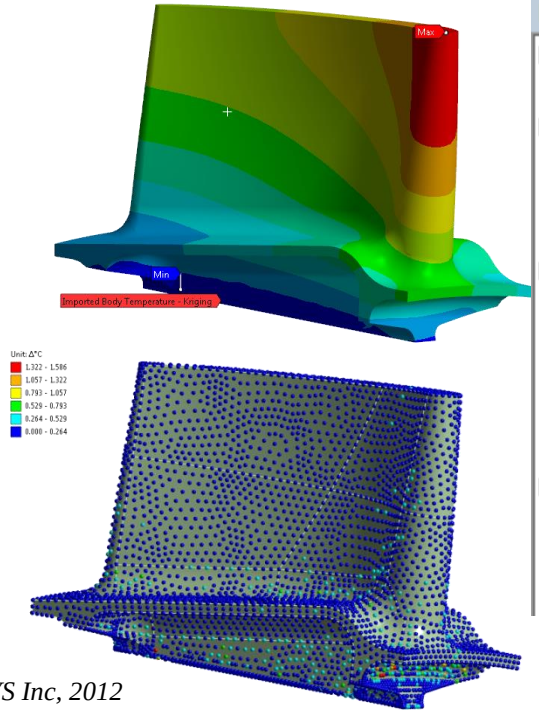
Plot normal stress with user defined CS



Better Data Mapping

- Mapping data from a text file onto a structural model
- Validating the Mapped Data
  - Visual tools have been implemented to control how well the data has been mapped onto the target structure

Node Number	X Location (m)	Y Location (m)	Z Location (m)	Temperature (°C)
1	-3.198e-002	-1.0697e-002	0.26812	572.44
30	-2.7427e-002	-9.8339e-003	0.26492	571.22
1515	-1.7777e-002	-8.5543e-003	0.27292	571.66
1517	-2.6033e-002	-9.9145e-003	0.27287	572.4
792	-3.1981e-002	-2.585e-002	0.26709	572.88
552	-2.7431e-002	-2.4808e-002	0.26394	571.6
1528	-1.7777e-002	-2.3981e-002	0.27199	572.21
1527	-2.6033e-002	-2.5337e-002	0.27187	572.91
265	-3.1978e-002	4.4898e-003	0.2683	572.34
1516	-2.6033e-002	5.5394e-003	0.27299	572.38
1514	-1.7777e-002	6.9001e-003	0.27296	571.68
294	-2.7423e-002	5.1701e-003	0.26505	571.11
793	-3.1978e-002	1.9662e-002	0.26761	572.34
1060	-2.6033e-002	2.0976e-002	0.27224	572.54
1061	-1.7777e-002	2.2332e-002	0.27214	571.91
1033	-2.7418e-002	2.0157e-002	0.26433	571.04
1519	-3.4288e-002	-1.1273e-002	0.27282	573.29
39	-3.8116e-002	-1.1791e-002	0.27032	573.48
1526	-3.4288e-002	-2.669e-002	0.27174	573.81
561	-3.8115e-002	-2.7066e-002	0.26922	573.95
303	-3.8117e-002	3.5221e-003	0.27056	573.39
1518	-3.4288e-002	4.1799e-003	0.27302	573.21
1024	-3.8118e-002	1.8824e-002	0.26993	573.47
1059	-3.4288e-002	1.962e-002	0.27234	573.37
1446	-4.3846e-002	-1.2619e-002	0.26815	573.98
1445	-3.7258e-002	-1.1448e-002	0.26581	573.01
1452	-4.3846e-002	-2.777e-002	0.267	574.42
1453	-3.7258e-002	-2.6468e-002	0.26473	573.45
1437	-3.7258e-002	3.6091e-003	0.26603	572.89
1438	-4.3846e-002	2.5719e-003	0.26843	573.87
1085	-3.7258e-002	1.8654e-002	0.2654	572.89
1084	-4.3846e-002	1.7755e-002	0.26786	574.
1444	-3.1393e-002	-1.0348e-002	0.26198	571.4



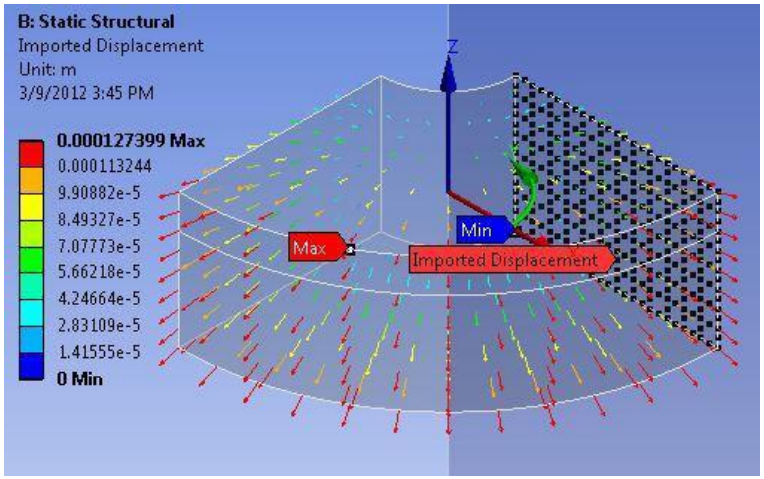
Details of "Validation"

