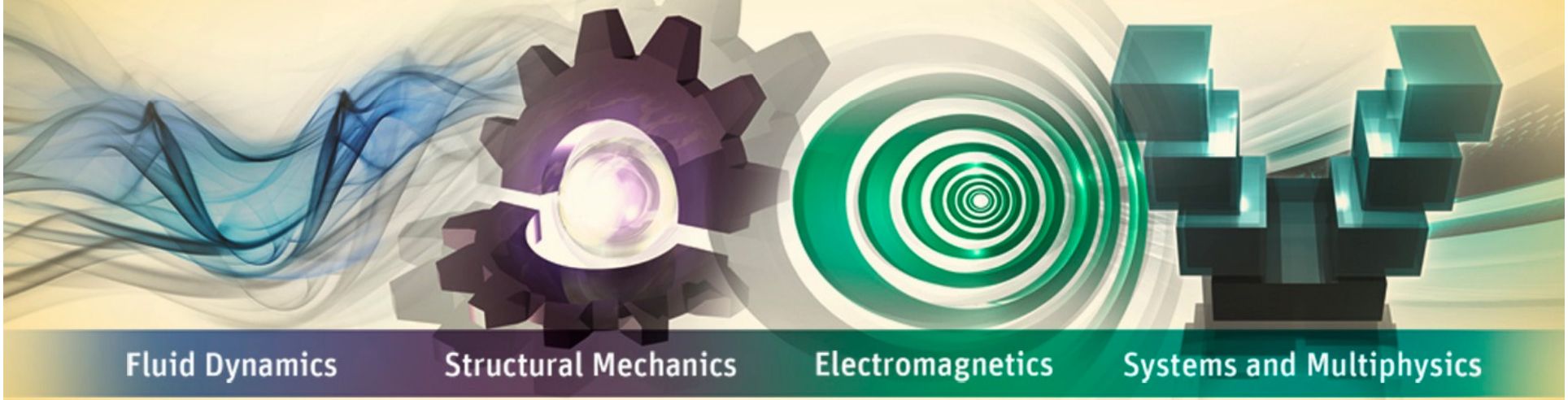
ANSYS

Realize Your Product Promise™

Lecture 6
Geometry Cleanup, Repair and Concept Modeling

14. 0 Release



Introduction to ANSYS DesignModeler

Geometry Cleanup/Repair: Introduction

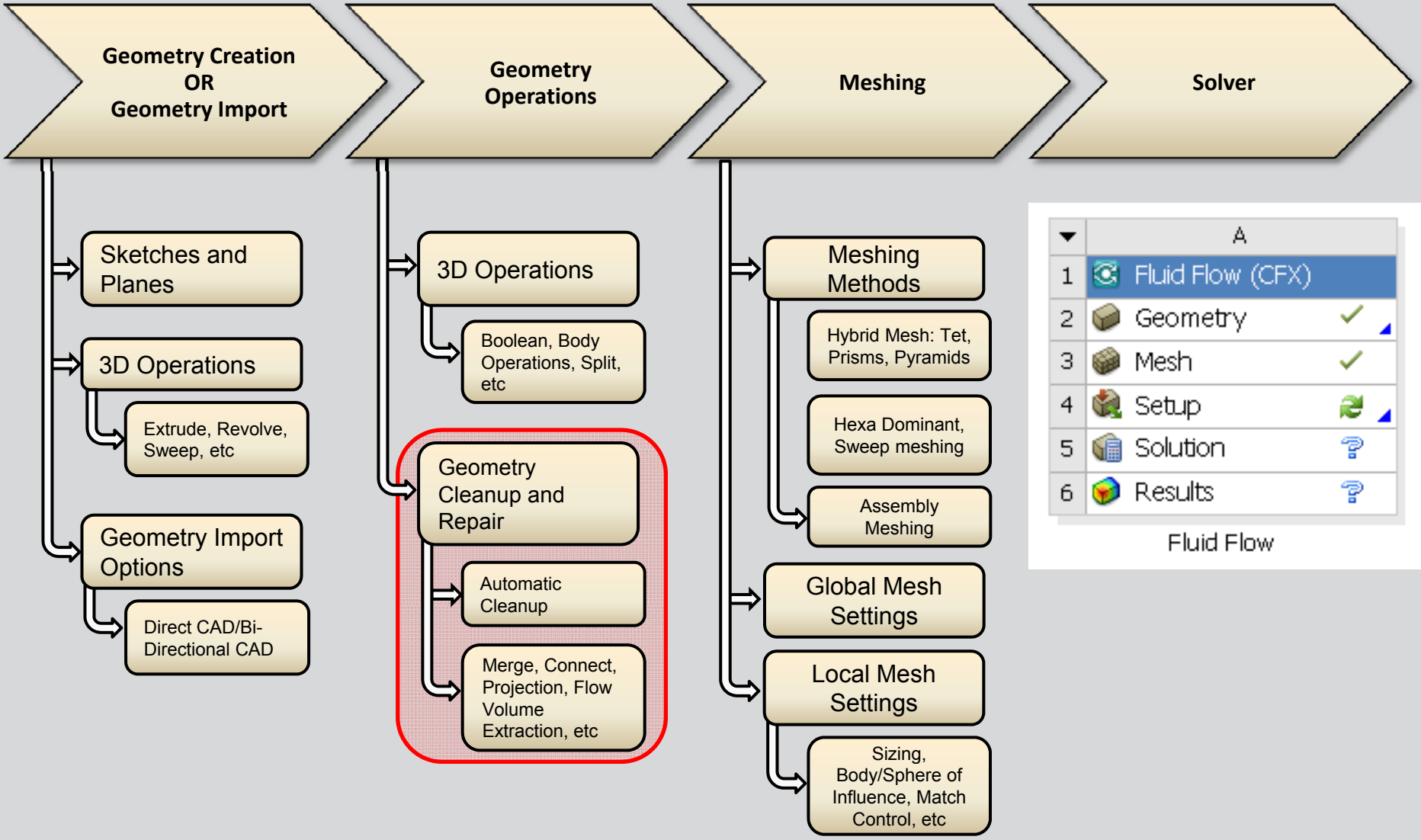
- **Several translation methods available to enable data exchange with CAD/CAE systems**
  - Direct Integration/CAD Readers
  - Import of generic CAD formats (IGES, ACIS etc)

- **Translation can:**
  - Return incomplete, corrupt, or disconnected geometry
  - Return geometry details unnecessary for CAE analysis

- **Geometry cleanup refers to processes required to prepare geometry for meshing**
  - Fix incomplete or corrupt geometry and connect disconnected geometry
  - Remove unnecessary details (defeaturing)
  - Decompose geometry into meshable sections

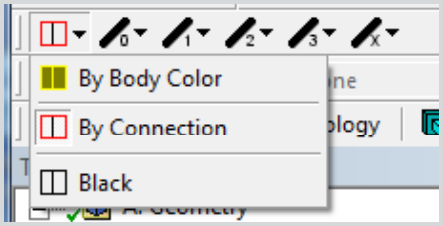
- **This lecture covers some of the tools available within DM to prepare the geometry, and examples of where they might be used**

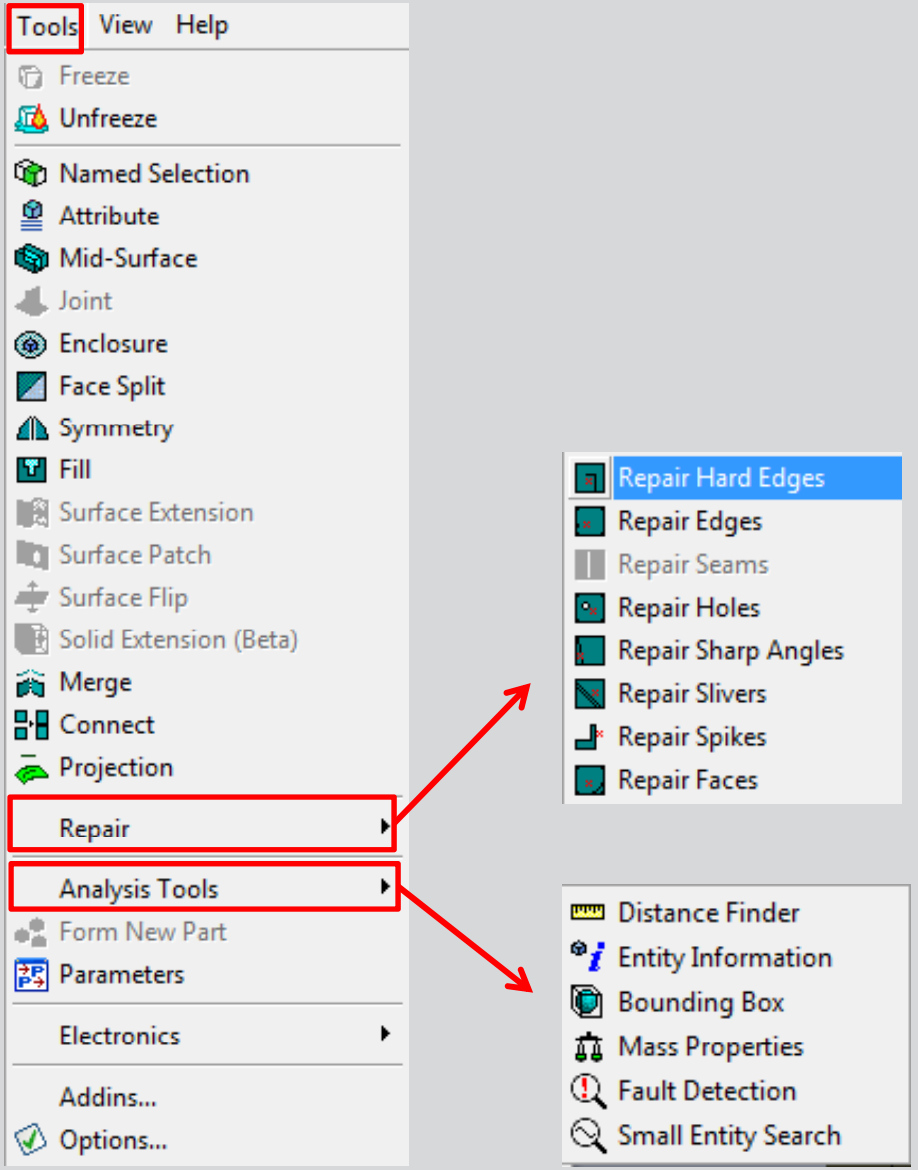
Preprocessing Workflow



Geometry Cleanup/Repair: Introduction

- DM provides geometry tools to:
  - Analyze
  - Repair
  - Modify/Simplify
- All these commands are available under the Tools Menu
- May need to view the model in wireframe mode to visualize the defects
- DM also give the ability to color edges depending on connectivity

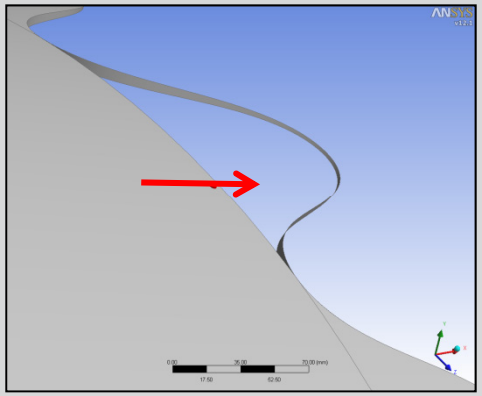




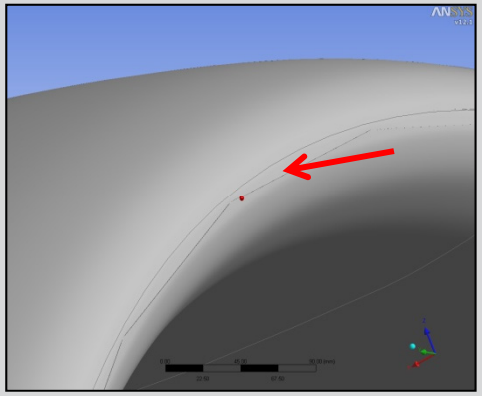
Typical Geometry Issues

Many potential issues

- Missing faces
- Sliver faces
- Hard edges
- Small edges
- Sharp angles
- Others …



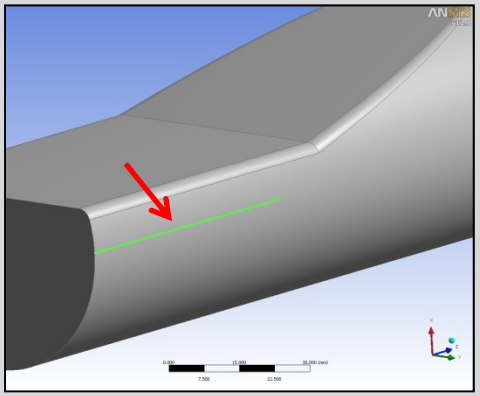
Missing faces



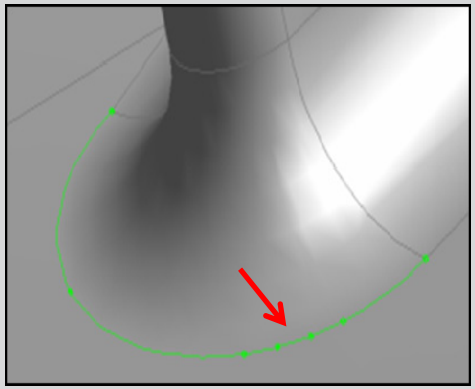
Sliver faces

These issues must be fixed to

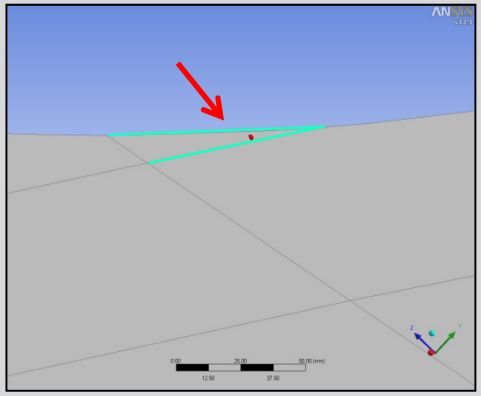
- Create watertight volume bodies
- Prevent meshing issues



