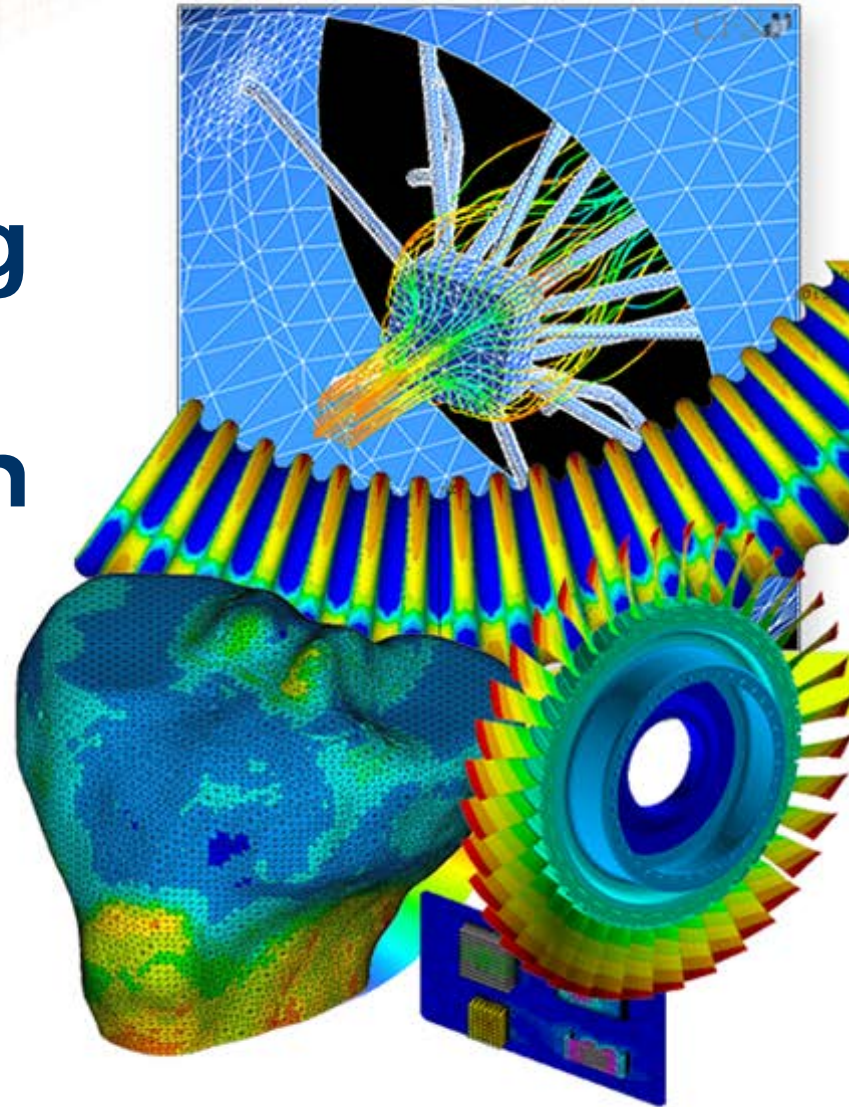# Advanced Meshing Techniques in ANSYS Workbench

Presented by:

Eric Stamper

4/9/2015

CAE Associates Inc.

- Engineering Consulting Firm in Middlebury, CT specializing in FEA and CFD analysis.
- ANSYS® Channel Partner since 1985 providing sales of the ANSYS® products, training and technical support.

e-Learning Webinar Series
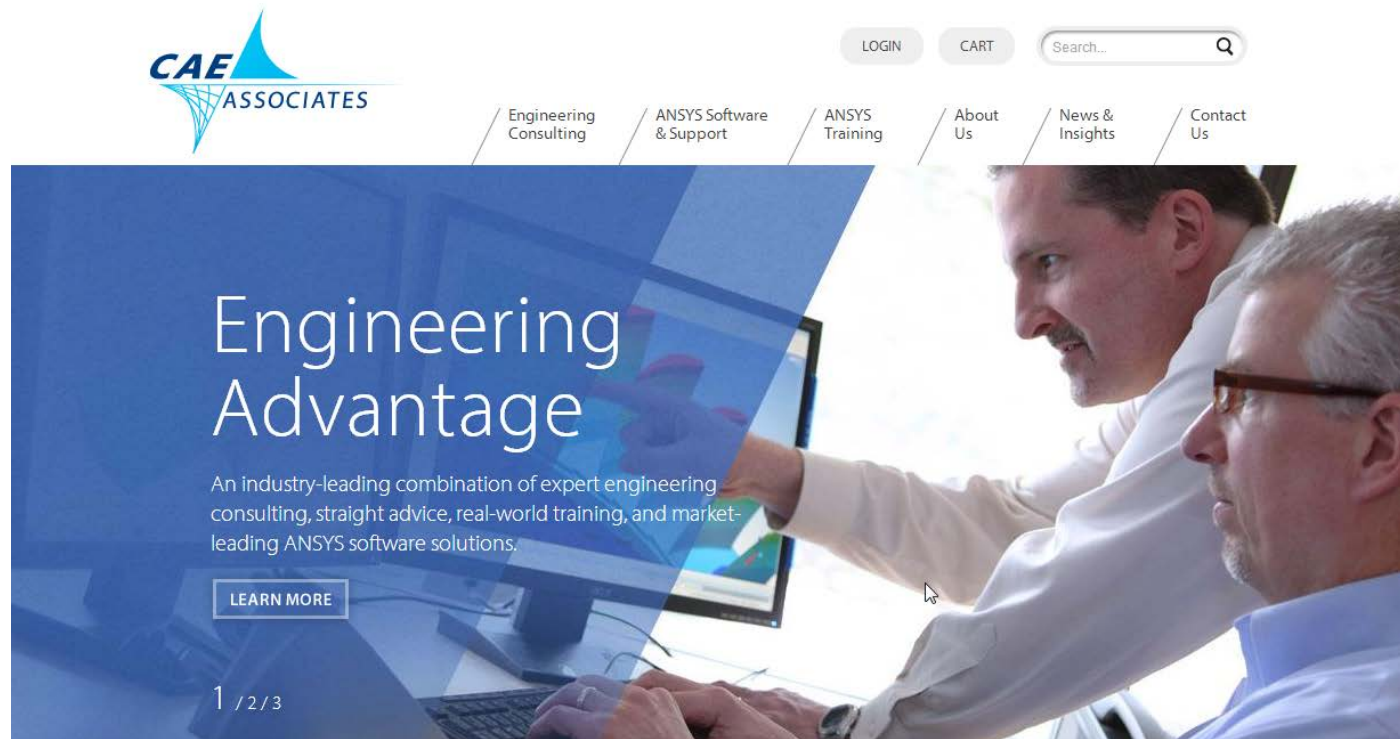
- This presentation is part of a series of e-Learning webinars offered by CAE Associates.

- You can view many of our previous e-Learning sessions either on our website or on the CAE Associates YouTube channel:
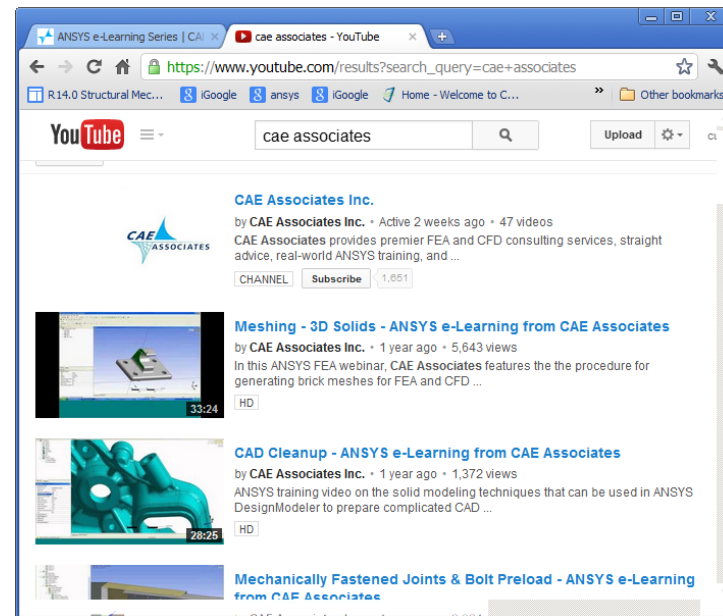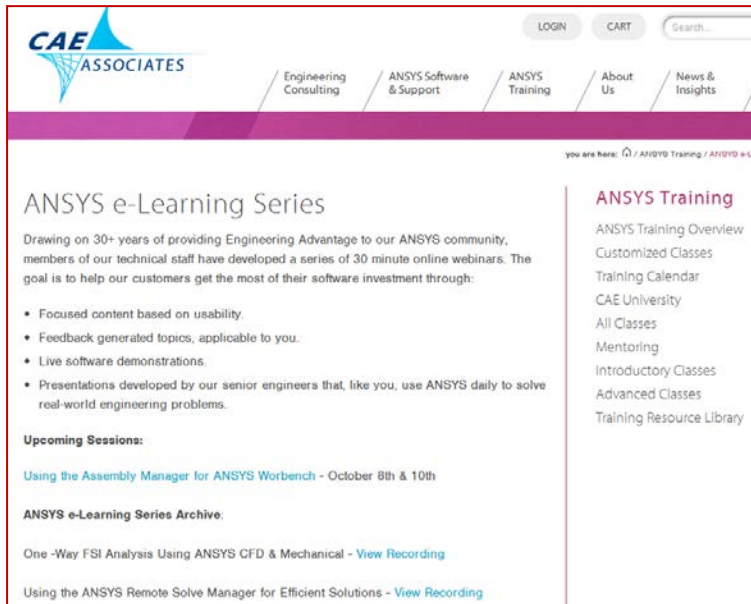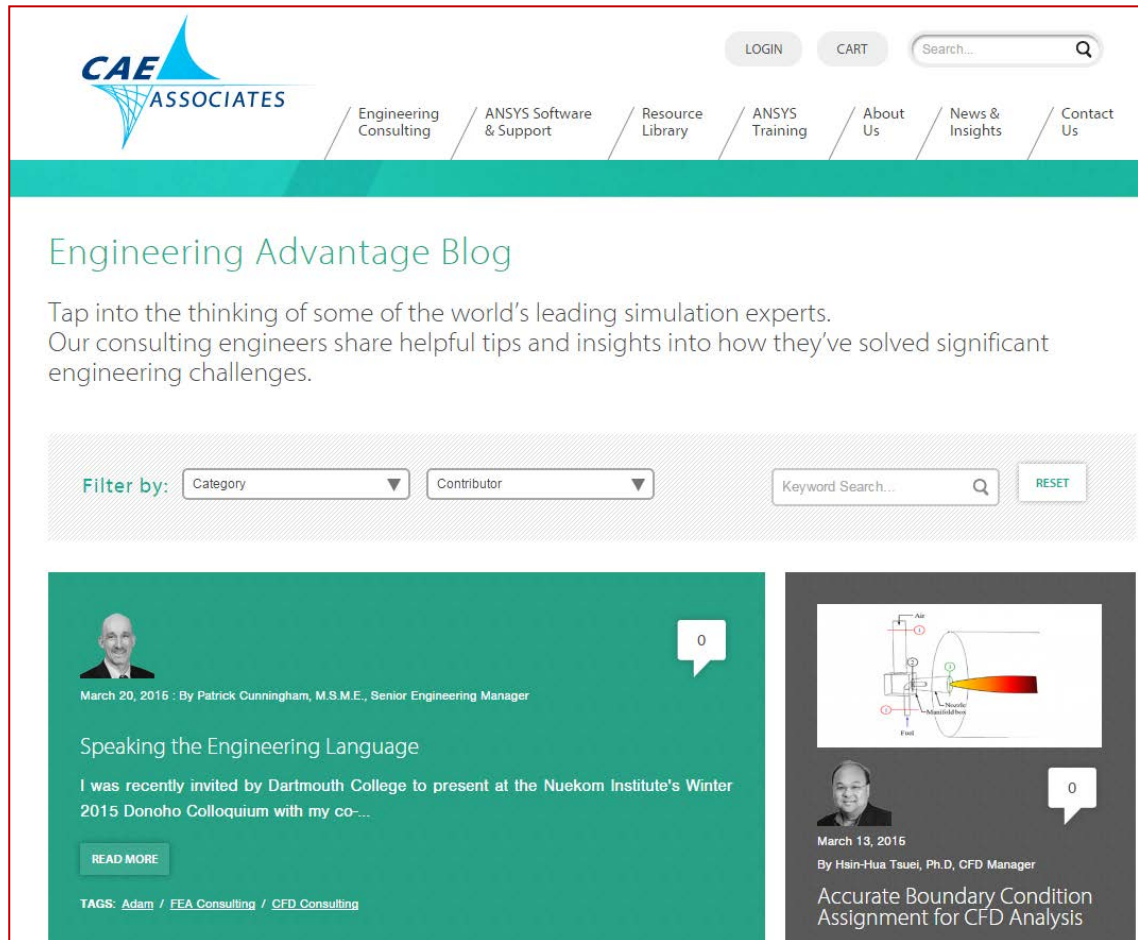