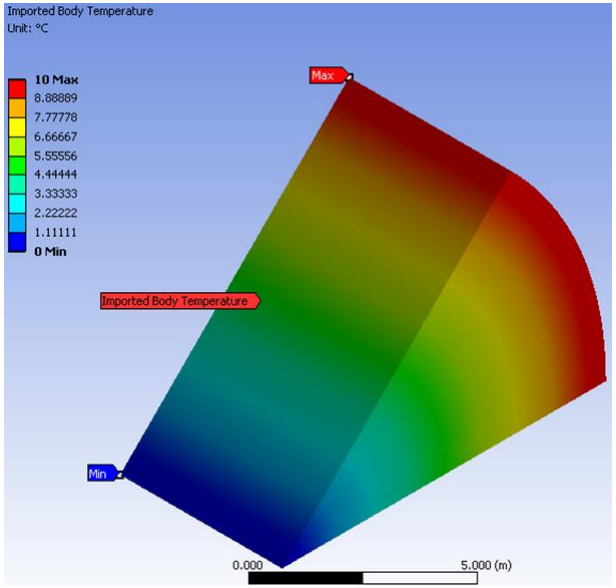
Definition	
File Identifier	File1:Temperature1
Settings	
Type	Distance Based Average Comparison
Number of Points	3
Output Type	Absolute Difference
Graphics Controls	
Display	Colored Spheres
Scale	0.2
Display Minimum	4.6618e-008 C
Display Maximum	1.5858 C
Display In Parent	On
Statistics	
Minimum	4.6618e-008 C
Maximum	1.5858 C
Number Of Items	21688

Fig From ANSYS Inc, 2012

Better Data Mapping

- Contour Plots for Imported Vector Data
- Faster mapping with Kriging Algorithm
- New Legend Controls for Imported Load Objects





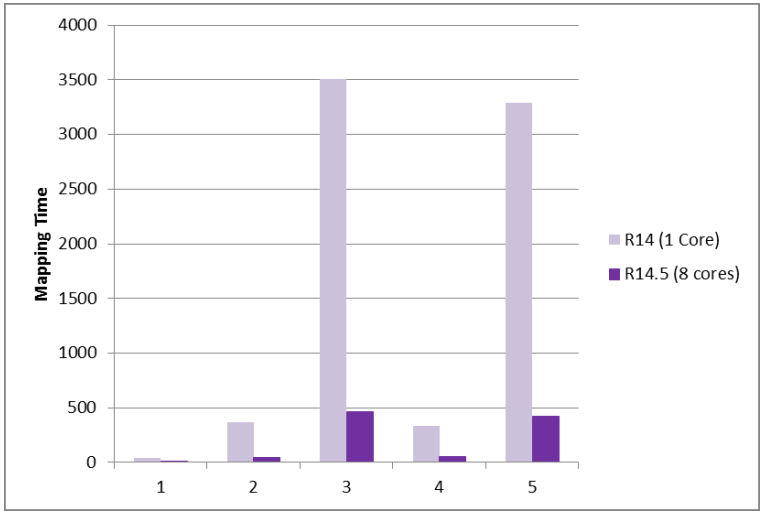
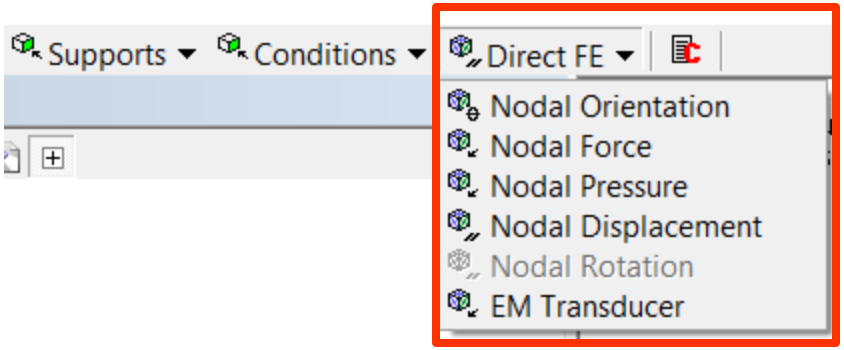
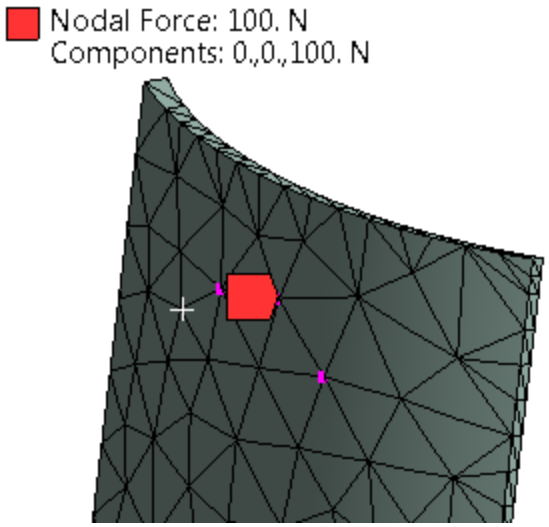