Hard Edges



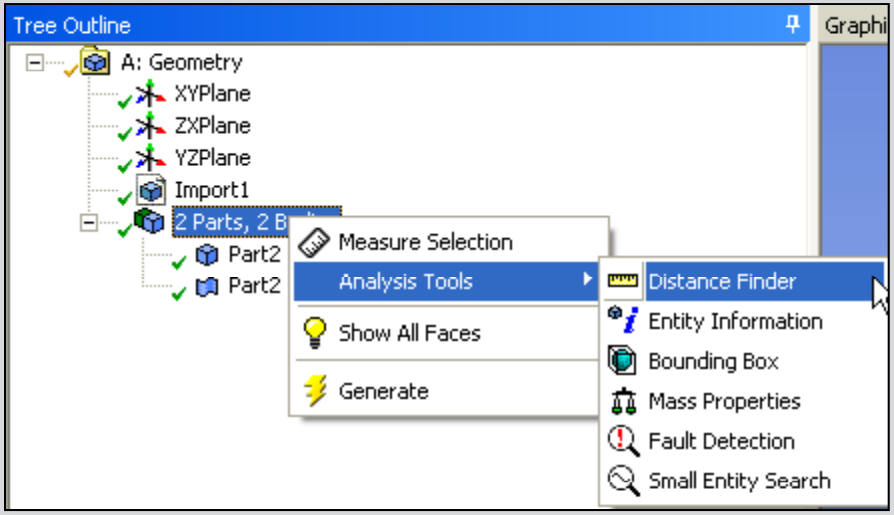
Small edges



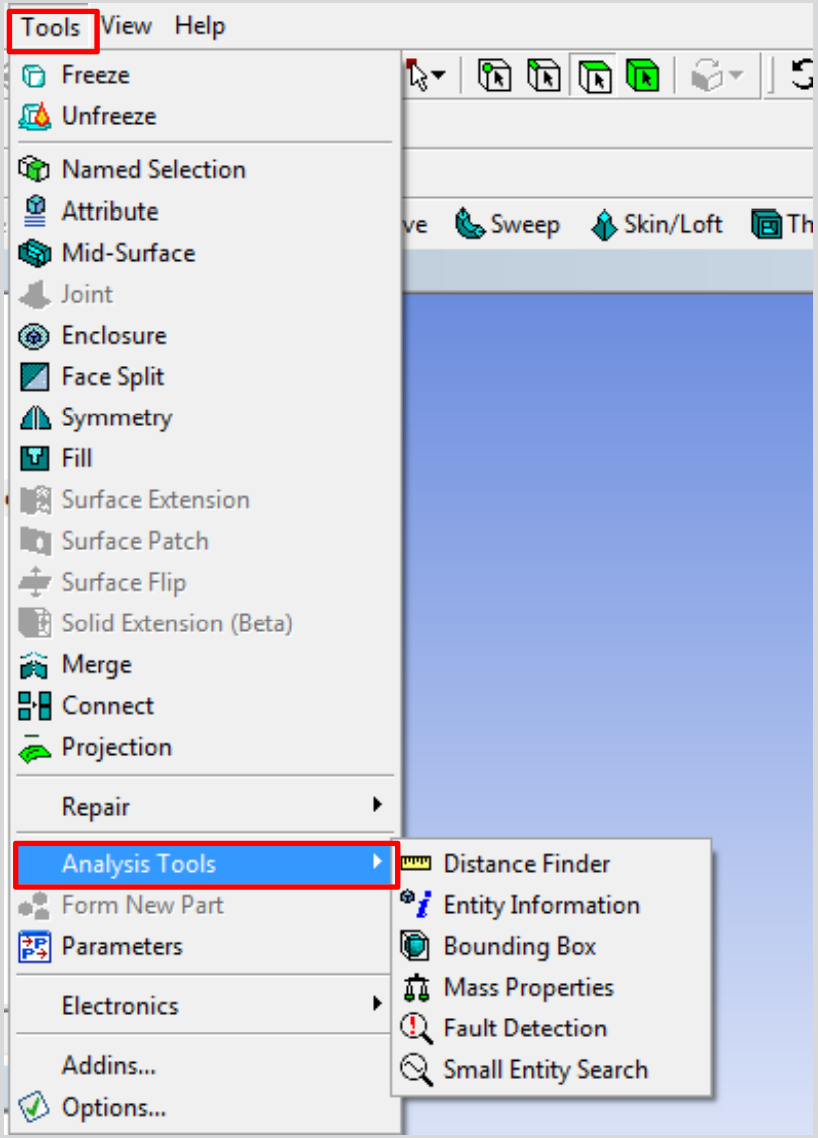
Sharp angles

Analysis Tools

- Set of features that provide information, detect faults in geometry

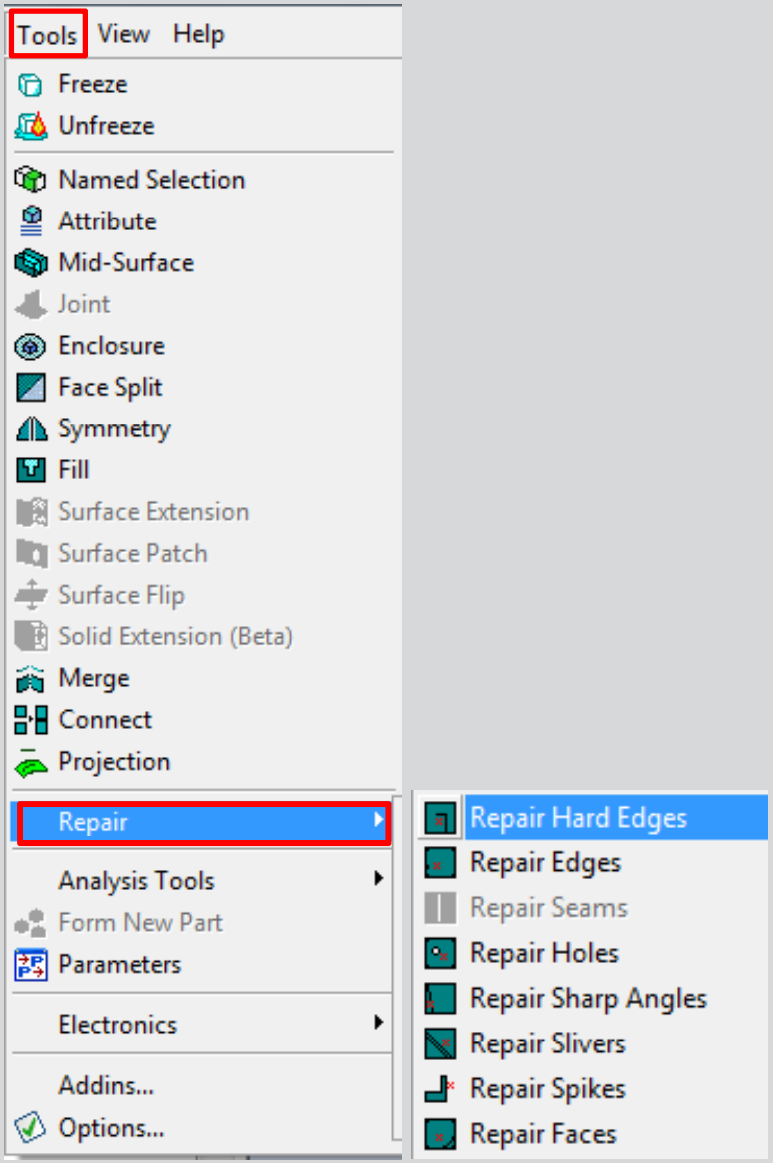


RMB on the part



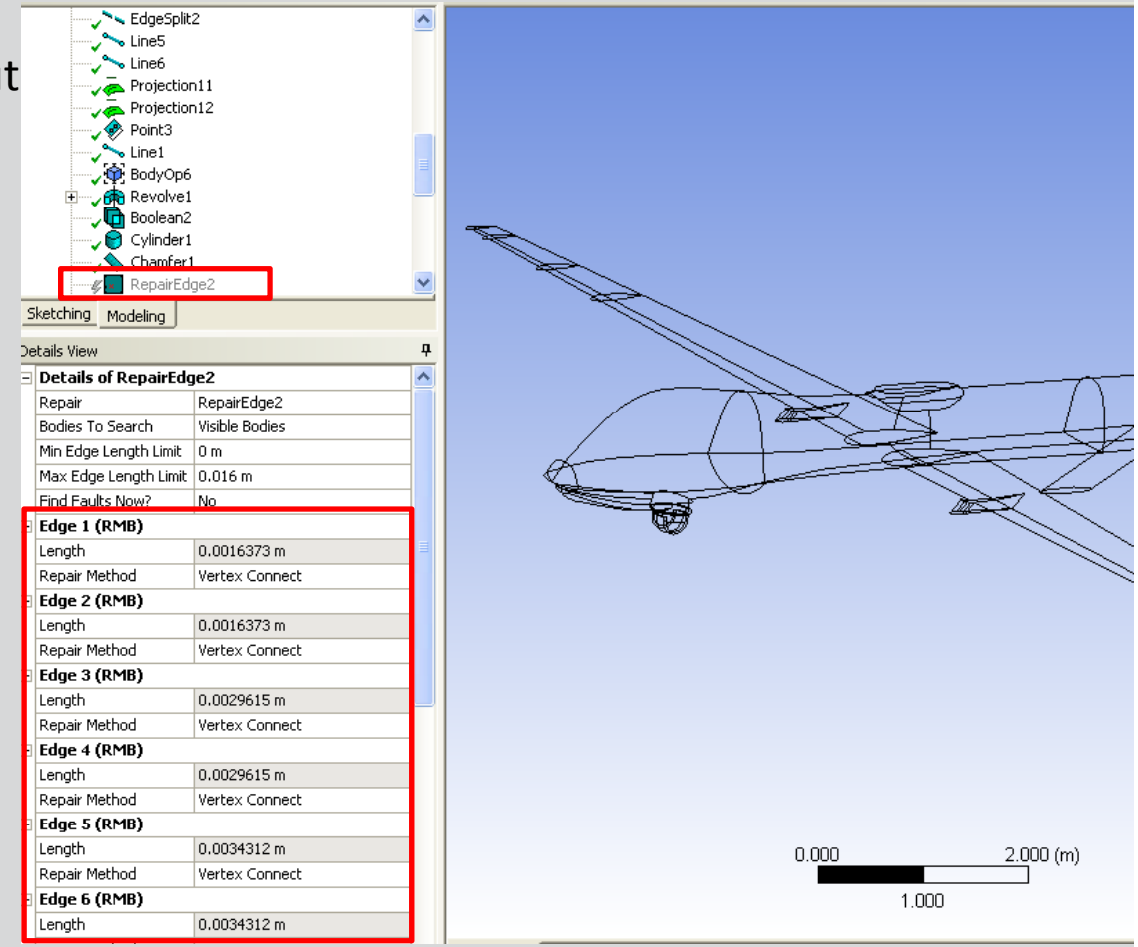
Repair

- Easy search and fix of unwanted geometrical features or geometric errors
- Can be executed on both frozen and active bodies
- Repair Types
  - Repair Hard Edges
  - Repair Edges
  - Repair Seams
  - Repair Holes
  - Repair Sharp Angles
  - Repair Slivers
  - Repair Spikes
  - Repair Faces



Repair: Automation

- Automatically detects and lists out geometrical issues
- Highlights the location of fault in the geometry
  - Zooms into the location, when clicked on the items in the list
- Proposes fixes to the issues
  - Choose a different method to fix, if needed
- Analyze the list
- Fix issues all at once
  - Upon clicking “Generate”
  - Can’t be done one after the other



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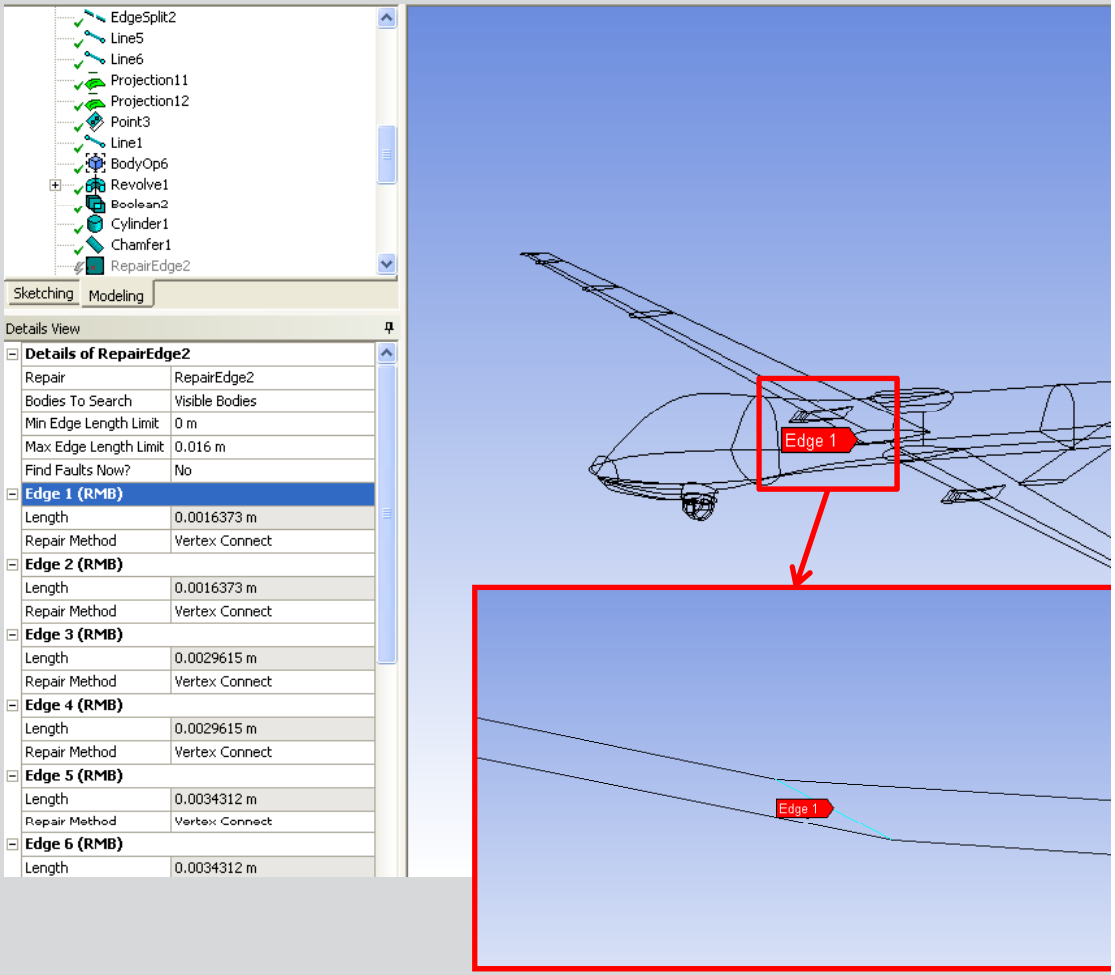