- If you are a New Jersey or New York resident you can earn continuing education credit for attending the full webinar and completing a survey which will be emailed to you after the presentation.

CAEA Resource Library

- Our Resource Library contains over 250 items including:
  - Consulting Case Studies
  - Conference and Seminar Presentations
  - Software demonstrations
  - Useful macros and scripts
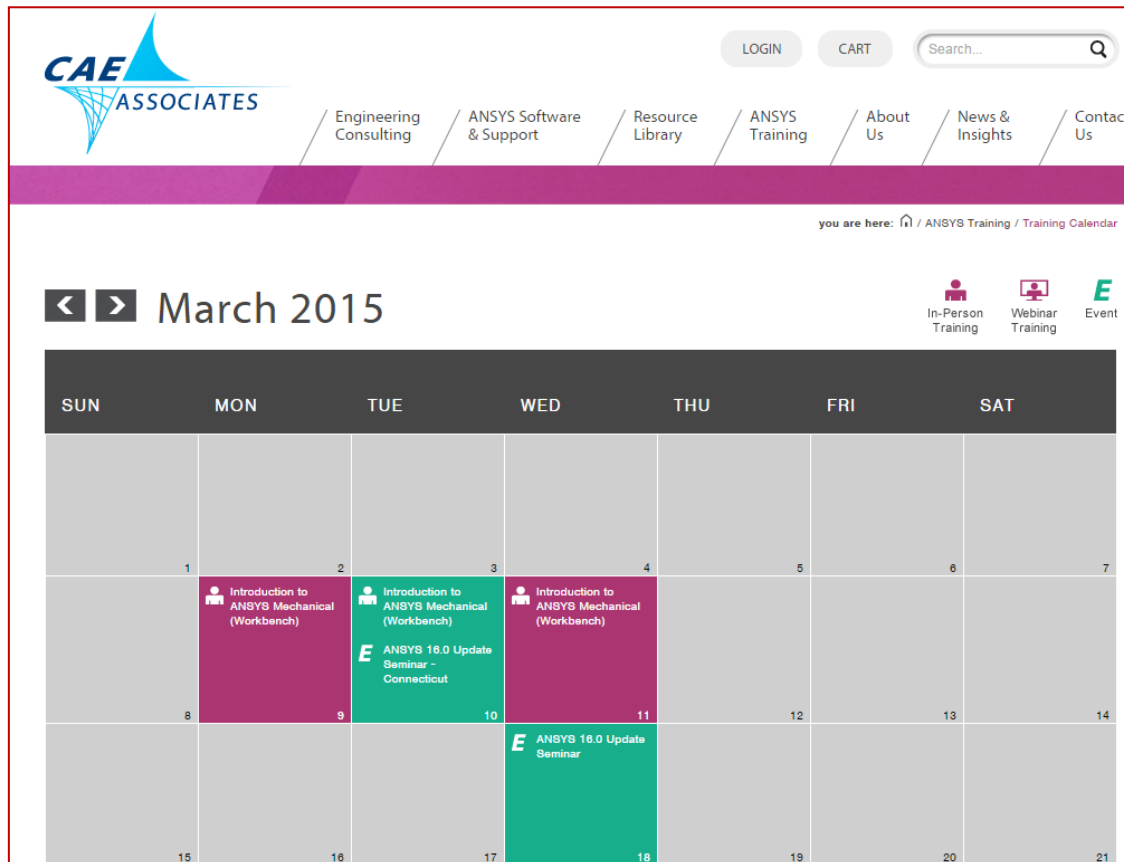- The content is searchable and you can download copies of the material to review at your convenience.

CAEA Engineering Advantage Blog
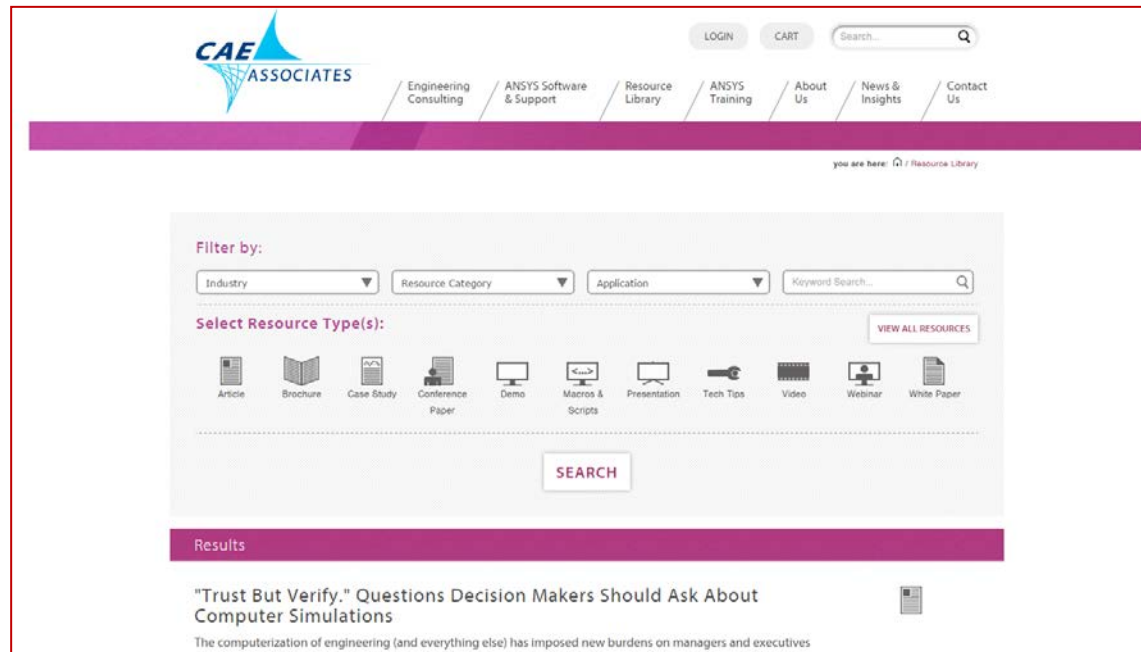
- Our Engineering Advantage Blog offers weekly insights from our experienced technical staff.

CAEA ANSYS® Training

- Classes can be held at our Training Center at CAE Associates or on-site at your location.
- CAE Associates is offering on-line training classes in 2015!
- Registration is available on our website.

Agenda

- Advanced Workbench Meshing Overview
  - Mesh Based Defeaturing
  - Hexahedral Meshing
  - Refinement within volumes

- CAE Associates has a 2-Day advanced ANSYS Workbench meshing class offered in our Middlebury, CT office.
- We're also offering a 4 hour online course that covers specialized meshing topics.
  - Sign up if you're interested!

Defeaturing

Defeature with Virtual Topology
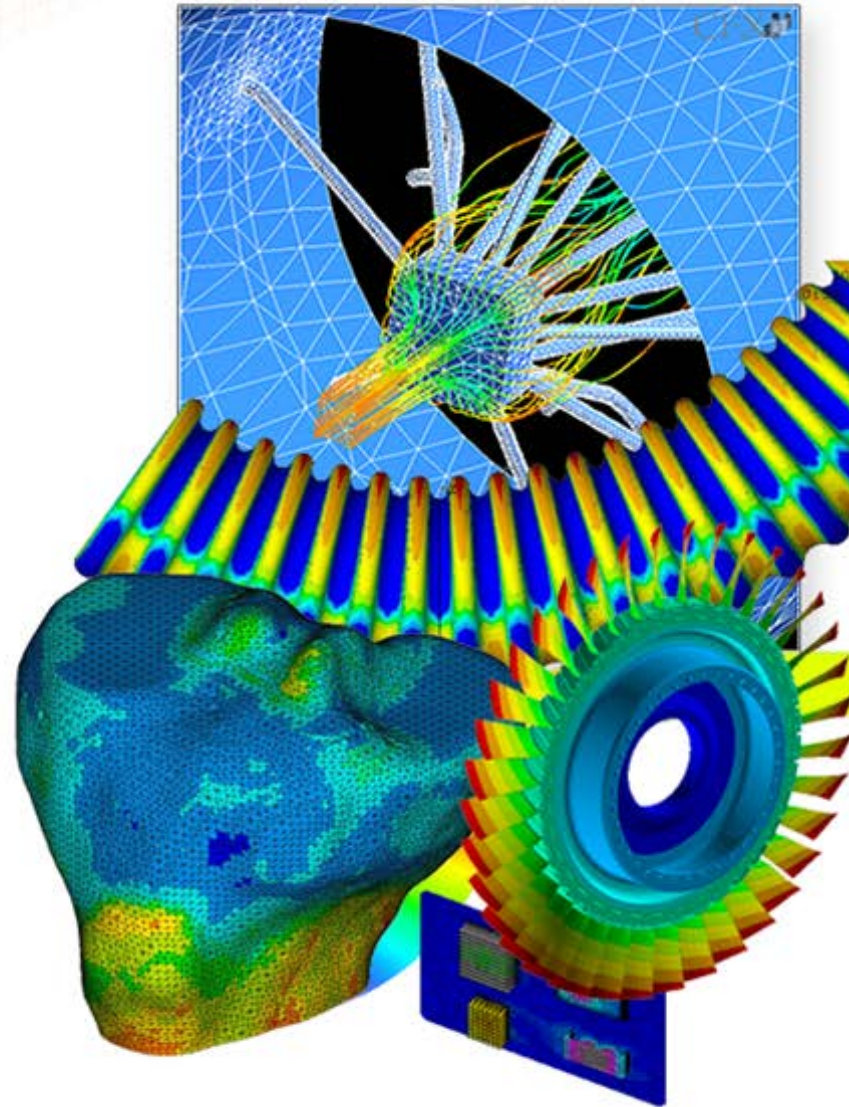
- Cleaning up messy geometry:
  - Virtual cells eliminate the need to mesh sliver surfaces.