Fig From ANSYS Inc, 2012

V14 - Direct FE Loads

- Apply load or BC to Nodal



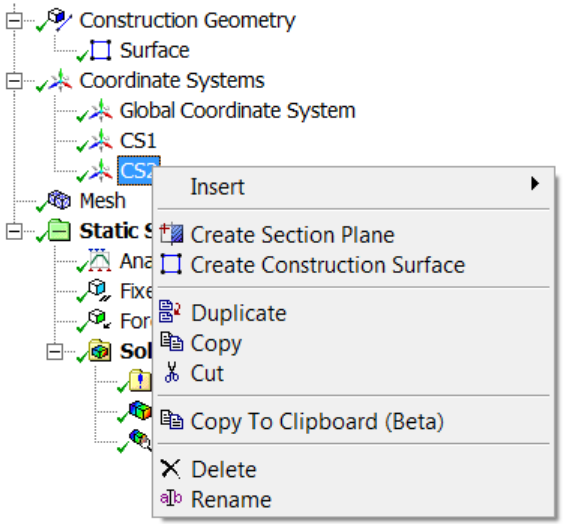


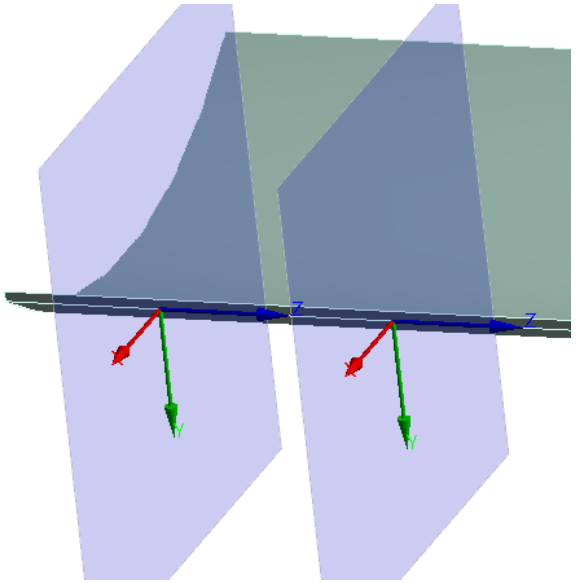
Details of "Nodal Force"

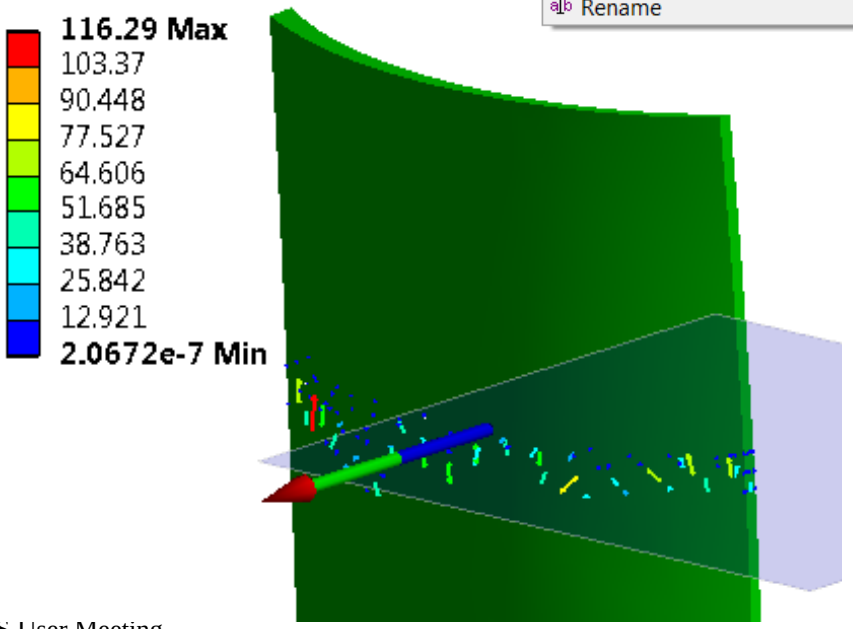
Scope	
Scoping Method	Named Selection
Named Selection	NodeSet
Definition	
ID (Beta)	39
Type	Force
Coordinate System	Nodal Coordinate System
X Component	0. N (ramped)
Y Component	0. N (ramped)
Z Component	100. N (ramped)
Divide Load by Nodes	Yes
Suppressed	No