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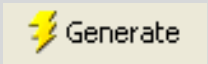
  - Upon clicking “Generate” 
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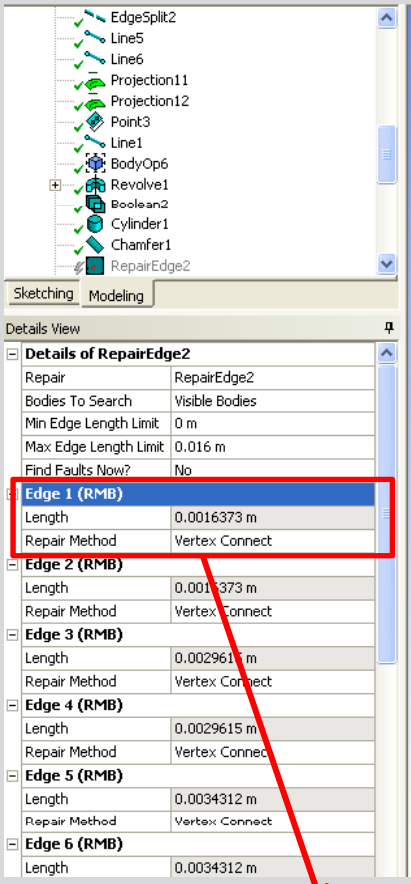
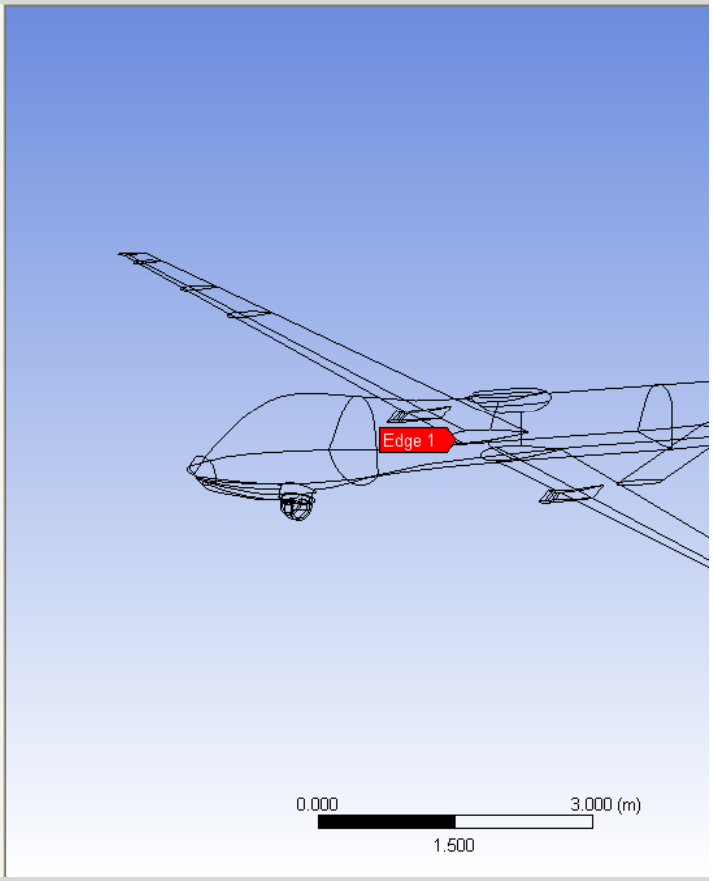
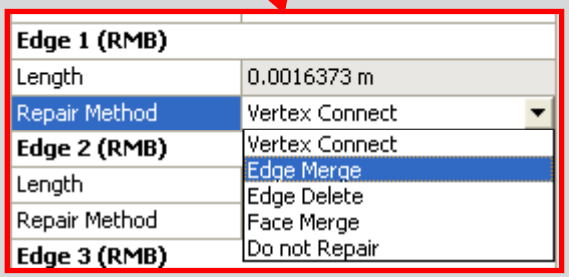
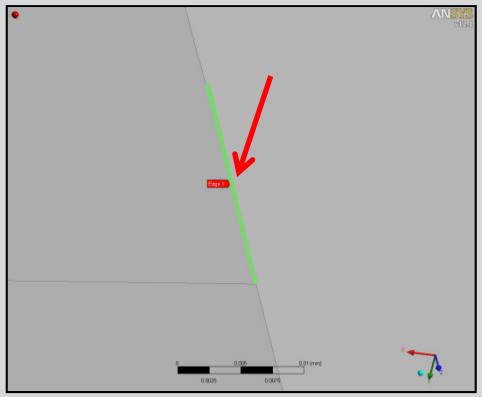






Repair: Example

Repair Edges

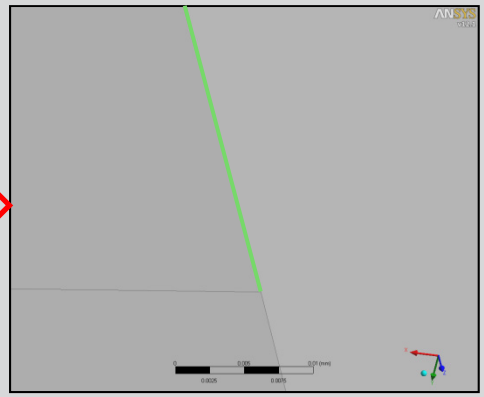


Small edge in the model

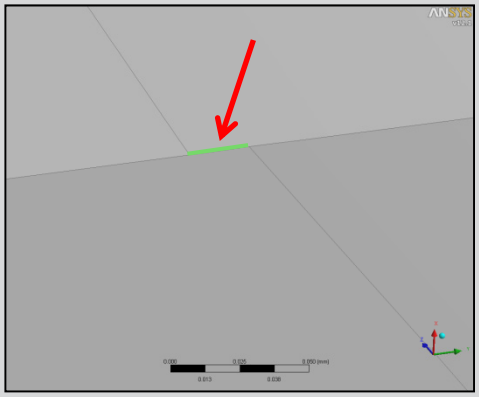
Details View

Details of RepairEdge1	
Repair	RepairEdge1
Bodies To Search	Visible Bodies
Min Edge Length Limit	0 mm
Max Edge Length Limit	0.03 mm
Find Faults Now?	No
Edge 1 (RMB)	
Length	0.029148 mm
Repair Method	Edge Merge
Merging Entity	Automatic Selection

Details View of Repair Edges



Small edge removed

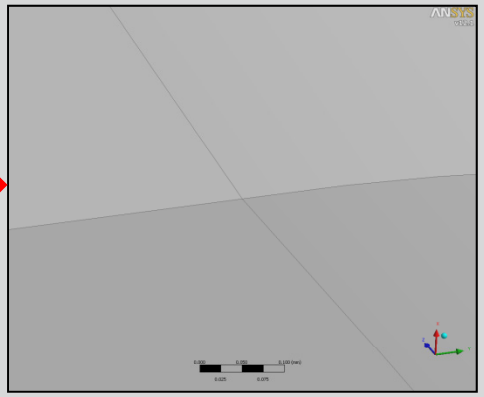


Small edge in the model

Details View

Details of RepairEdge2	
Repair	RepairEdge2
Bodies To Search	Visible Bodies
Min Edge Length Limit	0 mm
Max Edge Length Limit	0.23 mm
Find Faults Now?	No
Edge 1 (RMB)	
Length	0.023251 mm
Repair Method	Vertex Connect

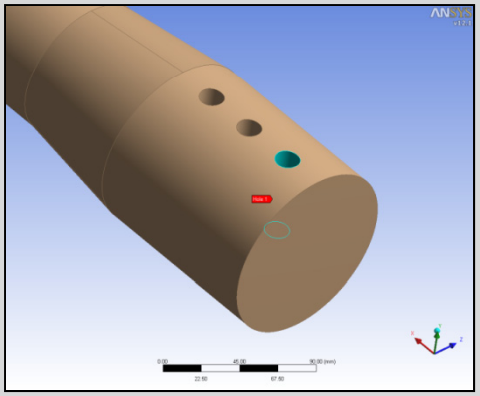
Details View of Repair Edges



Small edge removed

Repair: Example

Repair Holes



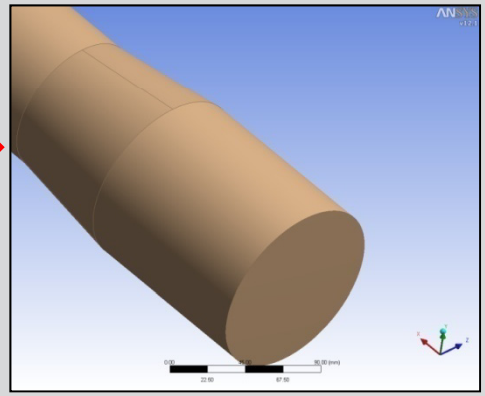
Holes in a solid body

Details View

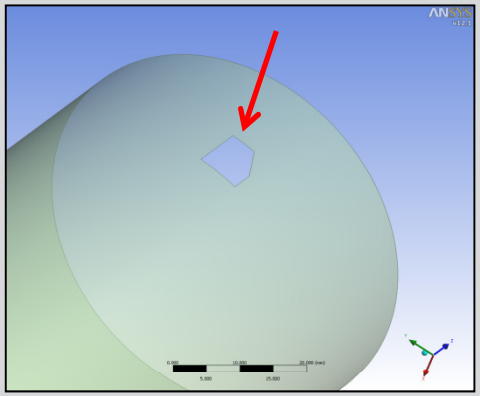
Details of RepairHole2	
Repair	RepairHole2
Bodies To Search	All Bodies
Min Hole Size Limit	0 mm
Max Hole Size Limit	Unlimited
Find Faults Now?	No
Hole 1 (RMB)	
Hole Size	21.287 mm
Repair Method	Fill Hole
Hole 2 (RMB)	
Hole Size	21.287 mm
Repair Method	Fill Hole
Hole 3 (RMB)	
Hole Size	21.287 mm
Repair Method	Fill Hole

Fill Hole
Do not Repair

Details View of Repair Holes



Holes removed



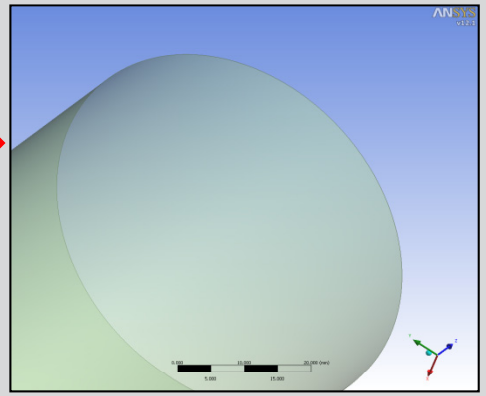
Hole in a surface body

Details View

Details of RepairHole3	
Repair	RepairHole3
Bodies To Search	Visible Bodies
Min Hole Size Limit	0 mm
Max Hole Size Limit	Unlimited
Find Faults Now?	No
Hole 1 (RMB)	
Hole Size	13.67 mm
Repair Method	Edge Delete
Hole 2 (RMB)	
Hole Size	84.853 mm
Repair Method	Edge Delete
Hole 3 (RMB)	
Hole Size	176.7 mm
Repair Method	Do not Repair

Edge Delete
Surface Patch
Edge Connect
Do not Repair

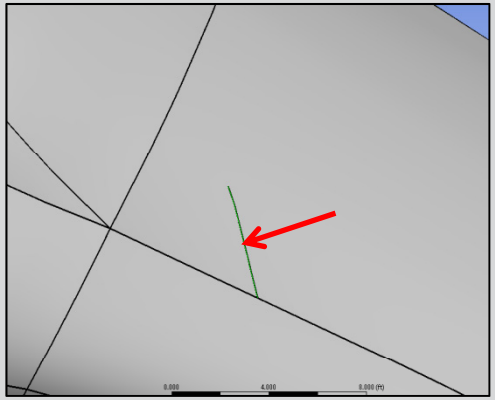
Details View of Repair Holes



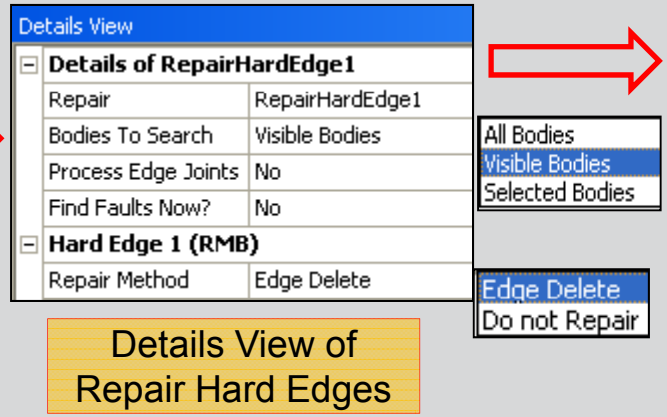
Hole removed

Repair: Example

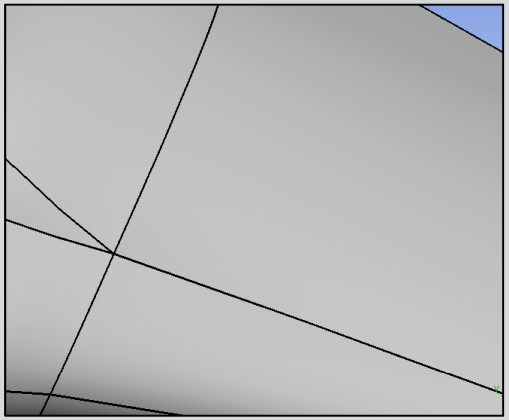
Repair Hard Edges



Hard edge in the model

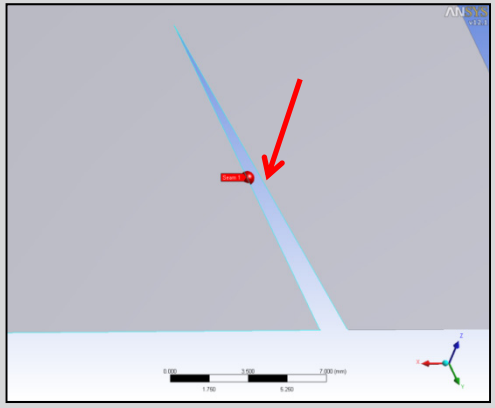


Details View of Repair Hard Edges

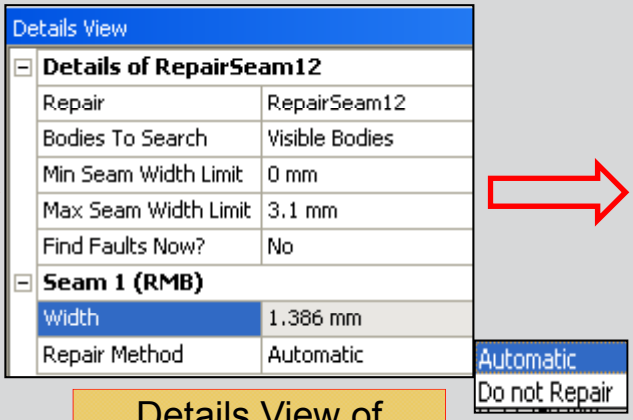


Hard edge removed

Repair Seams



Small crack in the model

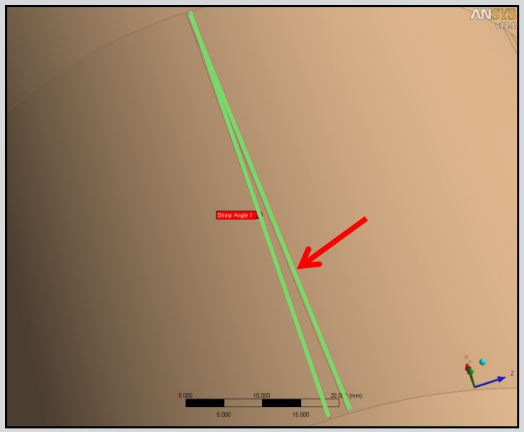


Details View of Repair Seams

Small crack removed

Repair: Example

Repair Sharp Angles



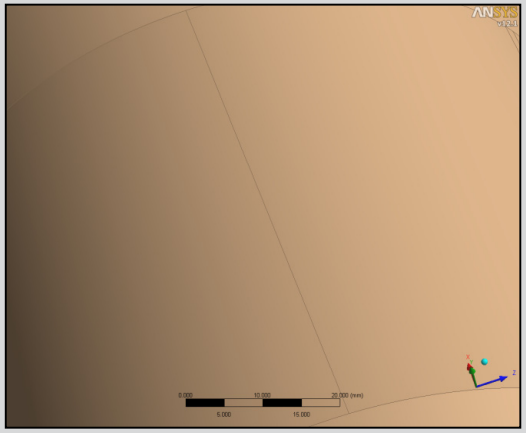
Sharp angle in the model

Details View

Details of RepairSharpAngle4	
Repair	RepairSharpAngle4
Bodies To Search	Visible Bodies
Min Sharp Angle Limit	0 °
Max Sharp Angle Limit	20 °
Find Faults Now?	No
Sharp Angle 1 (RMB)	
Repair Method	Face Merge
Merging Entity	Automatic Selection
Angle	1.6623 °