Model (A4)
- Geometry
- Virtual Topology
- Coordinate Syst
- Connections
- Mesh
- Static Structu

Generate Virtual Cells
Repair References (Beta)

Delete
Rename (F2)

Delete All Virtual Split Edges
Delete All Virtual Split Faces
Delete All Virtual Entities

Default Mesh

With Virtual Topology

Defeature with Virtual Topology
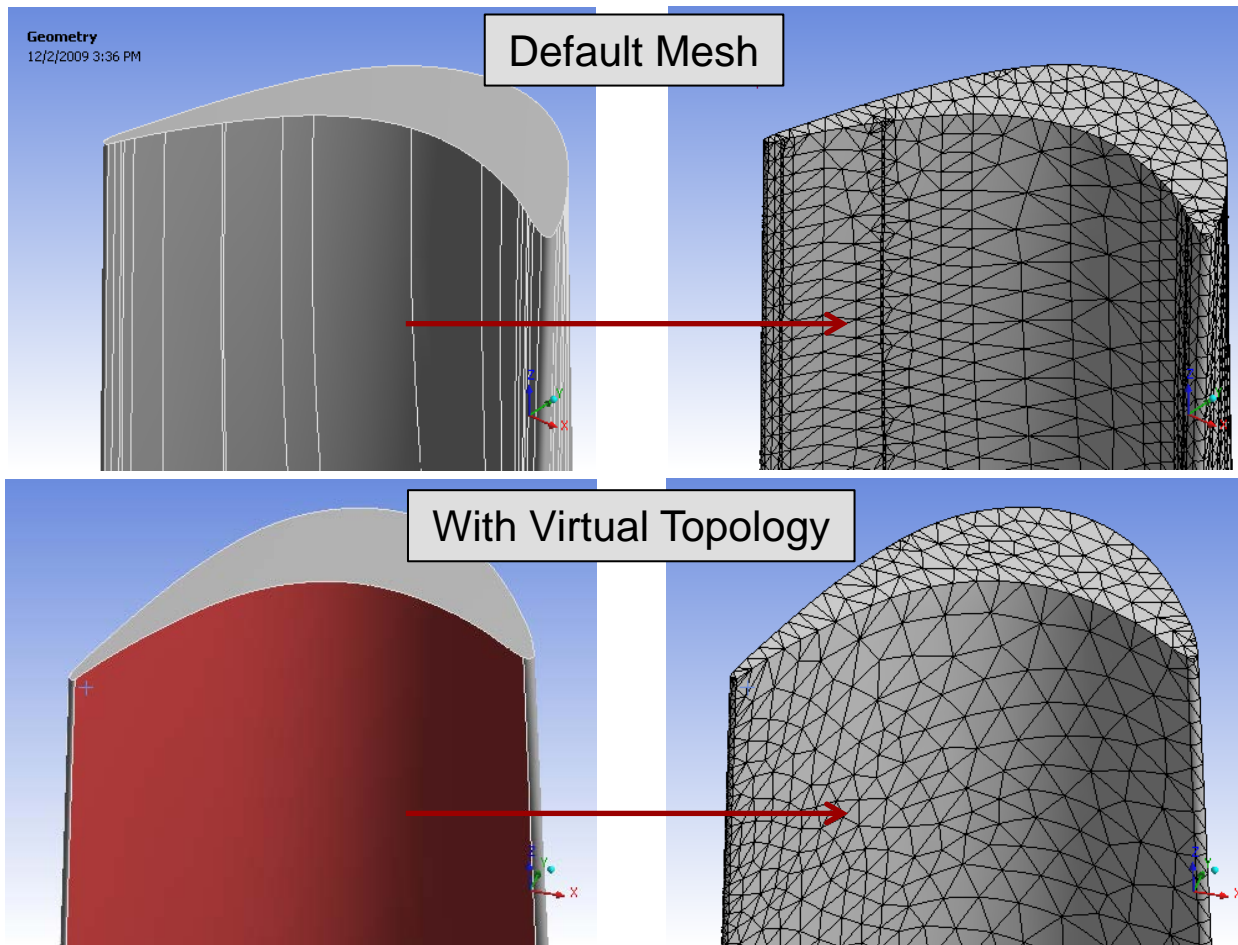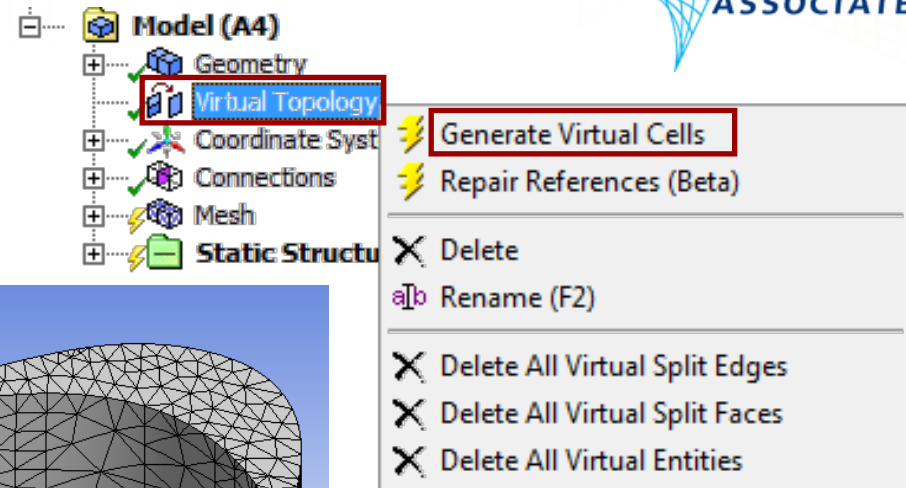
- Automatic Edge Concatenation:
  1. "Show Vertices"
  2. Set "Edges Only" in details menu of Virtual Topology
  3. RMB Click > Generate Virtual Cells

Geometry

Automatic VT Edges

Defeaturing – Mesh Based
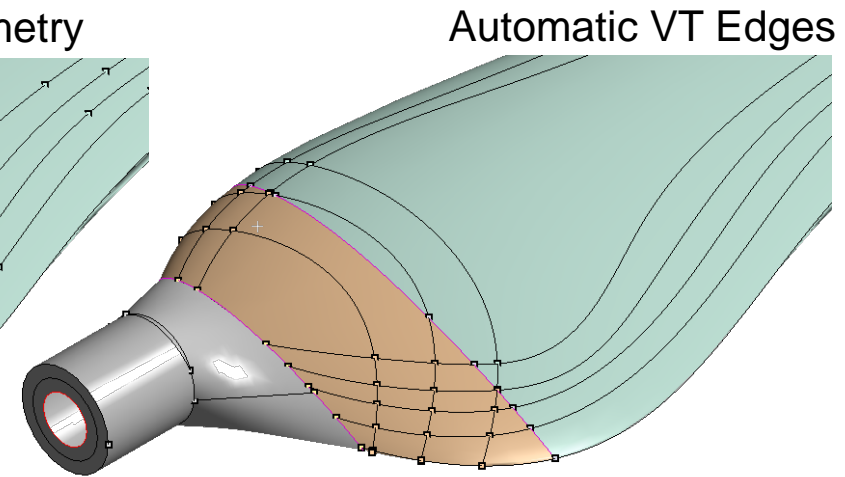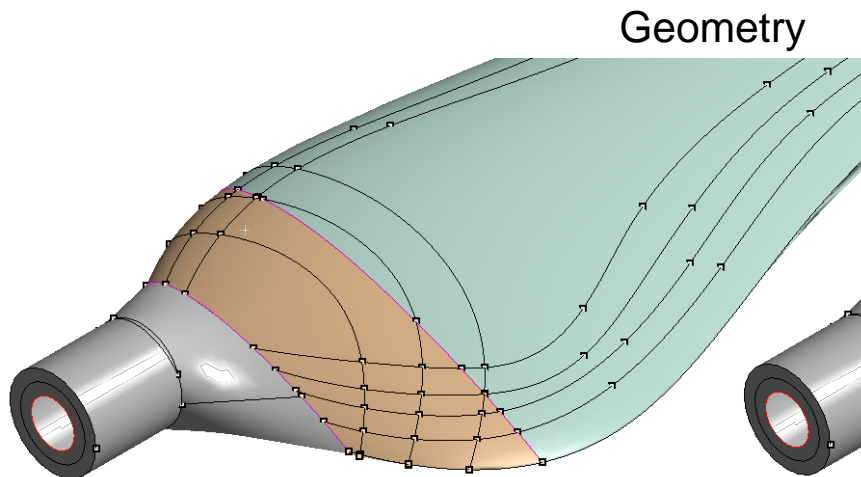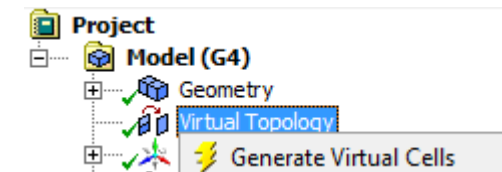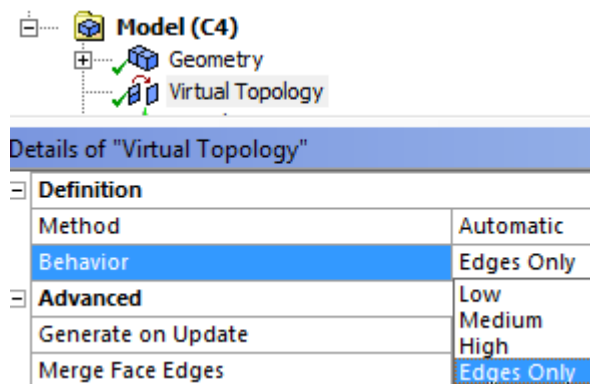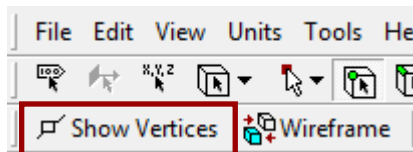
- Useful to:
  — Improve the mesh quality
  — Allow for a successful mesh to be created when these very small features would otherwise cause a meshing failure
- Removes small geometric features that are smaller than the Automatic Mesh Based Defeaturing (AMBD) tolerance