Reaction On Cutplanes

- You can now extract member forces and moment reactions through a model using a reaction probe scoped to a Surface Construction Geometry object.
  - Define local CS
  - Create Construction Surface
  - Get result

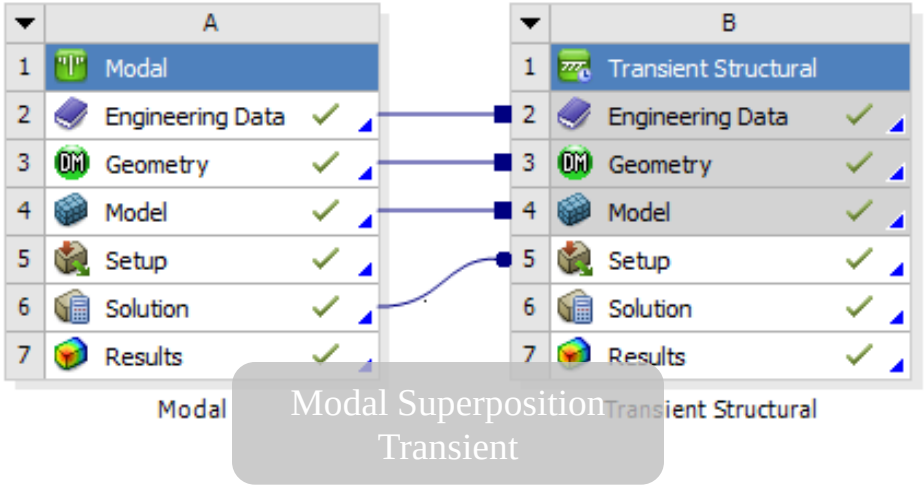


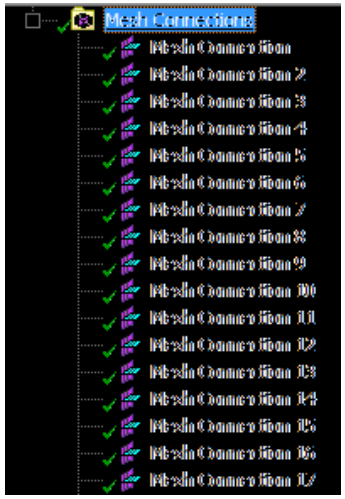


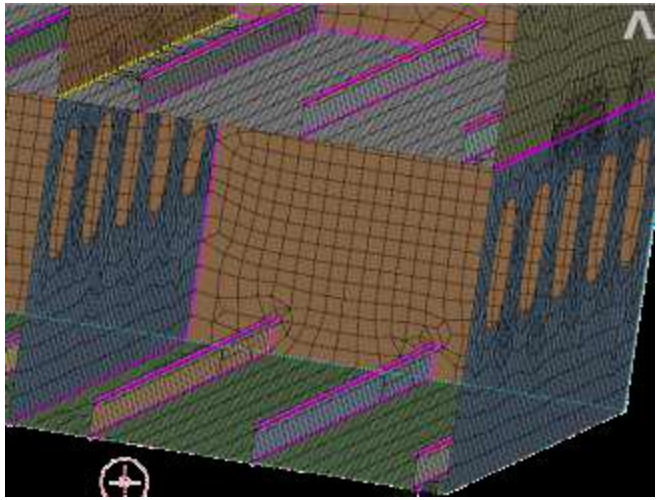


V14 Improvement

- v14- MSUP Transient Analysis supported (prestressed in 14.5)
- V14- Mesh connections work at part level:
  - As a post mesh operation
  - Base part mesh is stored to allow for quick changes in connections







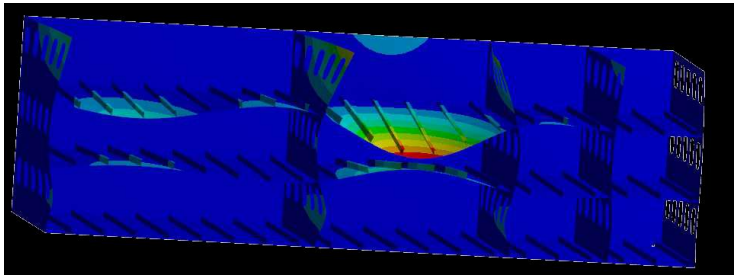


Fig From ANSYS Inc, 2012