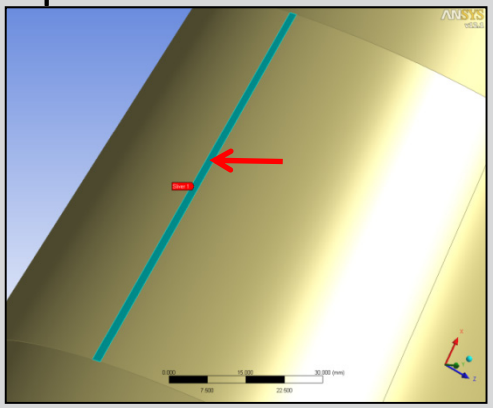
Face Merge
Do not Repair

Details View of Repair Sharp Angles



Sharp Angle removed

Repair Slivers



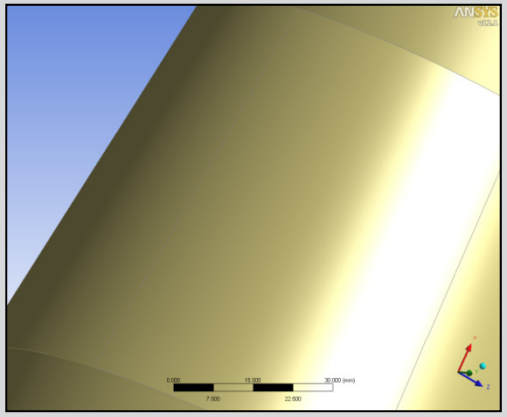
Sliver face in the model

Details View

Details of RepairSliver6	
Repair	RepairSliver6
Bodies To Search	Visible Bodies
Min Sliver Width Limit	0 mm
Max Sliver Width Limit	3.5 mm
Find Faults Now?	No
Sliver 1 (RMB)	
Width	1.992 mm
Repair Method	Automatic

Automatic
Edge Connect
Face Merge
Do not Repair

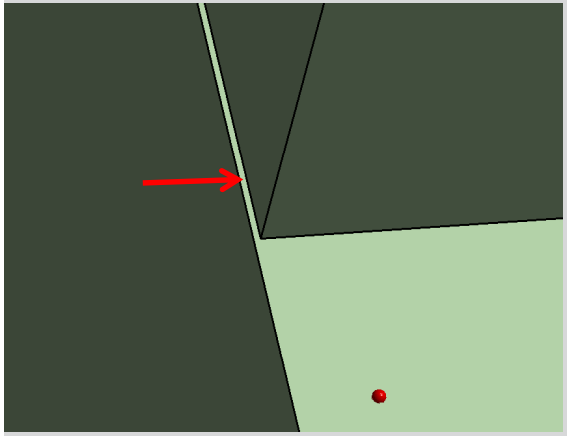
Details View of Repair Slivers



Sliver face removed

Repair: Example

Repair Spikes

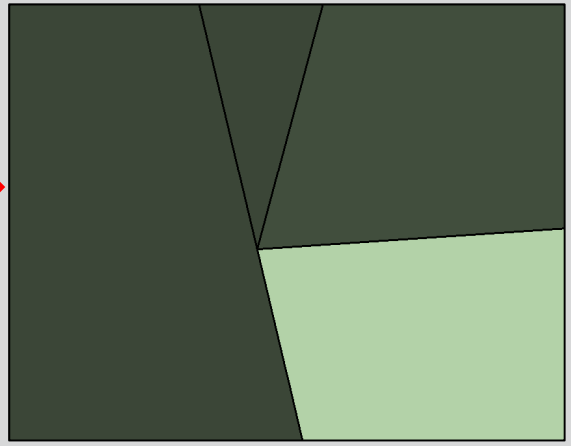


Spike in the model

Details View	
Details of RepairSpike8	
Repair	RepairSpike8
Bodies To Search	Visible Bodies
Min Spike Width Limit	0 mm
Max Spike Width Limit	6.3 mm
Find Faults Now?	No
Spike 1 (RMB)	
Width	0.62706 mm
Repair Method	Automatic

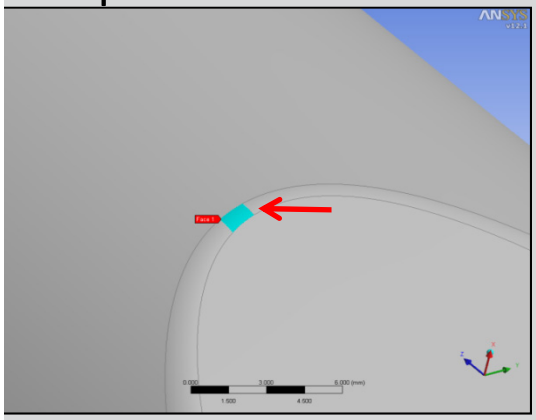
Automatic
Do not Repair

Details View of Repair Spikes



Spike removed

Repair Faces

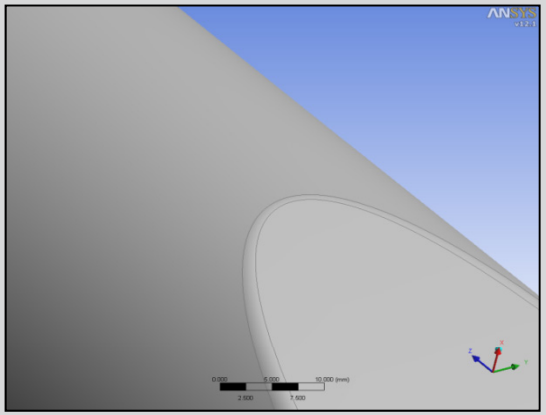


Small face in the model

Details View	
Details of RepairFace1	
Repair	RepairFace1
Bodies To Search	Visible Bodies
Min Face Area Limit	1 mm²
Max Face Area Limit	2.3 mm²
Find Faults Now?	No
Face 1 (RMB)	
Area	2.2278 mm²
Repair Method	Automatic

Automatic
Face Merge
Do not Repair

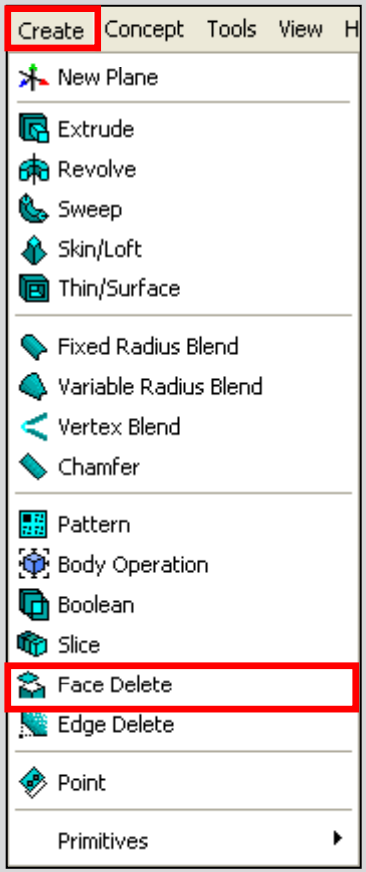
Details View of Repair Faces

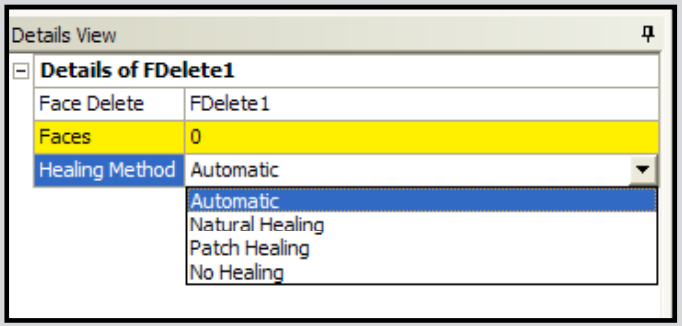


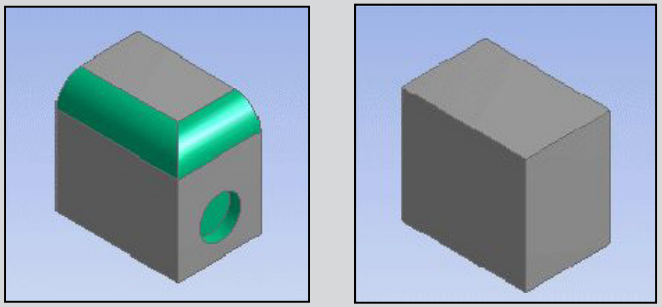
Small face removed

Face Delete

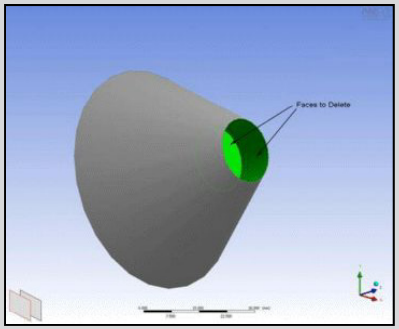
- Used to remove features such as fillets, chamfers, holes etc., and automatically heal the geometry at those locations
- Four Options for Healing: Automatic, Natural, Patch or No healing

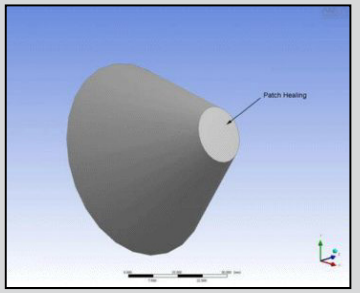




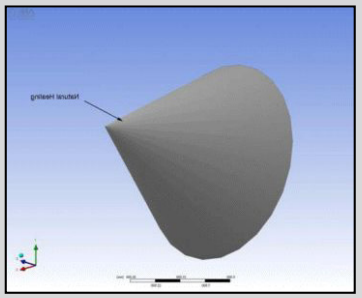


Automatic





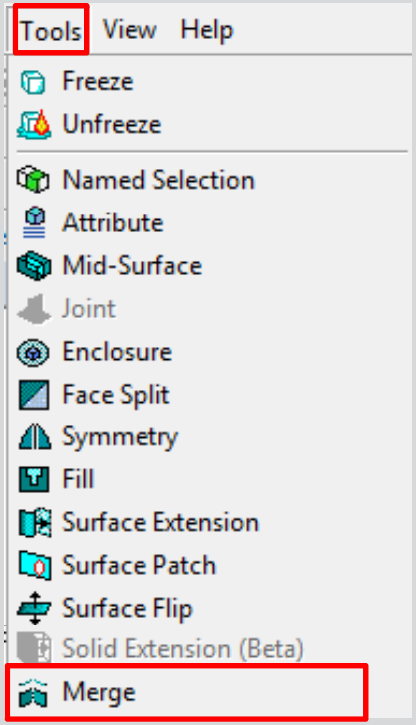
Patch Healing



Natural Healing

Merge

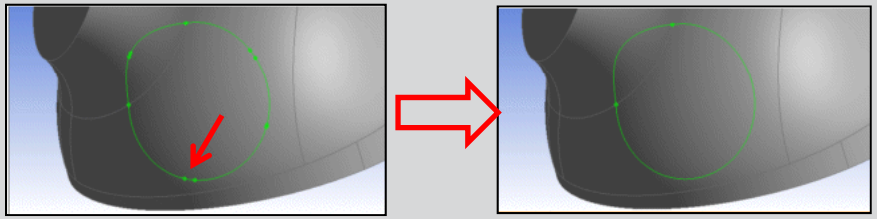
- Merges a set of edges or faces
- Useful to reduce model complexity
- Type
  - Edge merging
  - Face merging
- Method
  - Manual: user selects the entities to merge
  - Automatic: clusters of entities to merge are automatically selected and highlighted



Details View

Details of Merge2	
Merge	Merge2
Merge Type	Edges
Selection Method	Manual
Edges	4
Minimum Angle [0, 180]	135 °
Edges Not Merged	
Edges	4

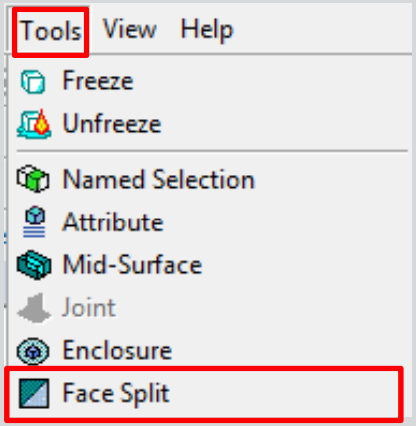
Details View of Merge

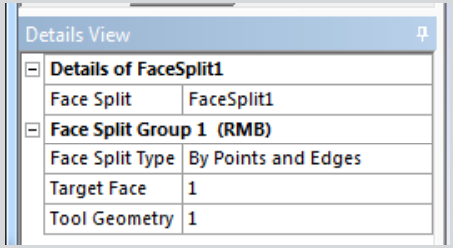


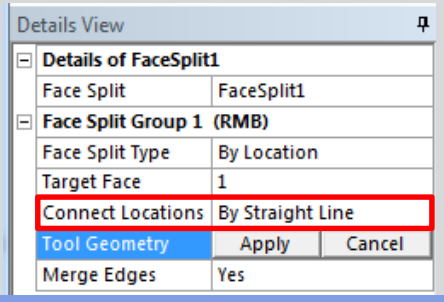
Edge Merging

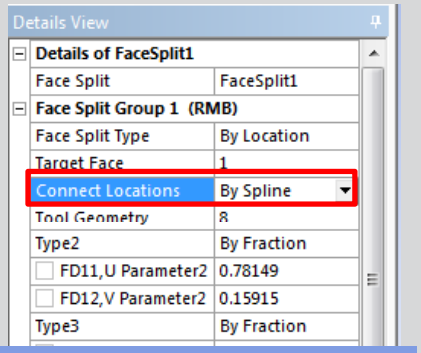
Face Split

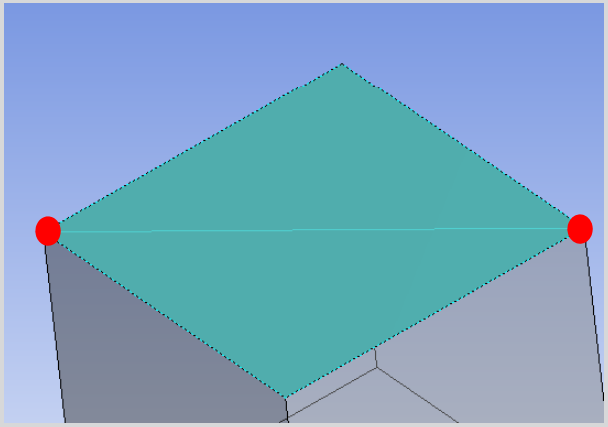
- Allows faces to be broken down by:
  - Points and Edges
    - Combinations of sketch and 3D geometry
  - Locations
    - "Click" on the surface
    - Do not need to close the loop