Details of "Mesh"	
Defaults	
Sizing	
Inflation	
Patch Conforming Options	
Patch Independent Options	
Advanced	
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Sheet Loop Removal	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	5.e-002 in

AMDB On

Defeature with Mesh Method
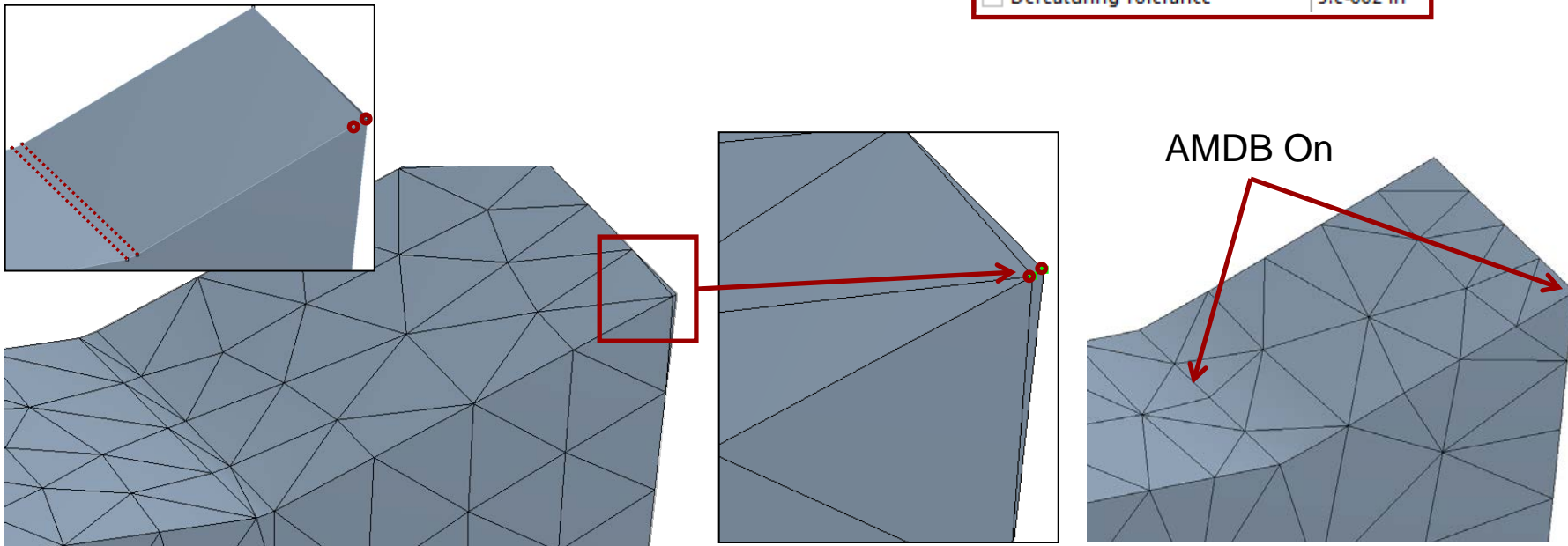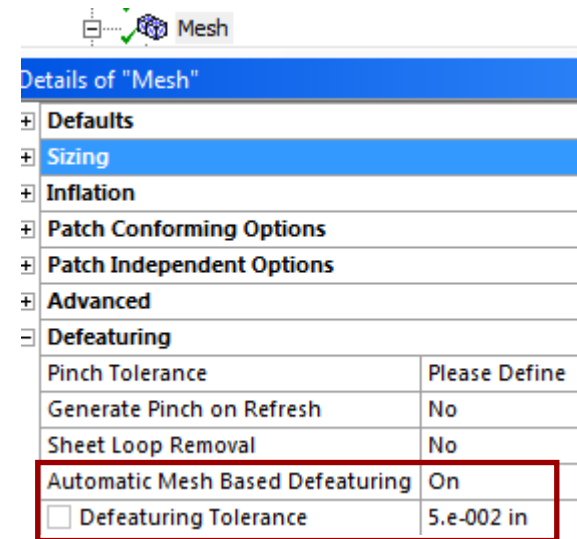
- Tetrahedron Surface Mesh Comparison:
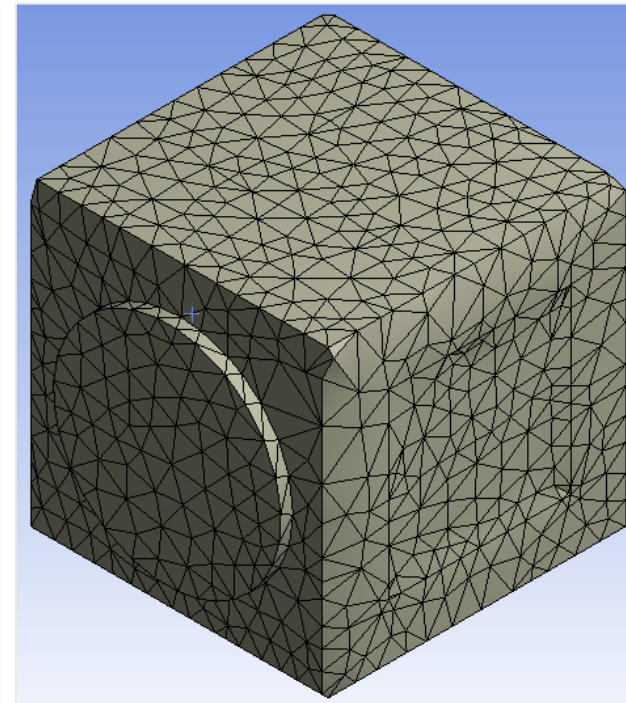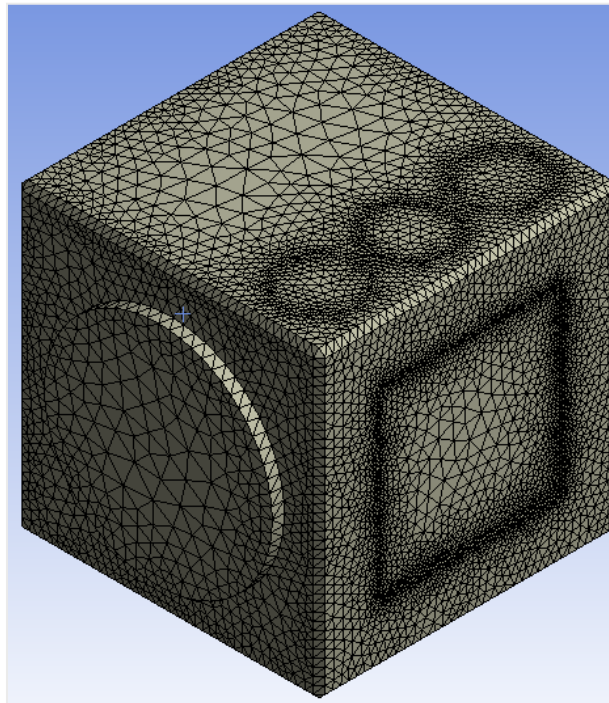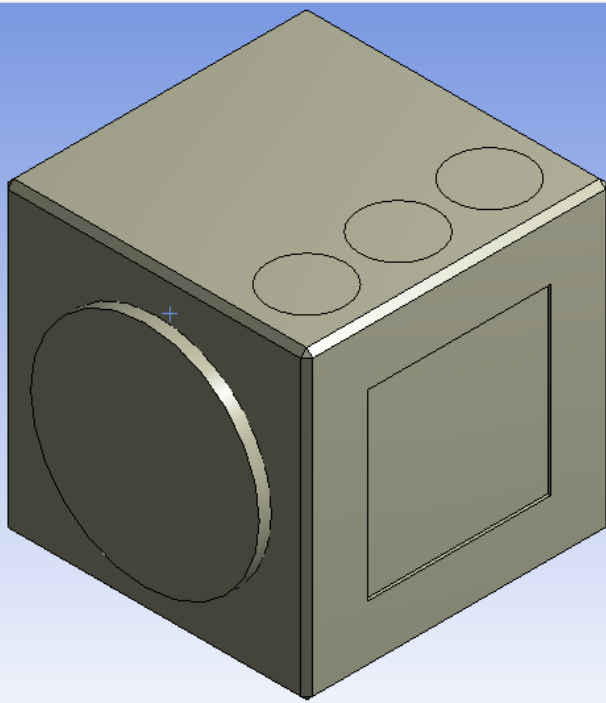
	Patch Conforming	Patch Independent
Geometry containing small details	All geometric detail is captured	Can ignore and defeature geometry

Defeature with Tetrahedrons Method
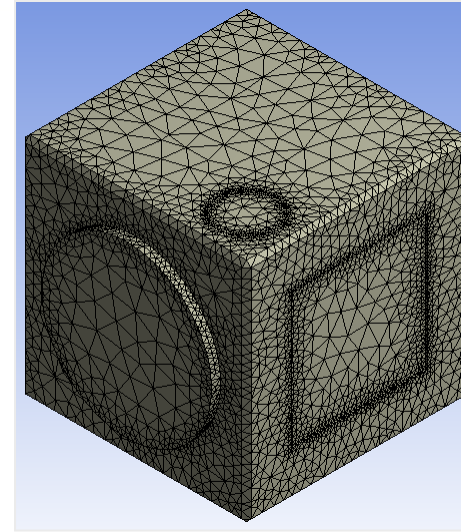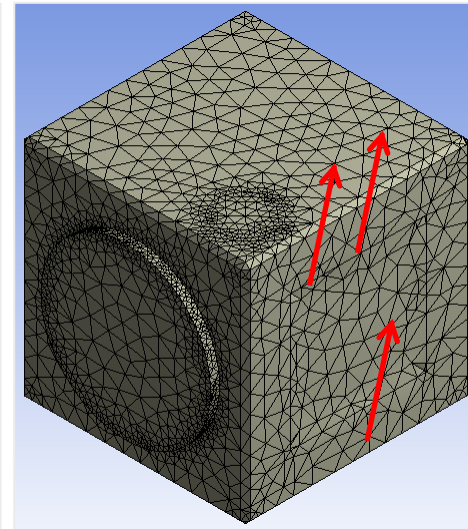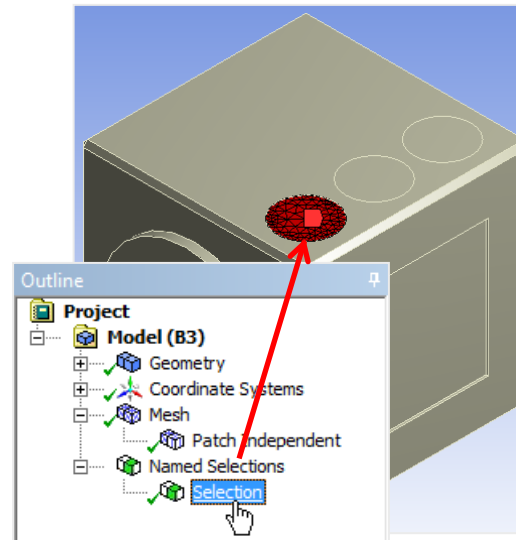
- **Patch Independent**
  - Defeaturing Control
    1. Set Mesh Based Defeaturing On
    2. Set Defeaturing Tolerance
    3. Assign Named Selections to selectively preserve geometry

Defeaturing Tolerance Off
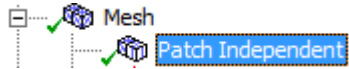
Advanced	
Defined By	Max Element Size
☐ Max Element Size	Default(0.175 m)
☐ Feature Angle	30.0 °
Mesh Based Defeaturing	On
☐ Defeaturing Tolerance	3.e-002 m
Curvature and Proximity Refinement	Yes

Named Selection assigned and Defeaturing Tolerance = 0.03m. Features > 0.03m respected.