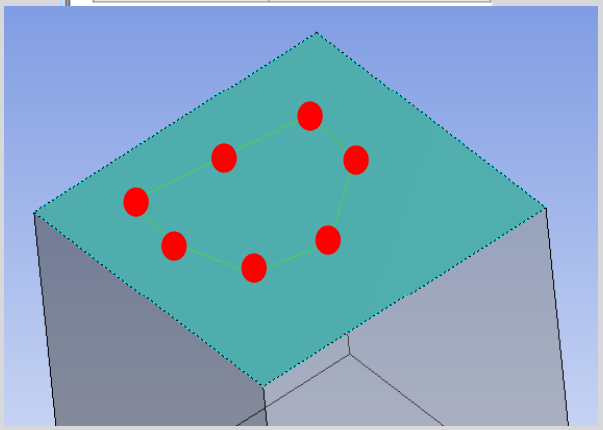


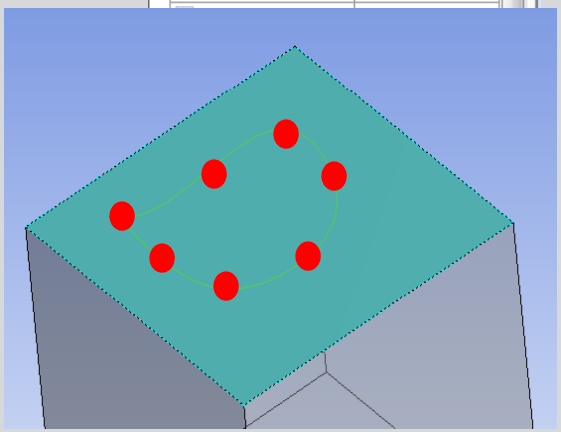






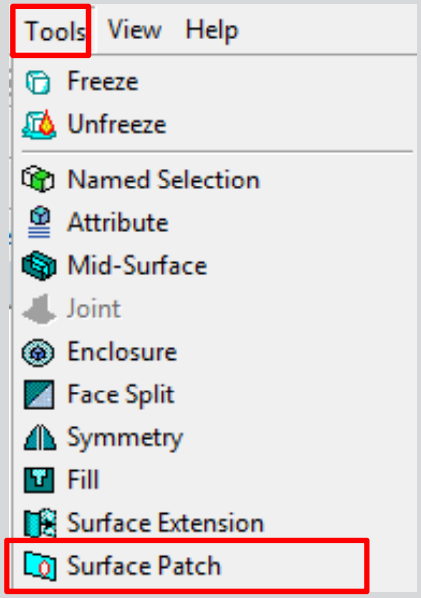


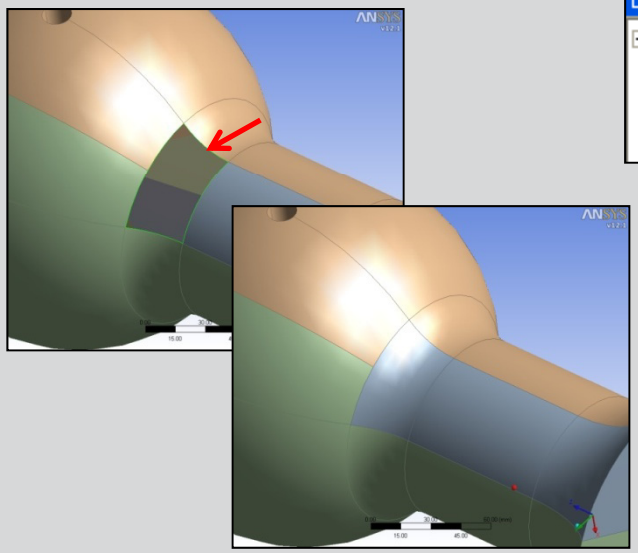




Surface Patch

- Fills the gaps in surface bodies
- Requires closed loop of edges
- Edges can be from different surface bodies
- Allows selection of multiple patch operations in a single go



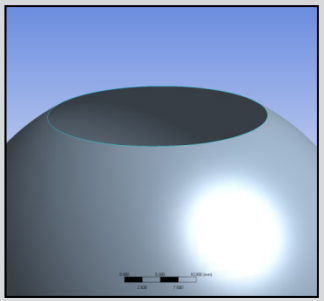


Gap filled using Surface Patch

Details View

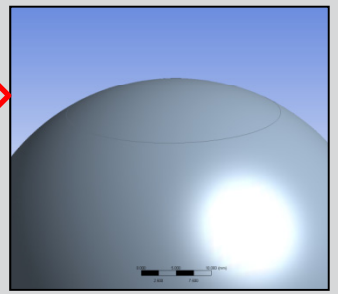
Details of SurfPatch2	
Surface Patch	SurfPatch2
Patch Edges	4
Patch Method	Automatic

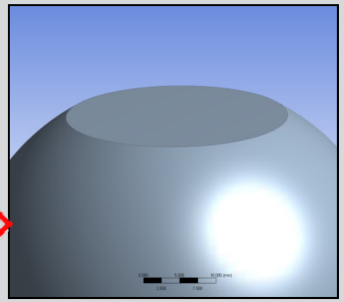
Details View of Surface Patch



Model with a hole

Natural Healing

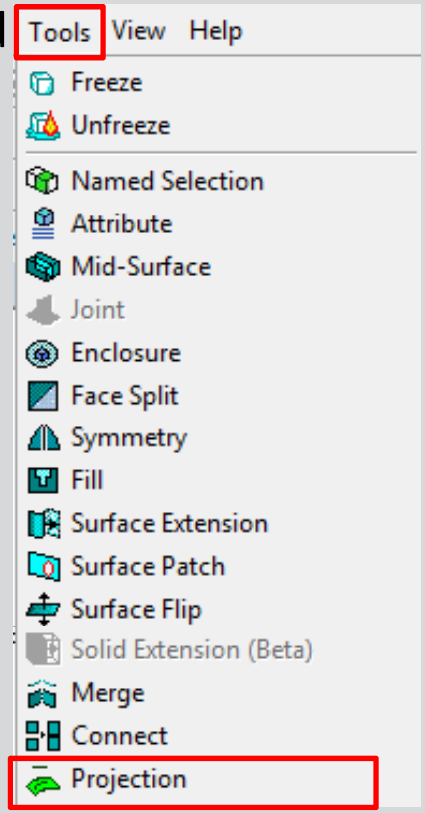




Patch Healing

Projection

- Allows projection of points on edges/faces and edges on faces/bodies
- Options
  - Points on edge or face
  - Edge on face or body
- Works on both frozen as well as active bodies



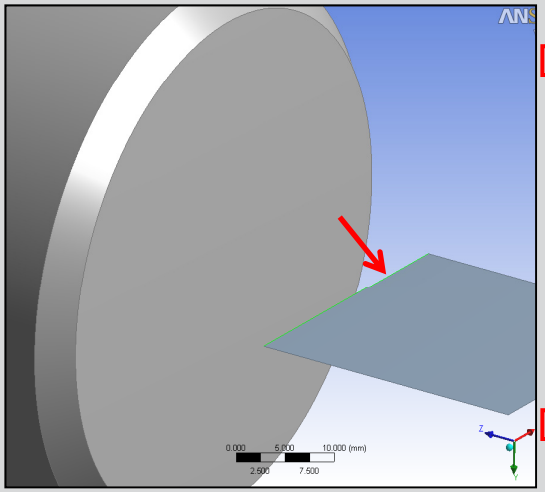
Details View

Details of Projection1	
Projection	Projection1
Type	Edges On Face
Edges	3
Target	1
Direction Vector	None (Closest Direction)
Imprint	Yes
Extend Edges	No

Details View of Projection

Projection: Example

Edge on Face

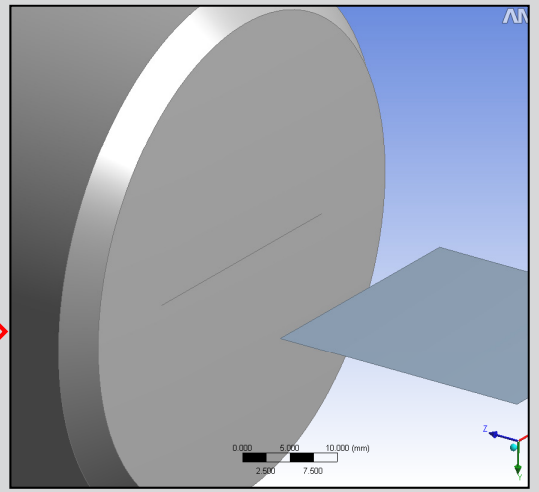


Edge to project

Details View

Details of Projection1	
Projection	Projection1
Type	Edges On Face
Edges	1
Target	1
Direction Vector	None (Closest Direction)
Imprint	Yes
Extend Edges	No

Type: Edges on Face

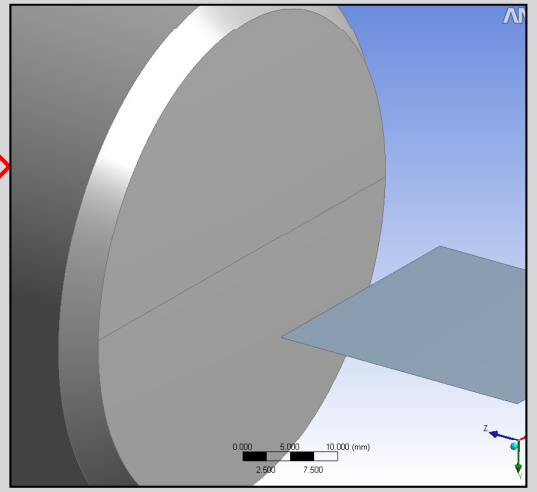


Edge projected on face

Details View

Details of Projection1	
Projection	Projection1
Type	Edges On Face
Edges	1
Target	1
Direction Vector	None (Closest Direction)
Imprint	Yes
Extend Edges	Yes

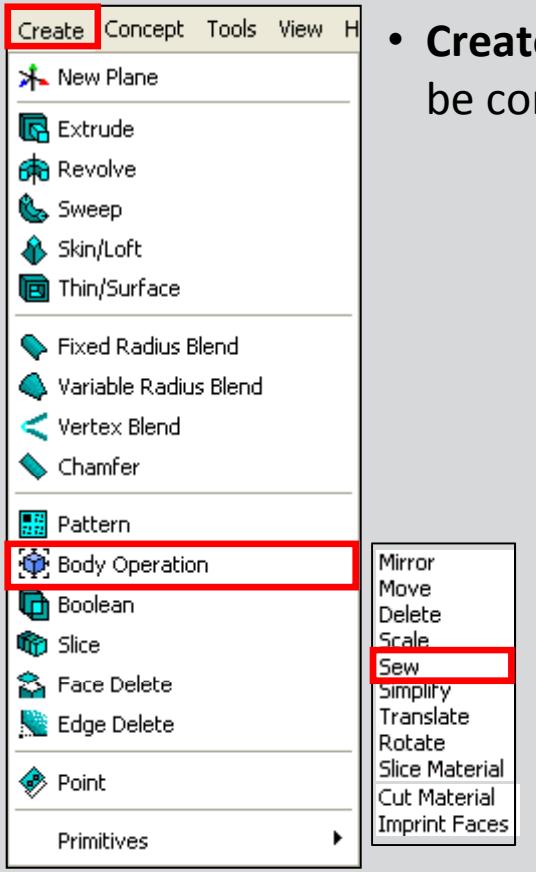
Extend Edges: Yes



Edge projected on face with 'Extend Edges' option YES

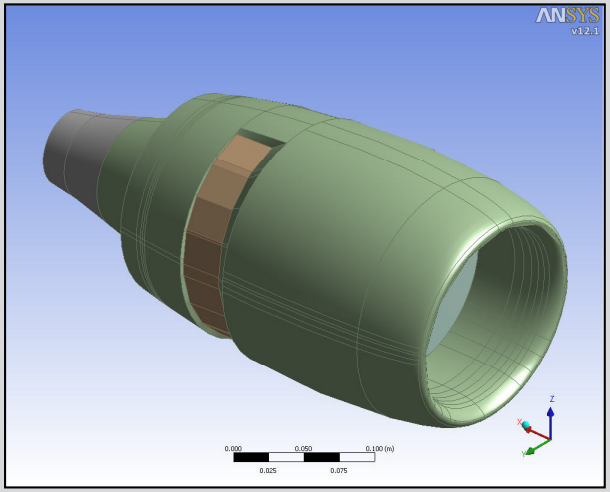
Body Operation: Sew

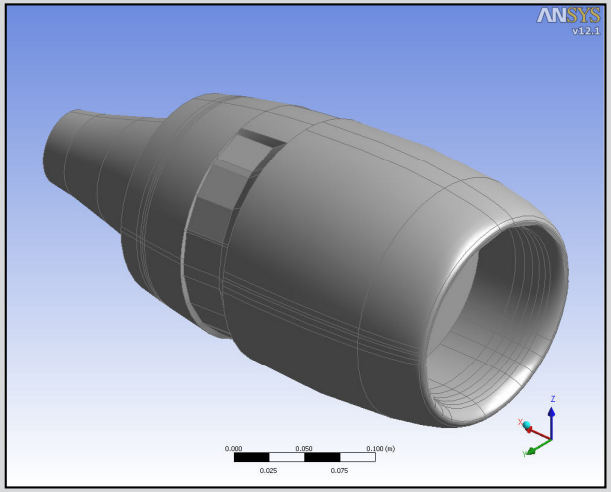
- Sews selected surface bodies to form a single surface body where they have edges common to within a given **Tolerance**
- **Create Solids?** option enables surface bodies forming a closed domain to be converted to solid bodies



Details View

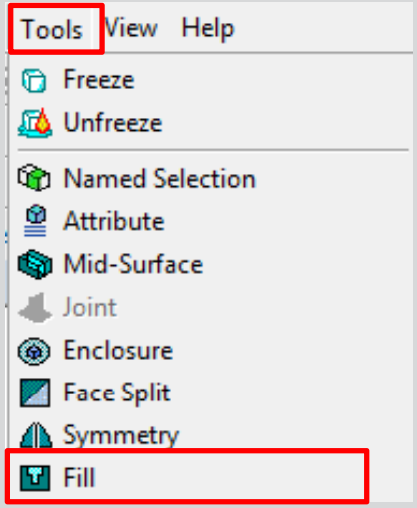
Details of BodyOp1	
Body Operation	BodyOp1
Type	Sew
Bodies	7
Create Solids?	Yes
Tolerance	Normal
Merge Bodies	Yes

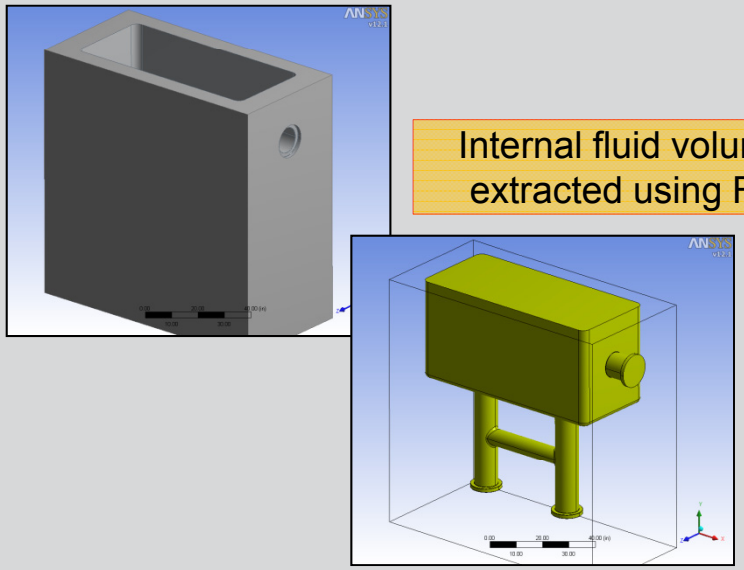




Fill

- Creates internal fluid volume
- Two options
  - By Cavity : user must select all wetted surfaces
  - By Caps : user must create closing surfaces at inlets and outlets, and select bodies





Internal fluid volume extracted using Fill

Details View

Details of Fill3	
Fill	Fill3
Extraction Type	By Cavity
Faces	66

Details View of Fill

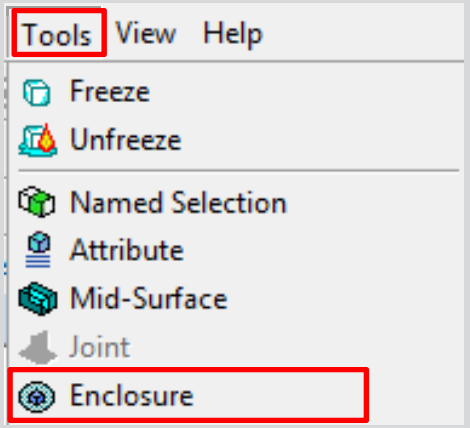
Details View

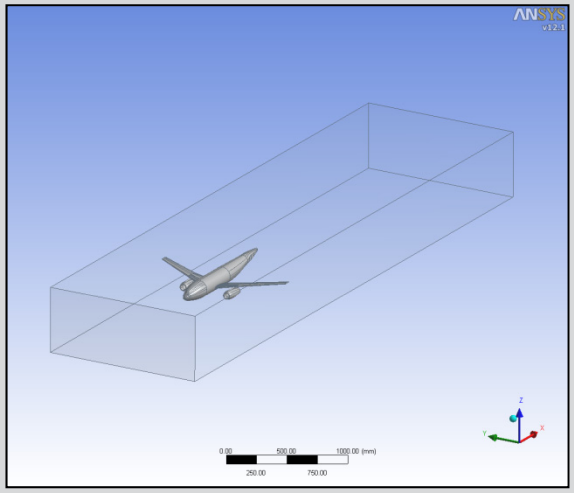
Details of Fill3	
Fill	Fill3
Extraction Type	By Caps
Target Bodies	All Bodies
Preserve Capping Bodies	No
Preserve Solids	Yes