Defeature with MultiZone

- MultiZone:
  - Default only captures sharp features, named selections, boundary conditions, etc. (patch independent)
 - All topology can be captured with Preserve Boundaries set to All, (patch conforming)

Details of "MultiZone" - Method	
+ **Scope**	
+ **Definition**	
− **Advanced**	
Preserve Boundaries	Protected
Mesh Based Defeaturing	Protected
Minimum Edge Length	All
Write ICEM CFD Files	No

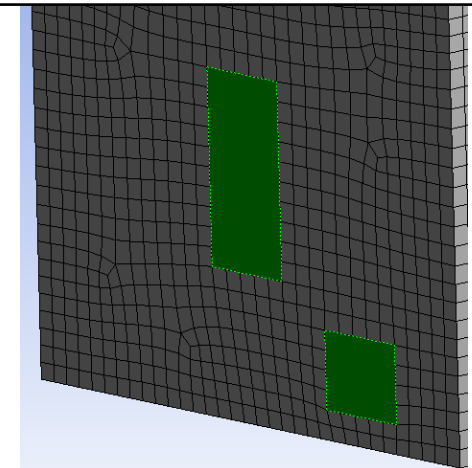Preserve Boundaries = Protected (Default)

Ignores imprint features
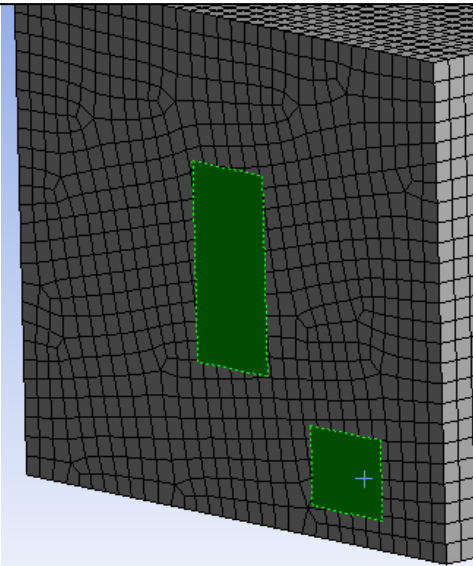
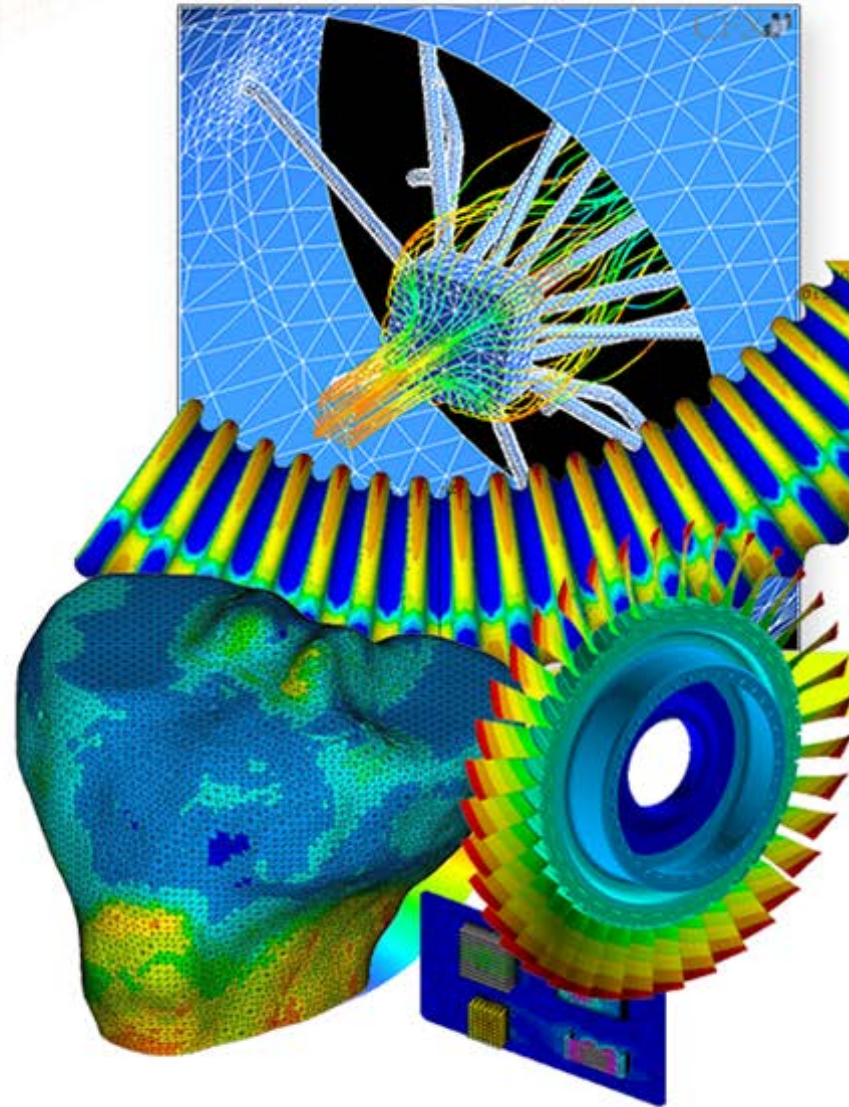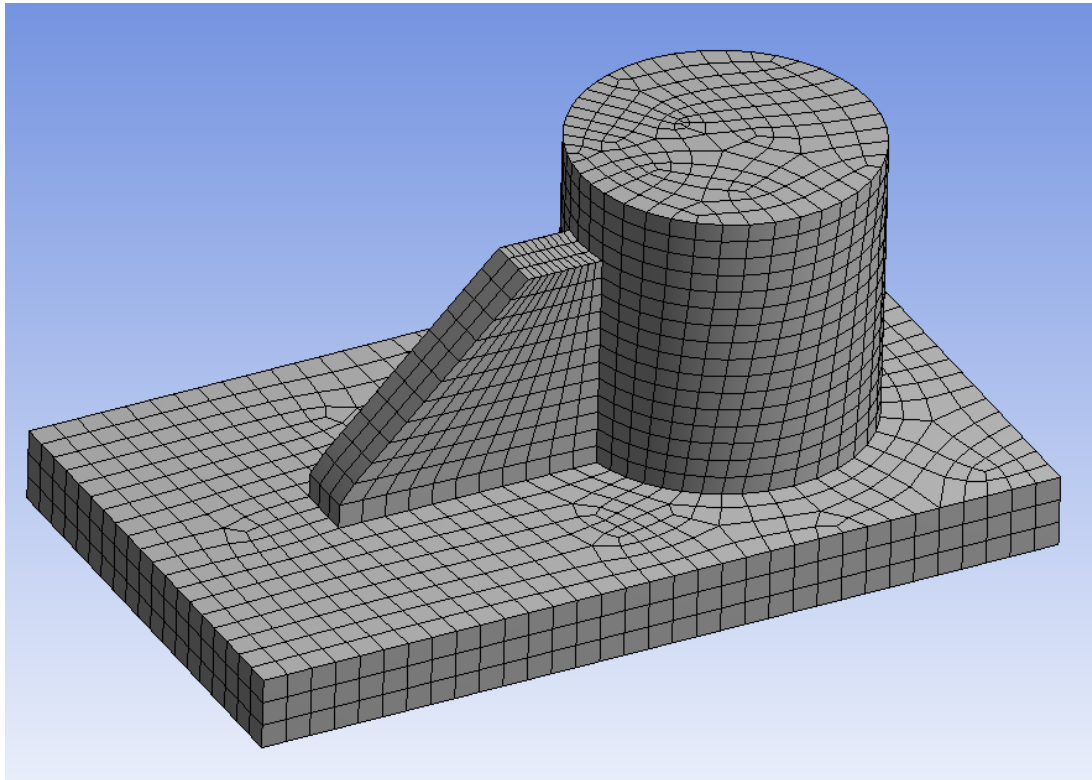If named selections are defined Topology is respected
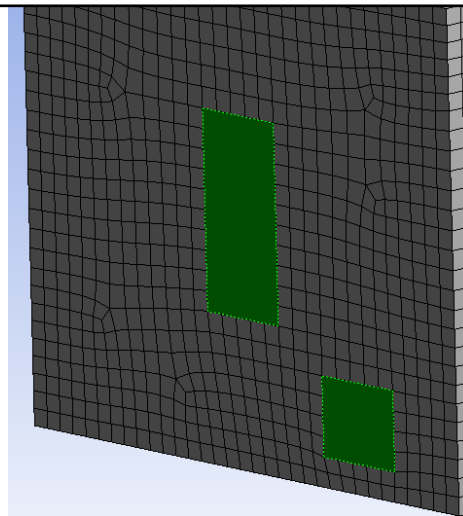
Preserve Boundaries = All

Mesh captures all topology, regardless of whether it is in a named selection, BC, etc.