Cap surface bodies must be selected

Enclosure

- Creates enclosure around the bodies
  - Useful for external aerodynamic analysis
  - Can be used for extracting internal flow domain
- Input
  - All or selected bodies
  - Shape of enclosure
  - Extent of enclosure
- Output
  - A frozen body around the selected parts with specified extents
  - Internal flow volume as a result of automatic Boolean subtract
- Supports symmetry models
- Full or partial models can be included in enclosure

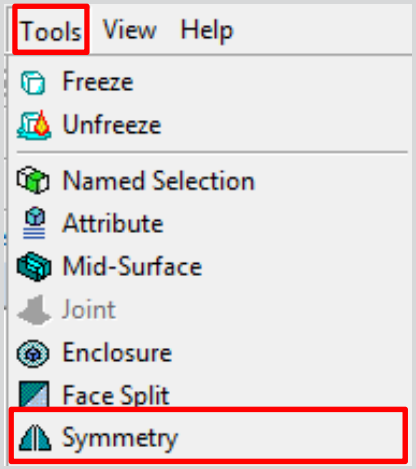




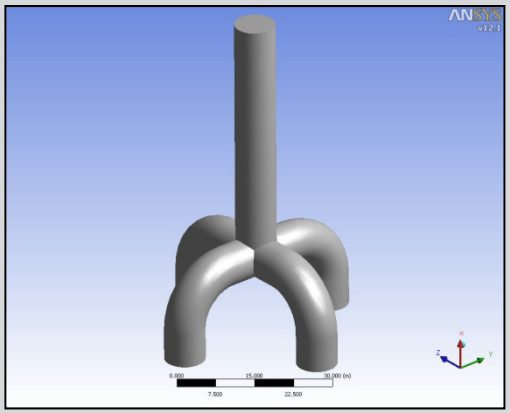
Enclosure created for an airplane

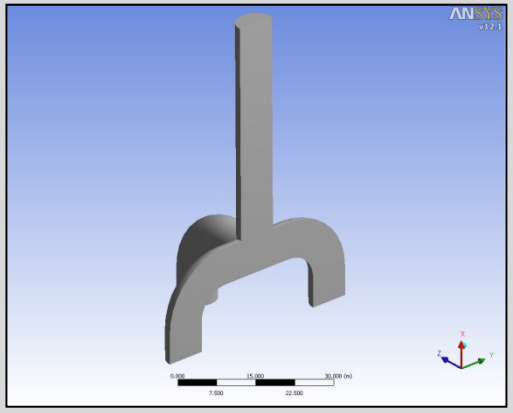
Symmetry

- Defines symmetry for the model
- Input
  - All or selected bodies
  - Up to three symmetry planes
- Operation
  - Symmetry planes slice the model
- Output
  - Sliced model (part lying on the positive side of the axis is retained)



Tip: The symmetry tool can be used as visualization tool when discovering the model (then the operation is deleted)





Using Symmetry

Details View

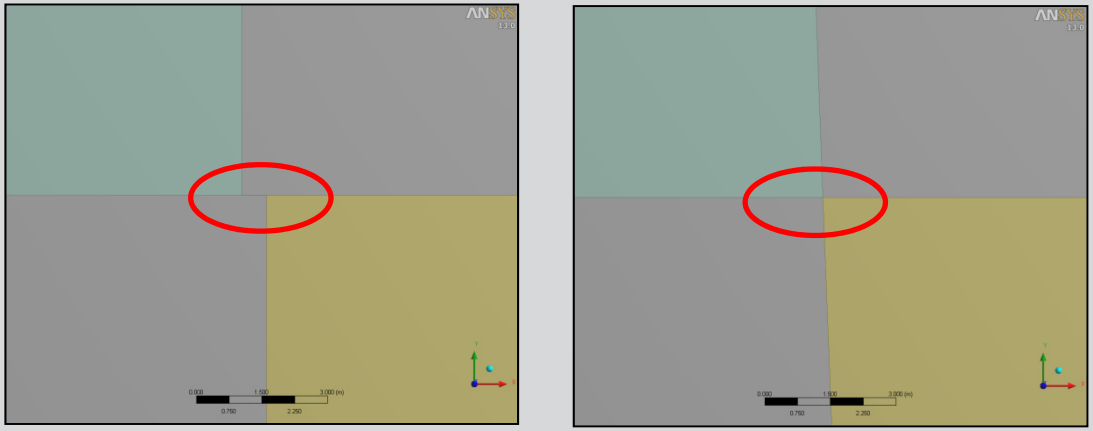
Details of Symmetry1	
Symmetry	Symmetry1
Number of Planes	2
Symmetry Plane1	XYPlane
Symmetry Plane2	ZXPlane
Model Type	Full Model
Target Bodies	All Bodies

Details View of Symmetry

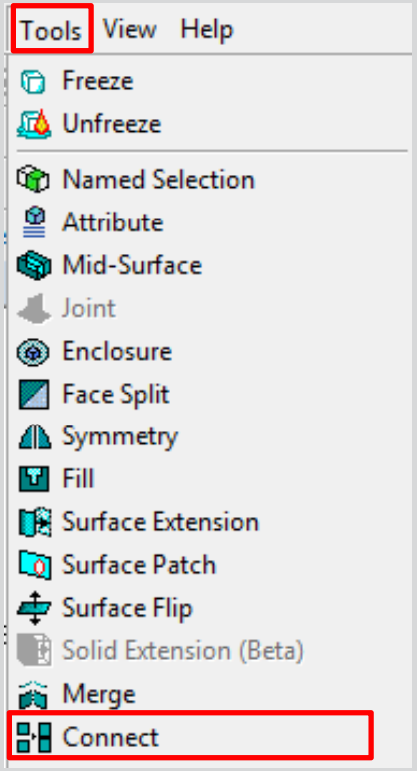
Note : Faces that are coincident with the symmetry plane are tagged with a "Symmetry" named selection under AMP

Connect

- Aligns and possibly joins a set of vertices, edges or faces
- Properties
  - Location property
  - T-junction property



Vertex Connect



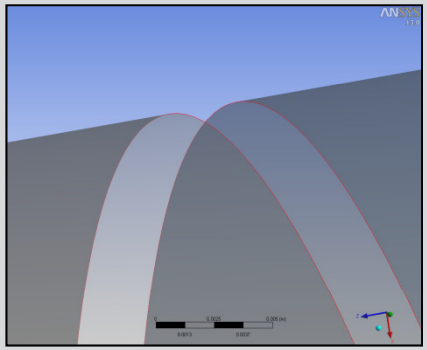
Details View

Details of Connect2	
Connect	Connect2
Connection Type	Vertices
Vertices	2
Tolerance	0.1 in
Location	Interpolated
Merge Bodies	Yes

Details View of Connect

Connect: Example

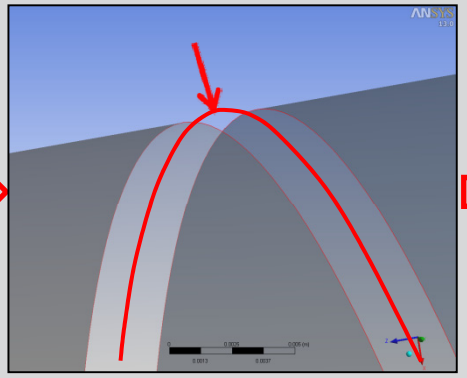
Edge Connect

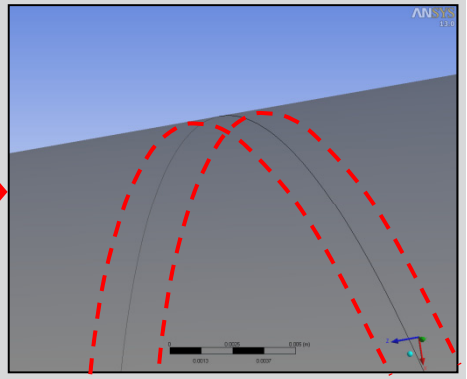


Model with a gap

Tolerance	0.1 mm
Location	Interpolated
T-Junction	Off

Location: Interpolated

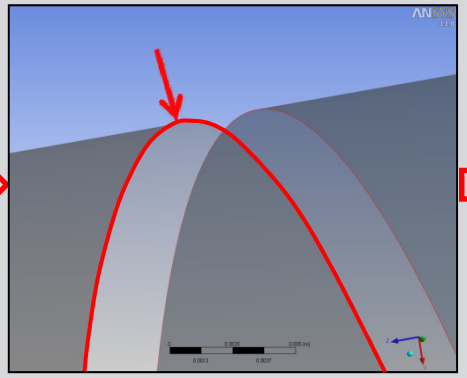


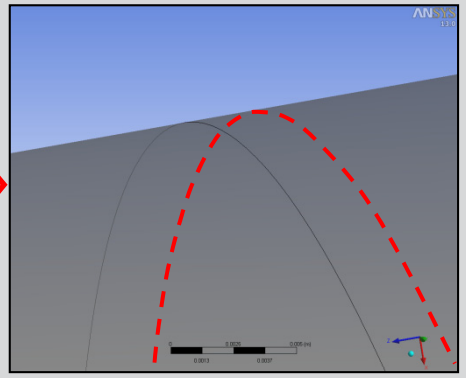


Both edges moved to interpolated location

Tolerance	0.1 mm
Location	Preserve First
T-Junction	Off

Location: Preserve First

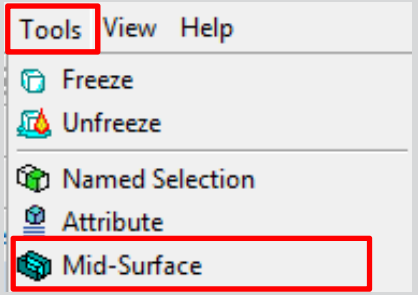




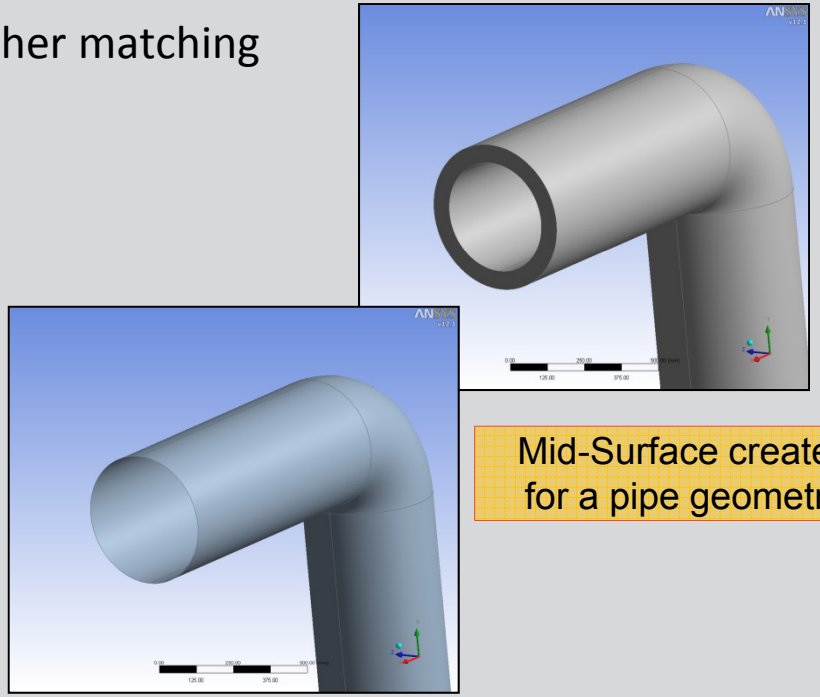
Second edge moved to first edge location

Mid-Surface

- Extract surface body that is midway between existing solid body faces



- Two Options:
  - Manual: Operates only on user specified face pairs
  - Automatic: Provides option to search for other matching face pairs



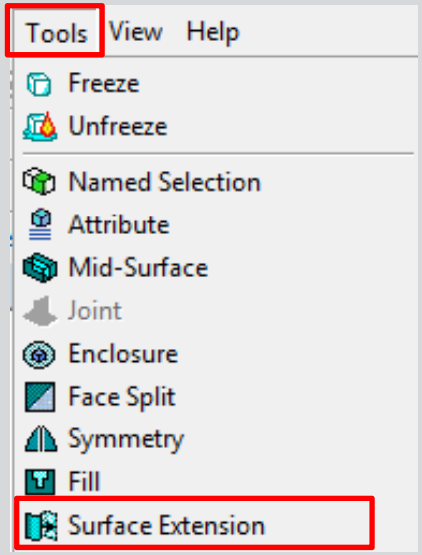
Mid-Surface created for a pipe geometry

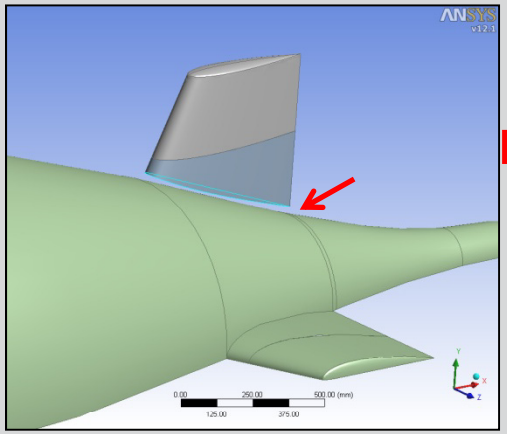
Details View	
Details of MidSurf1	
Mid-Surface	MidSurf1
Face Pairs	1
Selection Method	Manual
FD1, Thickness Tolerance (>=0)	0.01 mm
FD2, Sewing Tolerance (>=0)	0.001 mm
Extra Trimming	Intersect Untrimmed with Body
Ambiguous Face Delete	All
Preserve Bodies?	No

Details View of Mid-Surface

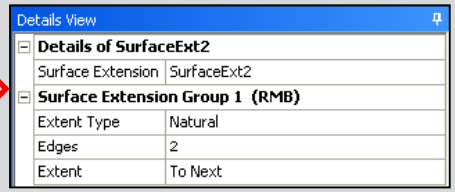
Surface Extension

- Allows extension of surface bodies to the desired extent
- Extension type
  - Natural: Based on gradients of selected edges
  - User Defined: User specifies the direction

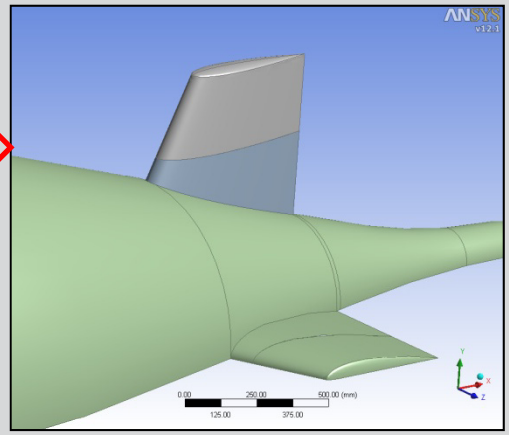




Model with gap



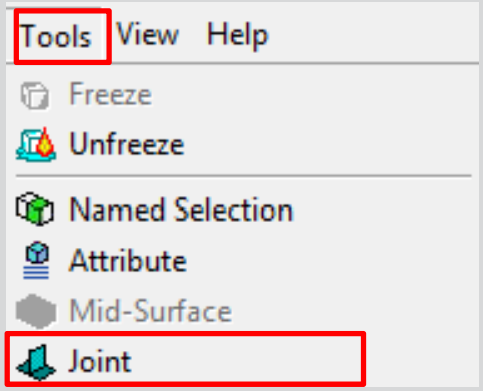
Details View of Surface Extension

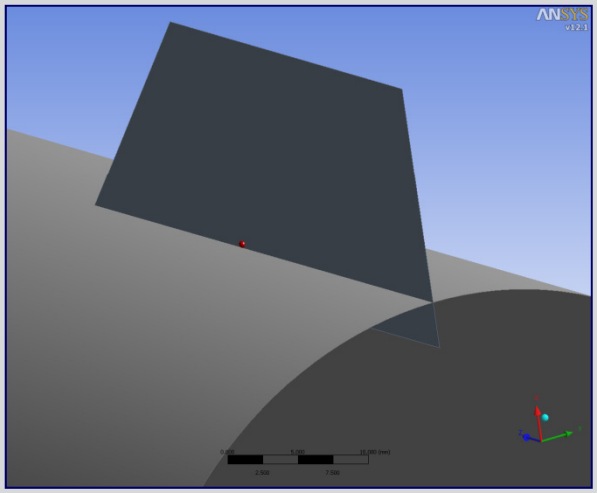


Model with gap closed

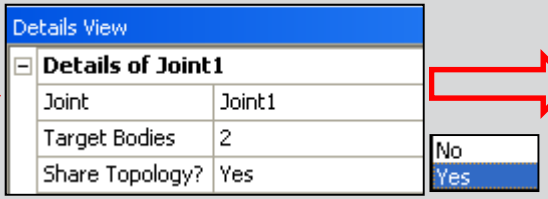
Joint

- Joins surface bodies together such that their contact regions share common edge
  - Prerequisite for conformal meshes
- Takes two or more surface bodies as input
- Imprints edges on all bodies where they make contact

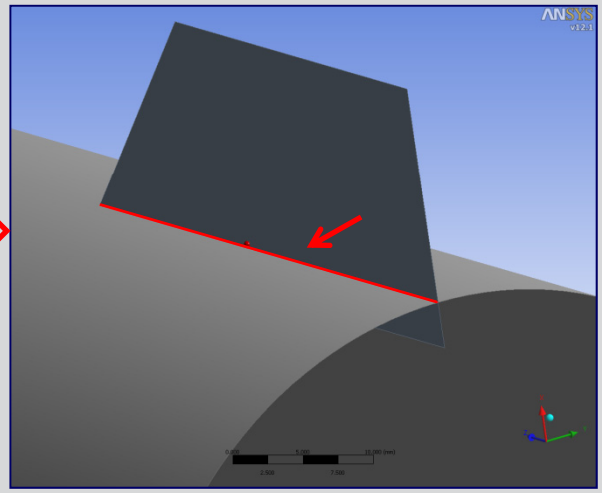




Surface bodies to be Joined

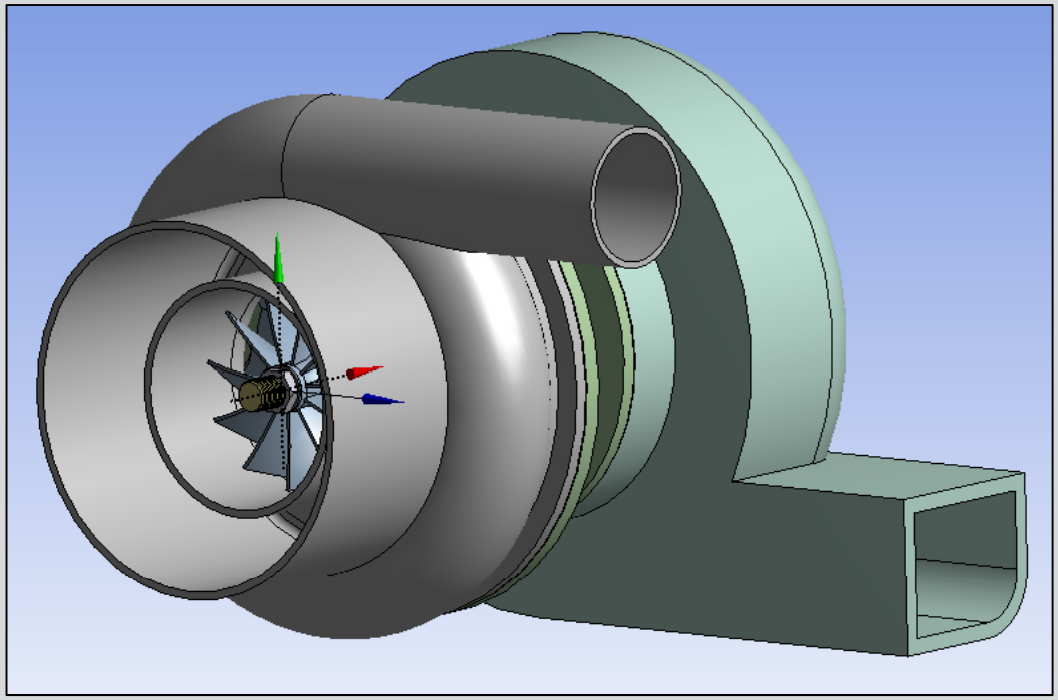


Details View of Joint



Surface bodies after Joint

Workshop 4a – Geometry Cleanup*



***Optionally continue with Concept Modeling lecture and complete workshop 4b**

ANSYS

Concept Modeling

Concept Modeling

- **The features in the Concept menu are used to create and modify line bodies and/or surface bodies which become FE beam or shell models**

- **To begin Concept Modeling, you can either:**
  - Create line or surface bodies using the features in the Draw toolbox to design a 2D sketch and/or generate a 3D model
  - Use the Import external geometry file feature

- **Line bodies can be created using the concept modeling tools:**
  - Lines from points
  - Lines from sketches
  - Lines from edges

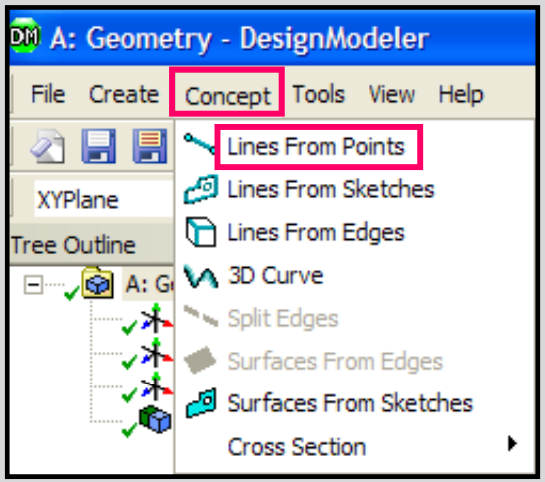
- **Surface bodies can be created using the concept modeling tools:**
  - Surfaces from line bodies
  - Surfaces from sketches
  - Surfaces from 3D edges

Creating Line Bodies (1)

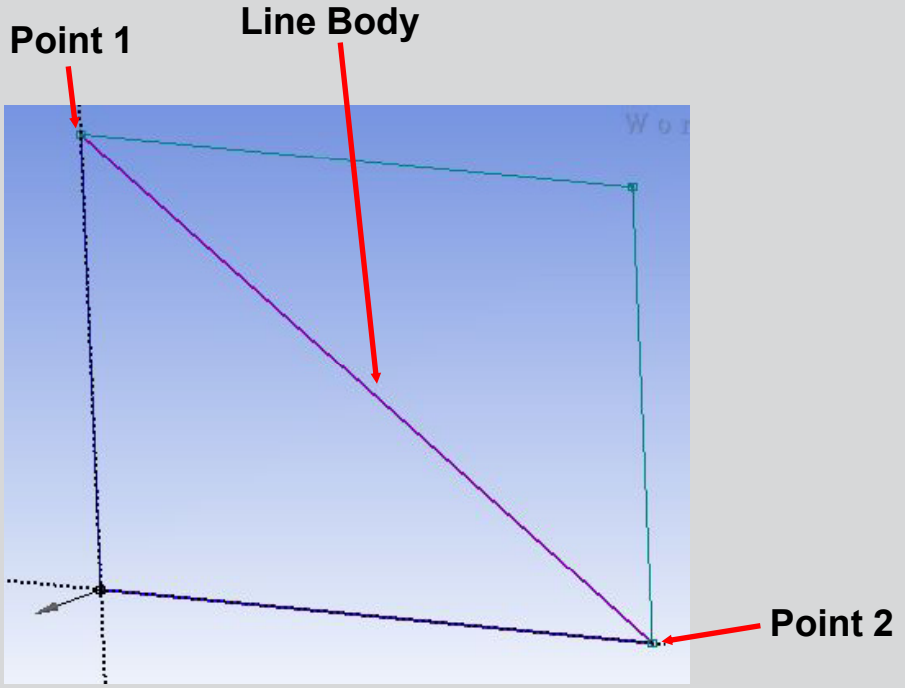
Lines From Points

[Main Menu] Concept → Lines From Points

- Points can be any 2D sketch points, 3D model vertices or Point Feature (PF) points.
- A point segment is a straight line connecting two selected points.
- The feature can produce multiple Line Bodies, depending on the connectivity of the chosen point segments.
- The Operation field allows Add or Add Frozen choices for line bodies.



Details View	
Details of Line1	
Lines From Points	Line1
Point Segments	1
Operation	Add Material

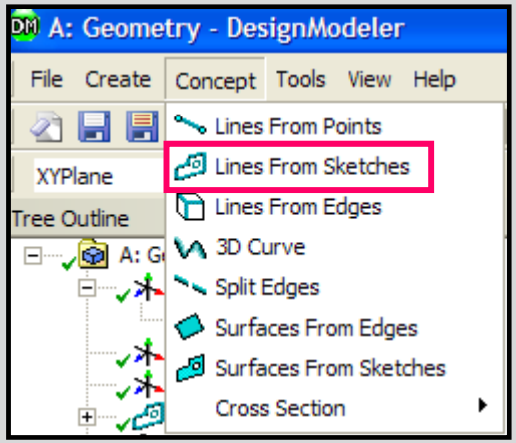


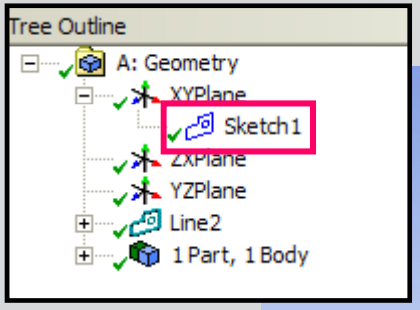
Creating Line Bodies (2)

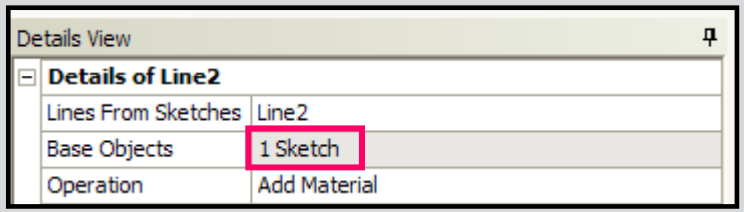
Lines From Sketches

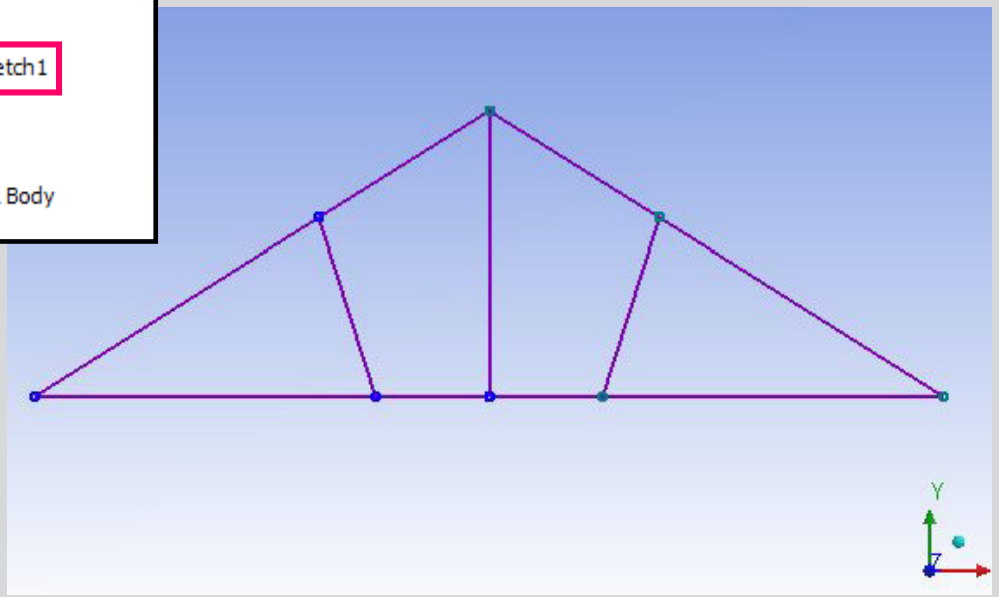
[Main Menu] Concept → Lines From Sketches

- Line bodies created based on sketches and planes from faces
- Multiple Line Bodies may be created depending on the connectivity of the edges within the base objects
- Select sketches or planes in the feature tree then “Apply” in the detail window
- Multiple sketches, planes, and combinations of sketches and planes can be used as the base object for the creation of line bodies







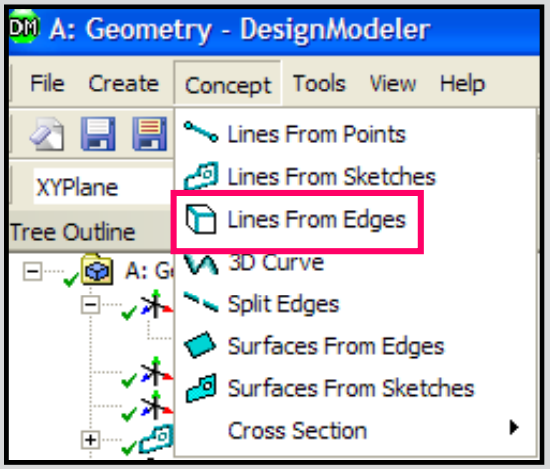


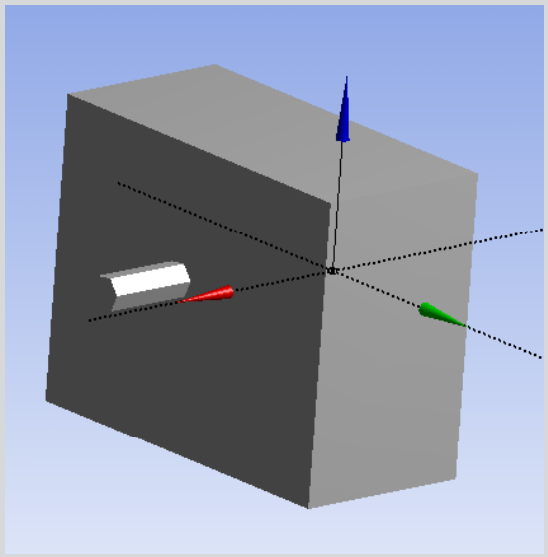
Creating Line Bodies (3)