Hexahedral Meshing

MultiZone Meshing

- Method Behavior
  - Automatically decomposes geometry into blocks
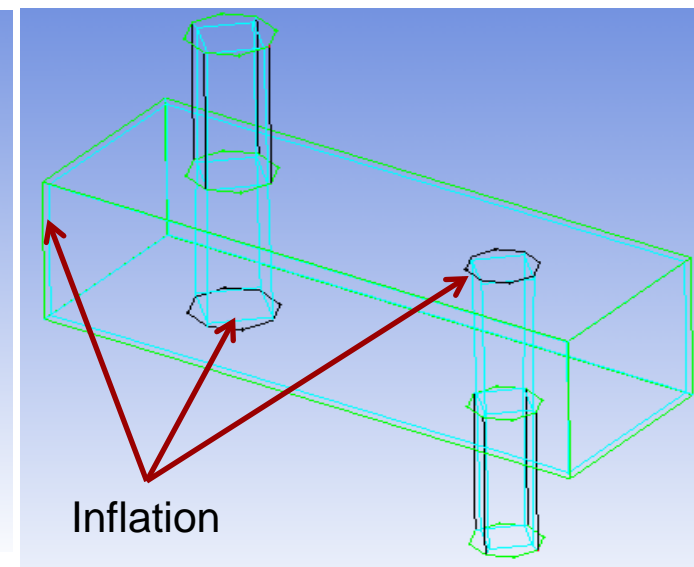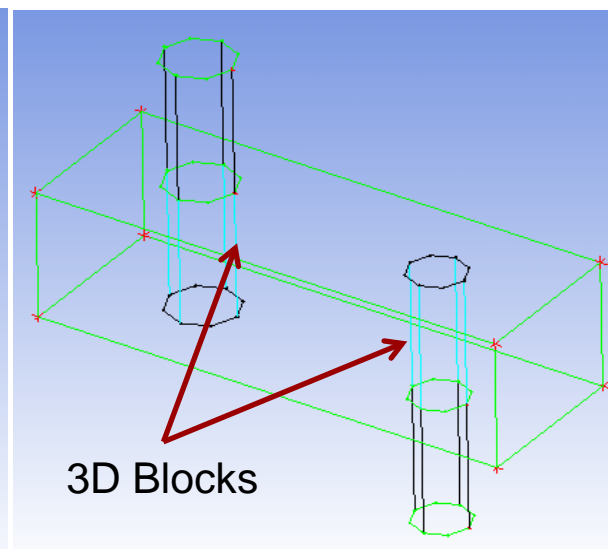 - Used to extend sweeping capabilities to a larger range of problems

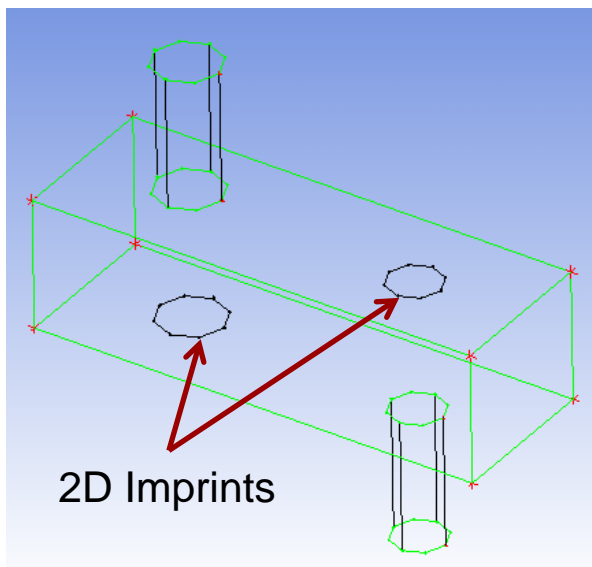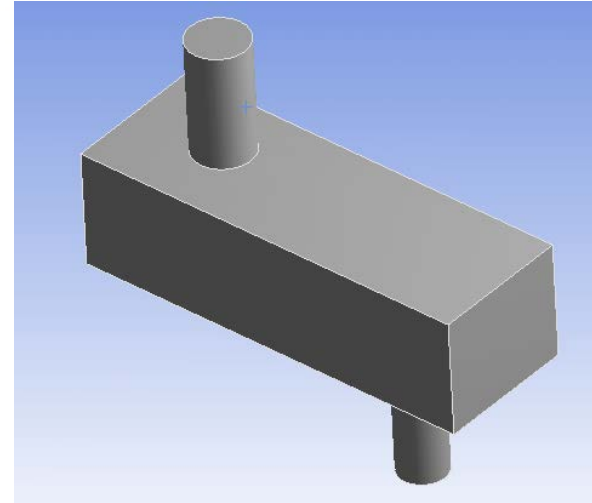| Details of "MultiZone" - Method	📌
Scope	
Scoping Method	Geometry Selection
Geometry	1 Body
Definition	
Suppressed	No
Method	MultiZone
Mapped Mesh Type	Hexa
Surface Mesh Method	Program Controlled
Free Mesh Type	Not Allowed
Element Midside Nodes	Use Global Setting
Src/Trg Selection	Manual Source
Source	4 Faces
Advanced	

Understanding MultiZone Method
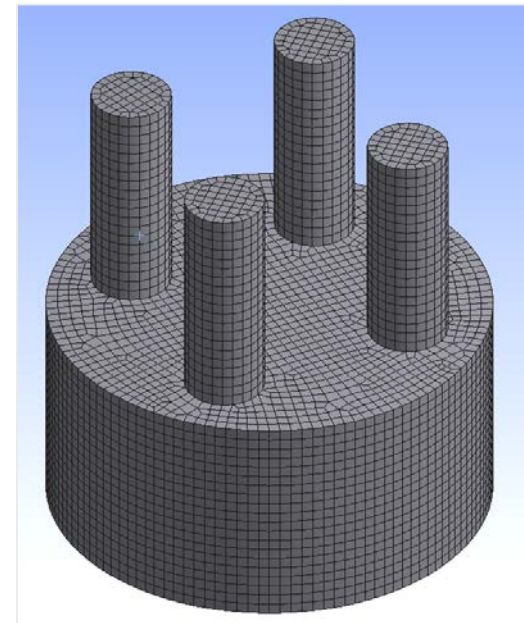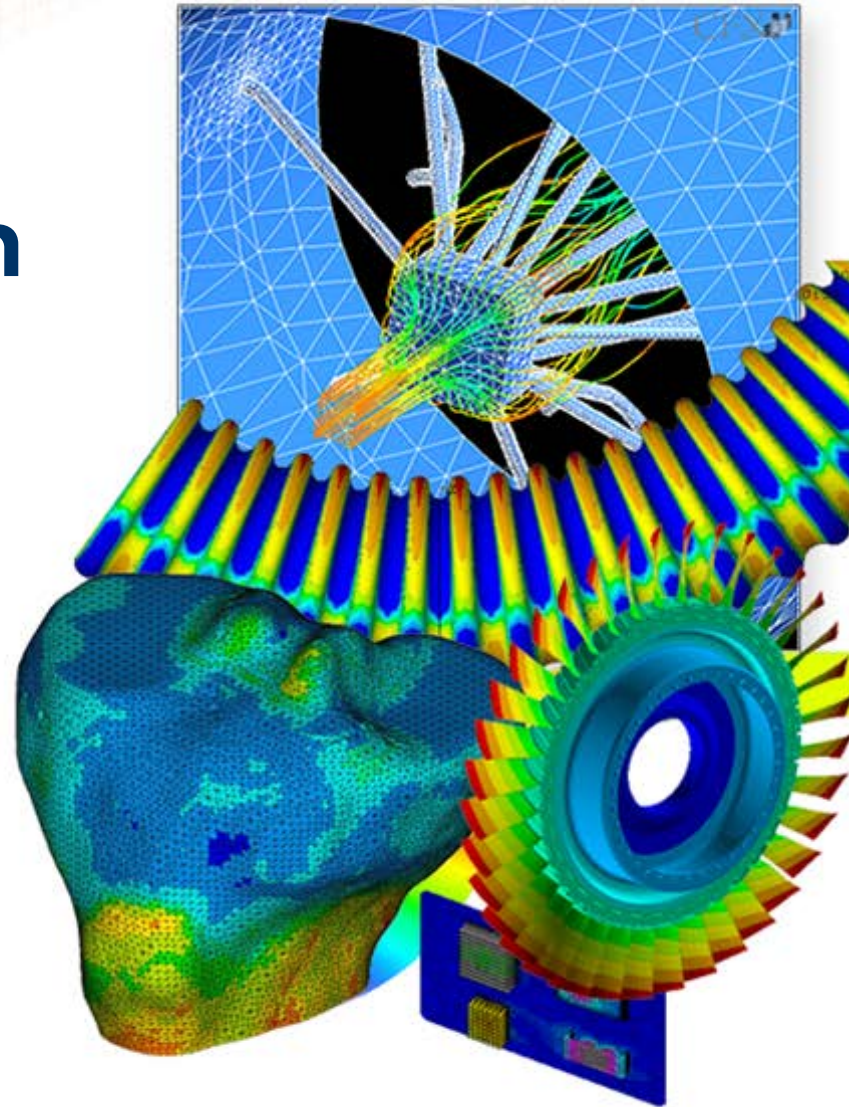
- Algorithm:
  — Step 1) 2D Blocking
  — Step 2) 3D Blocking
  — Step 3) Inflation (if applied)

2D Imprints

3D Blocks

Inflation

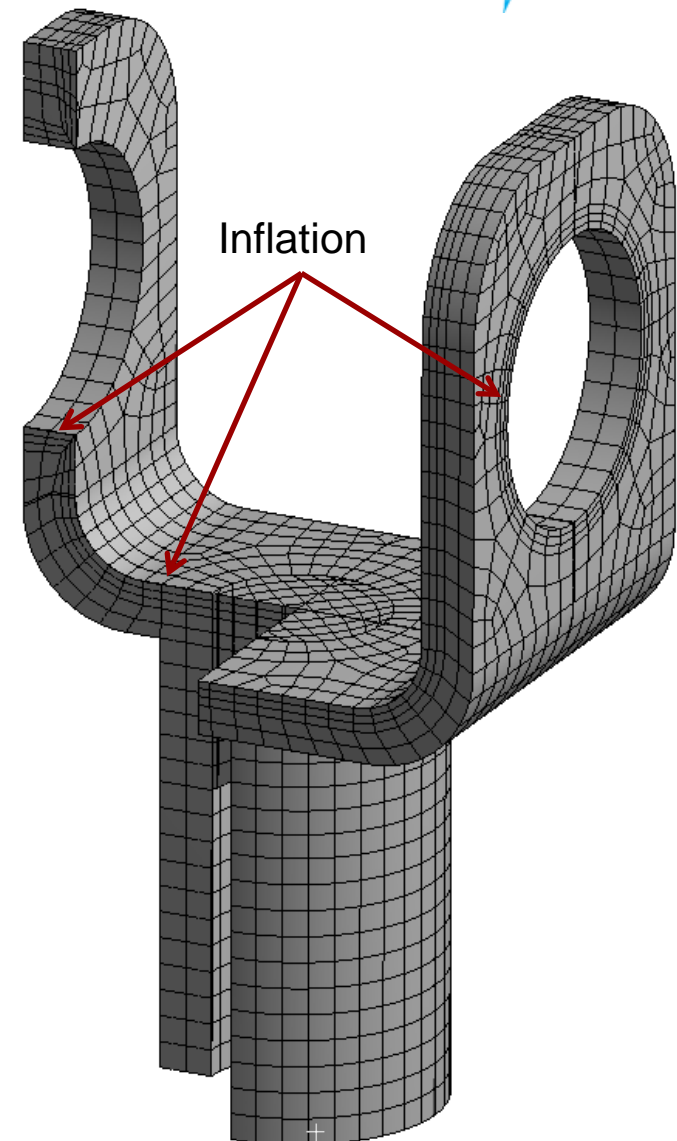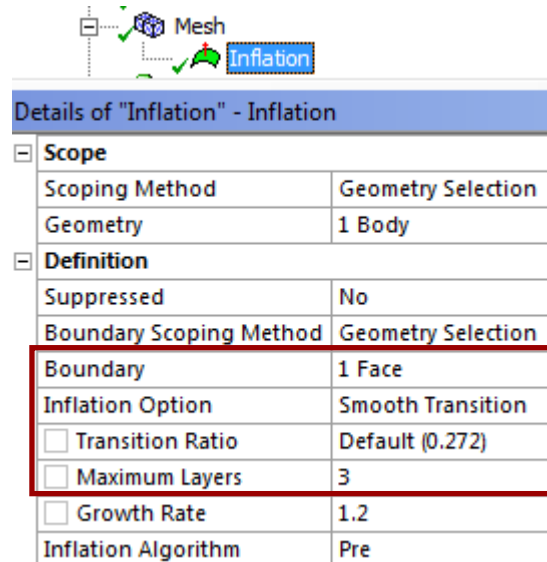# Multizone Examples:

Refinement within Volumes
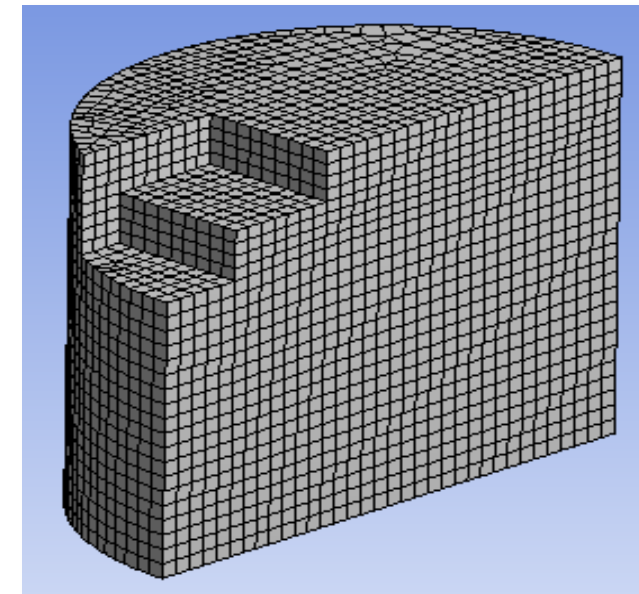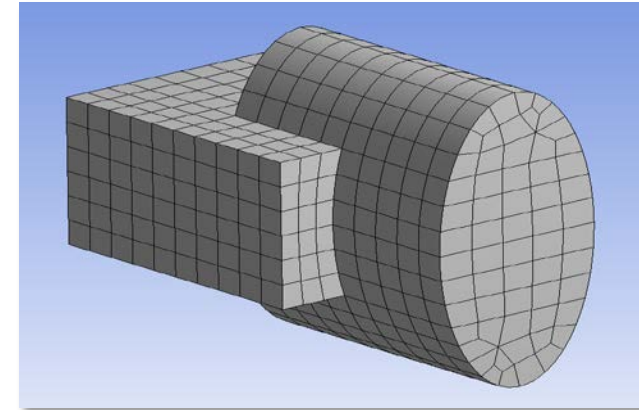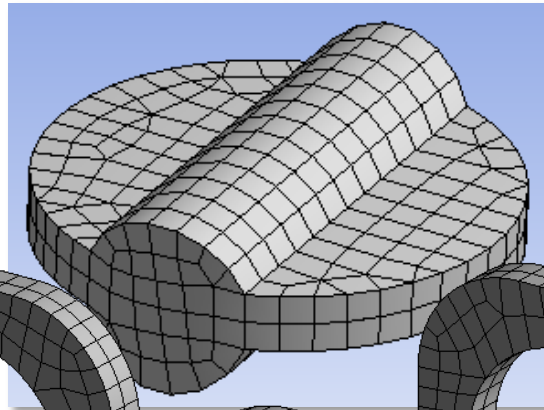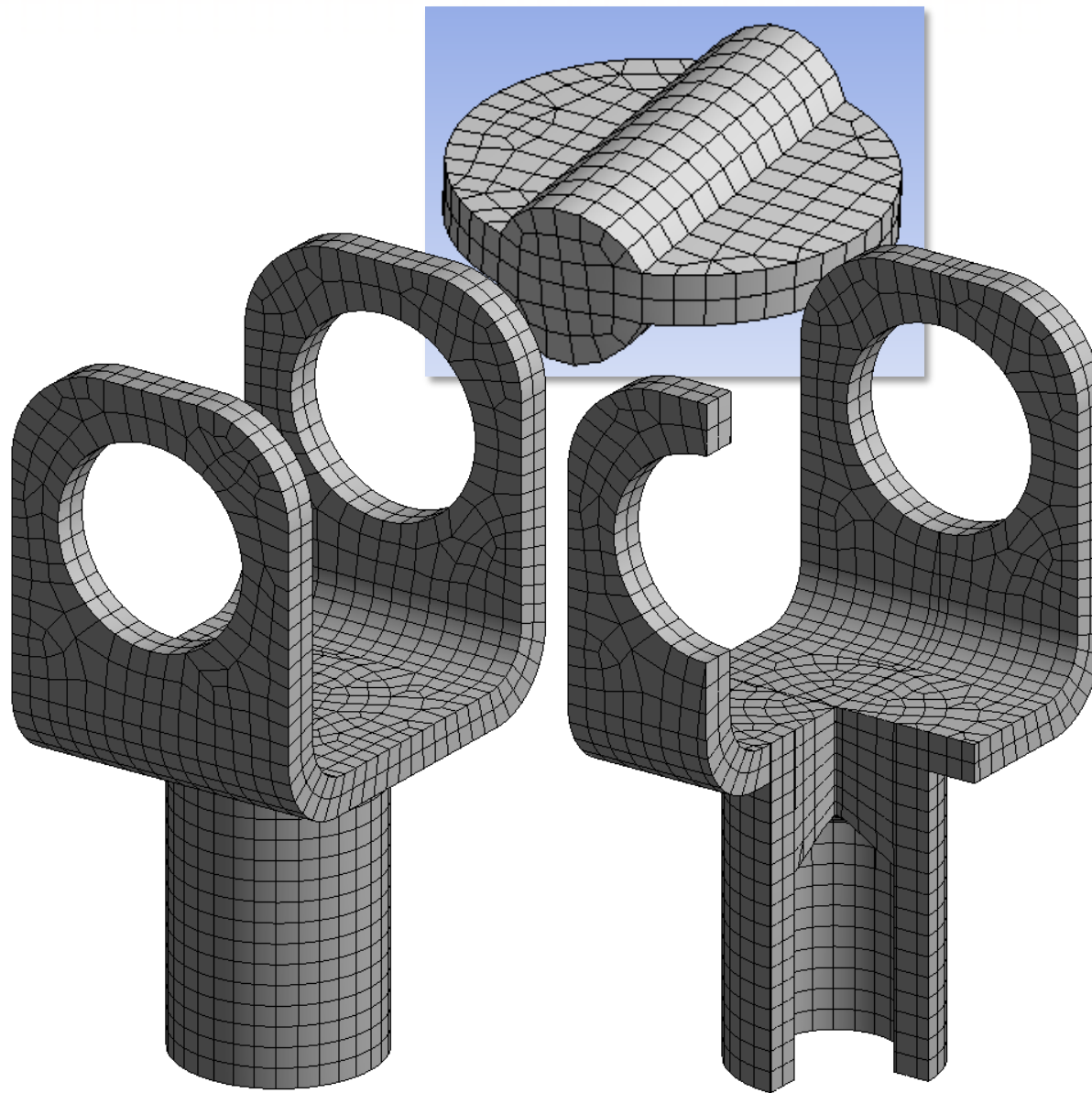
Refinement with Inflation

- Inflation
  - Used to generate thin elements adjacent to boundaries / surfaces
  - Useful to capture high subsurface result gradients:
- Elements shown are created by 'inflating' the 3D surface mesh into the volume
- Inflation works with both bricks and tets

Inflation

Details of "Inflation" - Inflation

Scope	
Scoping Method	Geometry Selection
Geometry	1 Body
Definition	
Suppressed	No
Boundary Scoping Method	Geometry Selection
Boundary	1 Face
Inflation Option	Smooth Transition
Transition Ratio	Default (0.272)
Maximum Layers	3
Growth Rate	1.2
Inflation Algorithm	Pre

Refinement with Inflation

- Inflation also works with surfaces
- Elements shown are created by "inflating"
  - 2D or 3D boundary edge onto the face
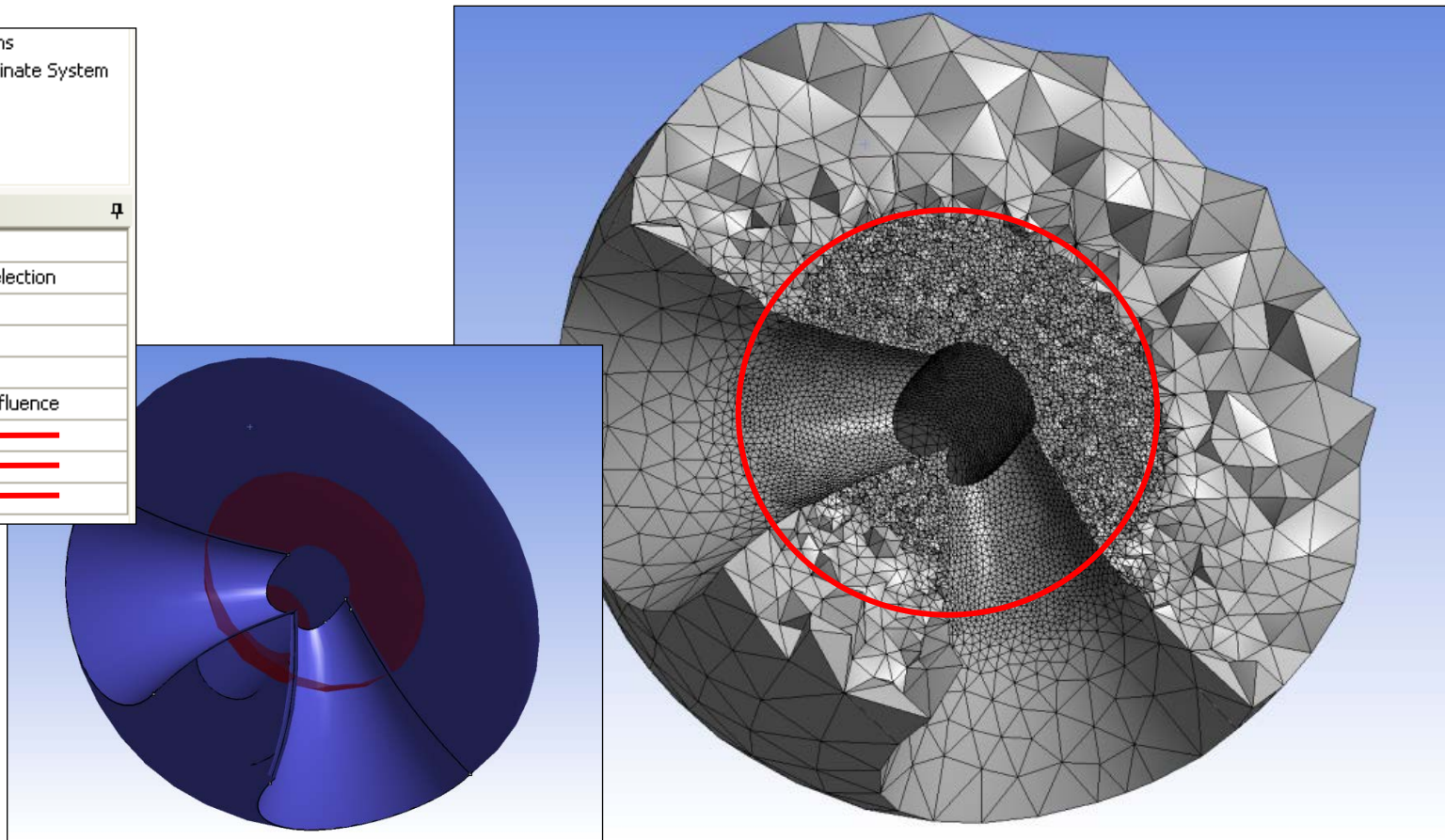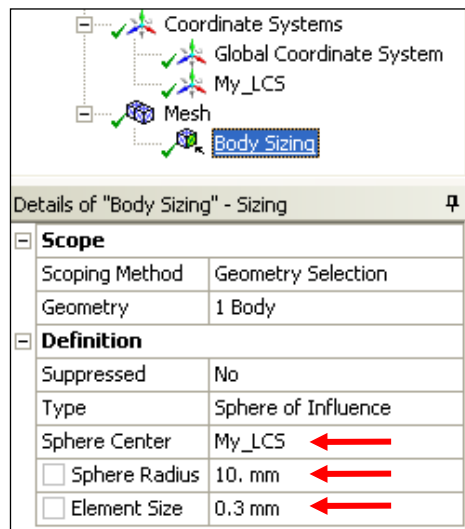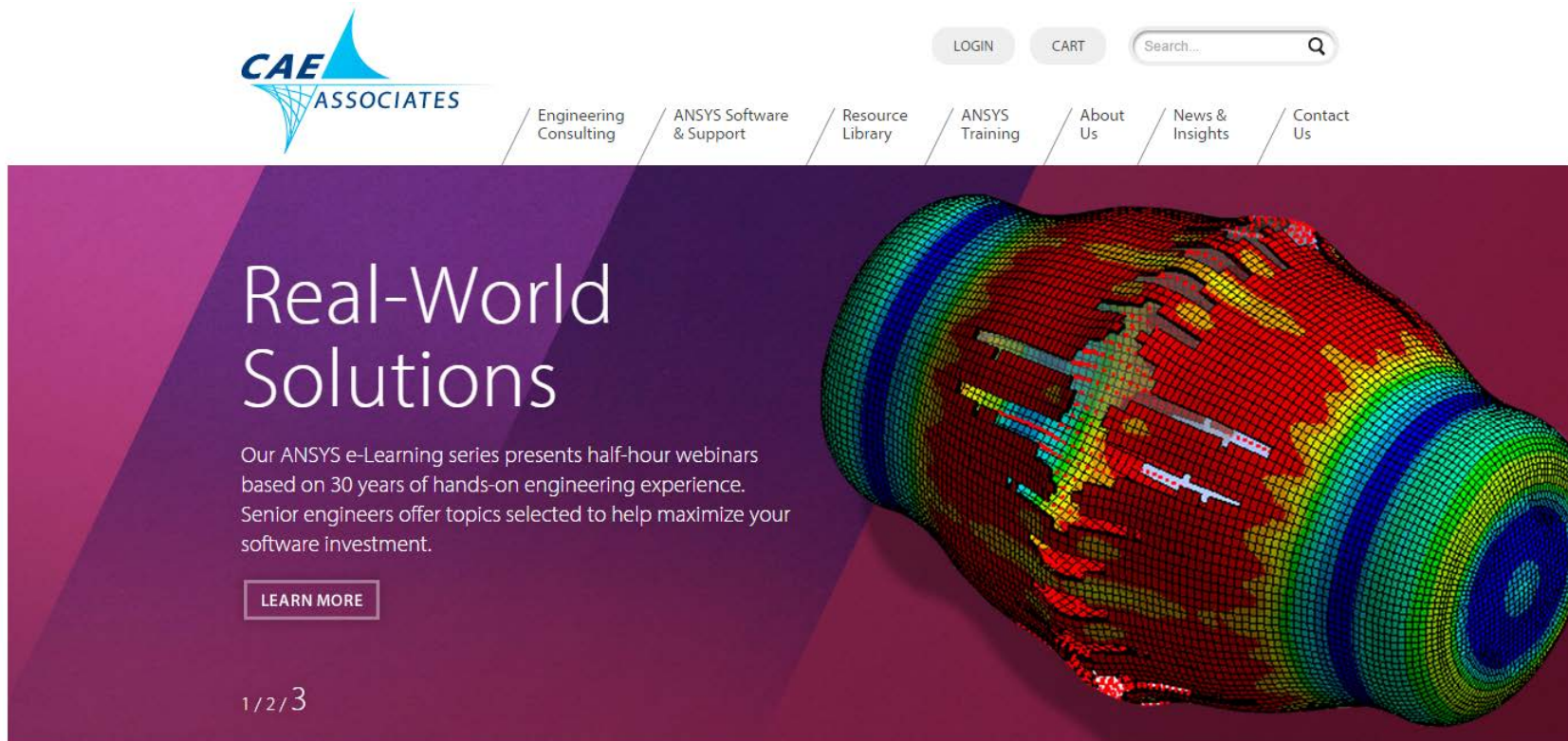
3D Shell

2D Surface
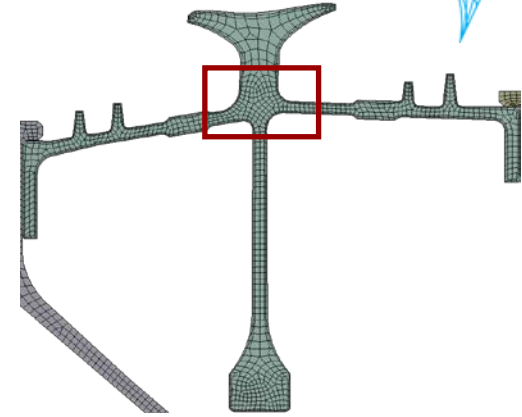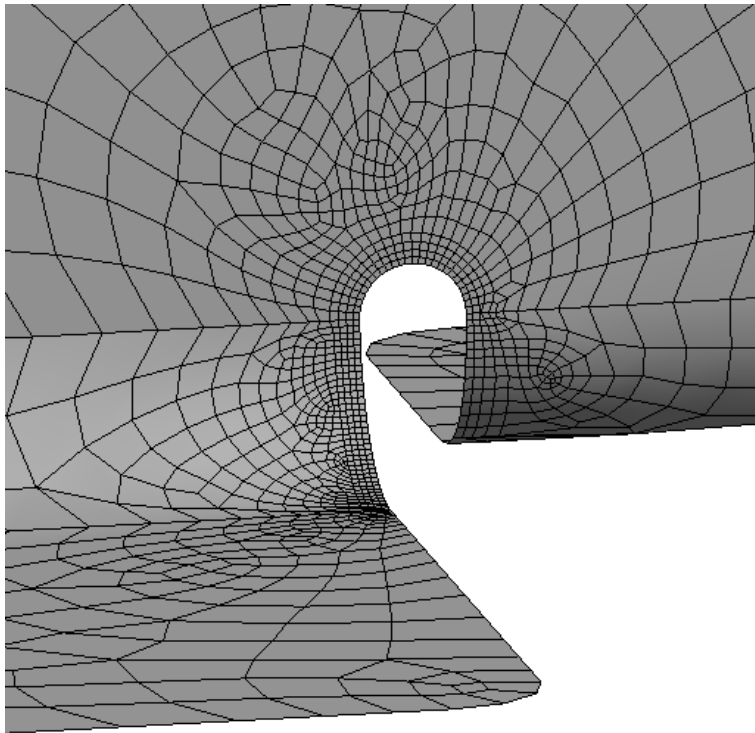
Refinement with Sphere of Influence
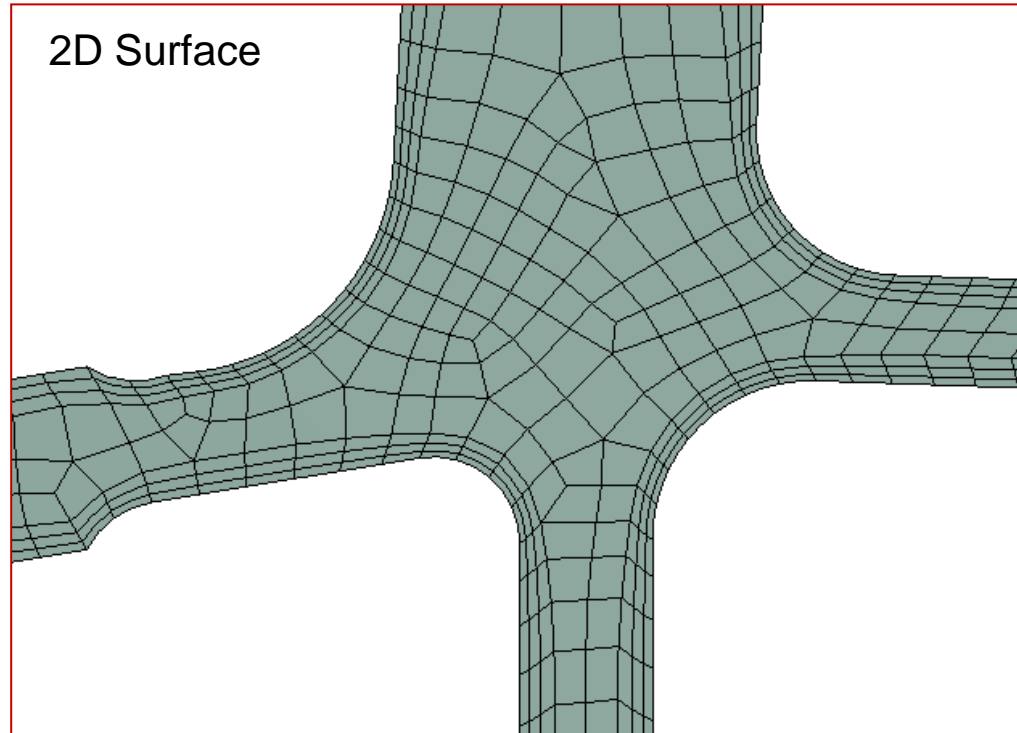
- Sphere of Influence: on Bodies
  - Constant element size is applied within the confines of a sphere
  - Use coordinate system to define the center of the Sphere

THANK YOU!

- Please visit us online at caeai.com