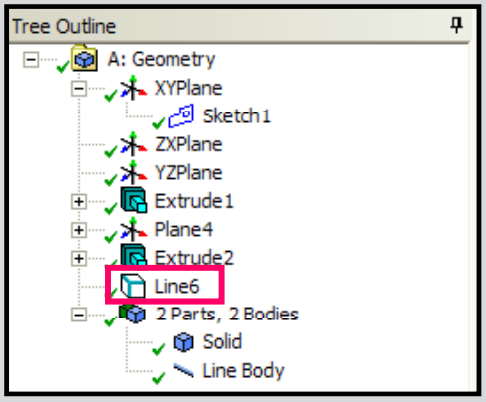
Lines From Edges

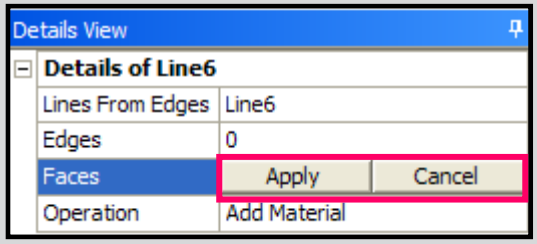
[Main Menu] Concept → Lines From Edges

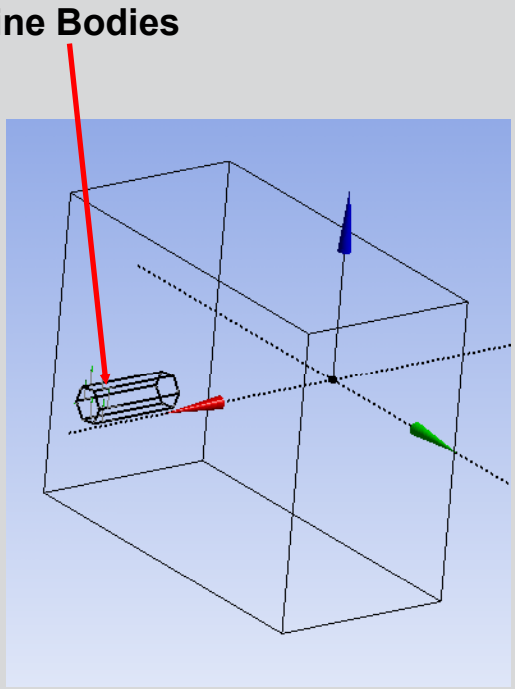
- Creates line bodies based on existing 2D and 3D model edges
- Can produce multiple line bodies depending on the connectivity of the selected edges and faces
- Can select edges and/or faces through two fields in the detail window then “Apply”









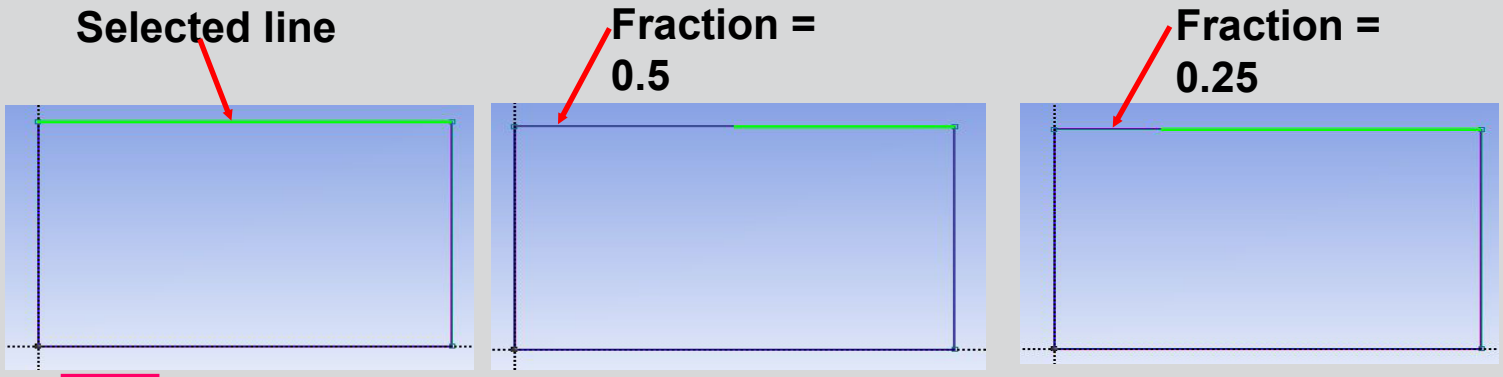


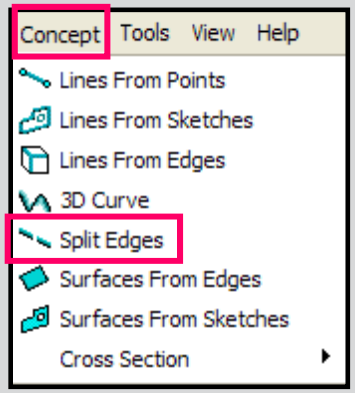
Split Edges

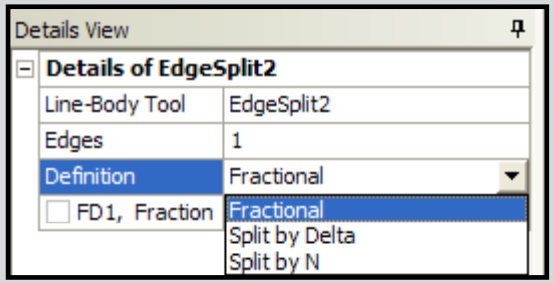
Split Line Body

[Main Menu] Concept → Split Edges

- Splits line body edges into two pieces
- Split location is controlled by the Fraction property (e.g. 0.5 = split in half).
- Other Options:
  - Split by Delta: Distance between each split is given by Delta along the edge
  - Split by N: Number of Divisions of the Edge



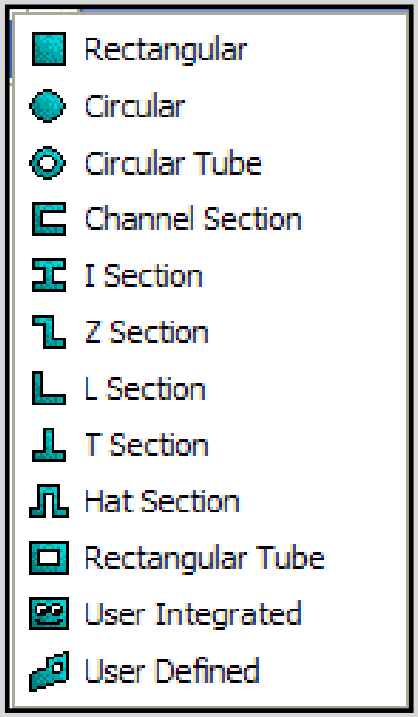




Cross Sections (1)

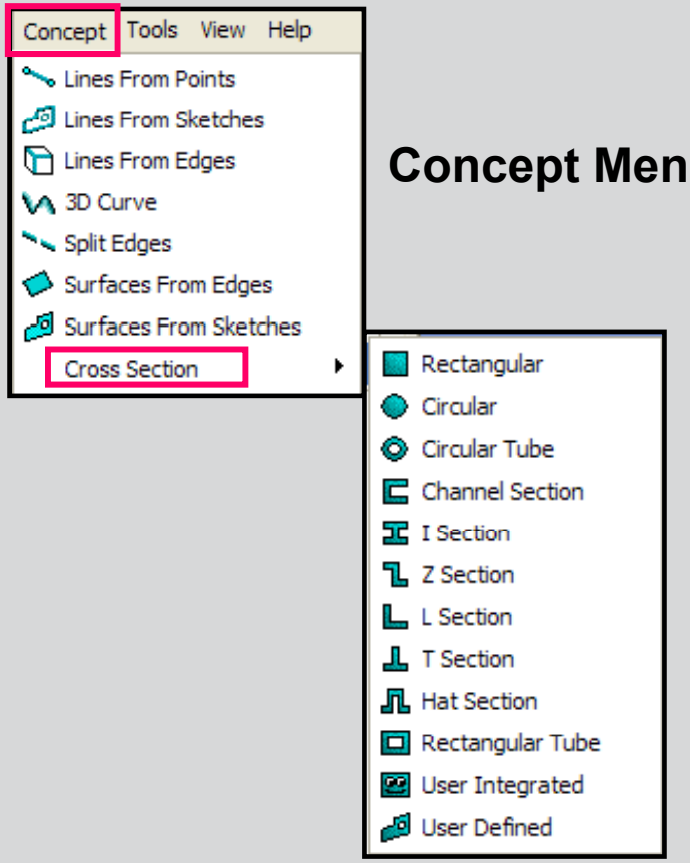
Cross Sections

- Cross sections are attributes assigned to line bodies to define beam properties in the FE simulation
- In DM, cross sections are represented by sketches and are controlled by a set of dimensions
  - Note: Design-Modeler uses a different coordinate system for cross sections than the one used in the ANSYS environment (described later)



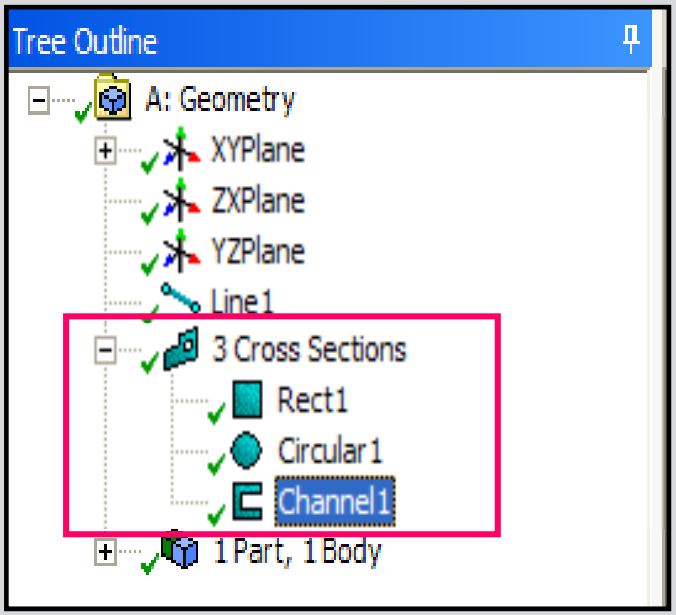
Cross Sections (2)

- Cross sections are selected from the Concept menu
- A cross section branch is inserted in the tree where each chosen cross section is listed



Concept Menu

List of Cross Sections



Cross Sections in Tree Outline

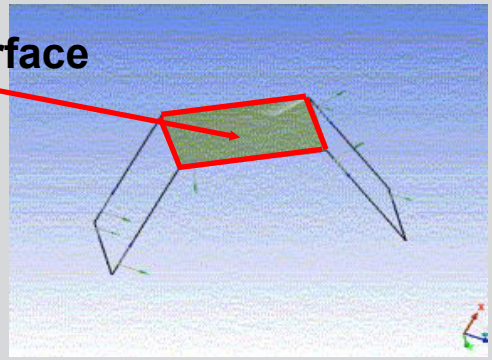
Surfaces From Edges (1)

Surfaces From Edges

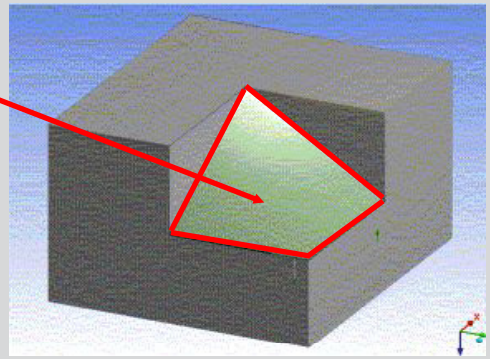
[Main Menu] Concept → Surfaces from Edges

- Creates surface body using line body edges as the boundary
- Line body edges must form non-intersecting closed loops
- Each closed loop creates a frozen Surface Body
- The loops should form a shape such that a simple surface can be inserted into the model:
  - Planes, cylinders, tori, cones, spheres and simple twisted surfaces

Planar surface



Non-planar surface



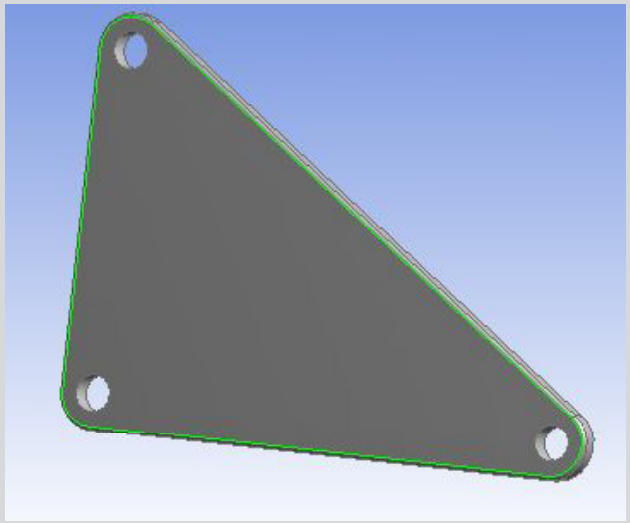
Details window:

- **Flip surface normals**
- **Input thickness which will be transferred to the FE model**

Details of Surf1	
Line-Body Tool	Surf1
Edges	4
# Edge joints generated	4
Flip Surface Normal?	No
Thickness (>=0)	0 mm

Surfaces From Edges (2)

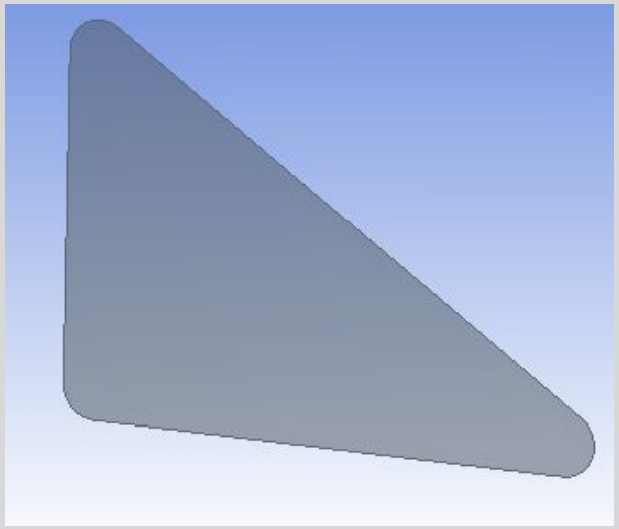
- Creates surfaces from existing body edges
- Can be solid or line body edges
- Edges must produce non-intersecting closed loops



Existing solid body edges are selected for new surface boundary.

Details View

Details of Surf1	
Line-Body Tool	Surf1
Edges	6
Flip Surface Normal?	No
Thickness (>=0)	0 mm



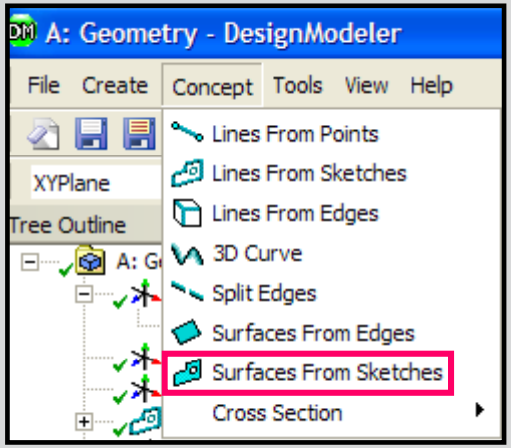
New, frozen, surface body generated (note, solid body is hidden).

Surfaces From Sketches

Surfaces From Sketches

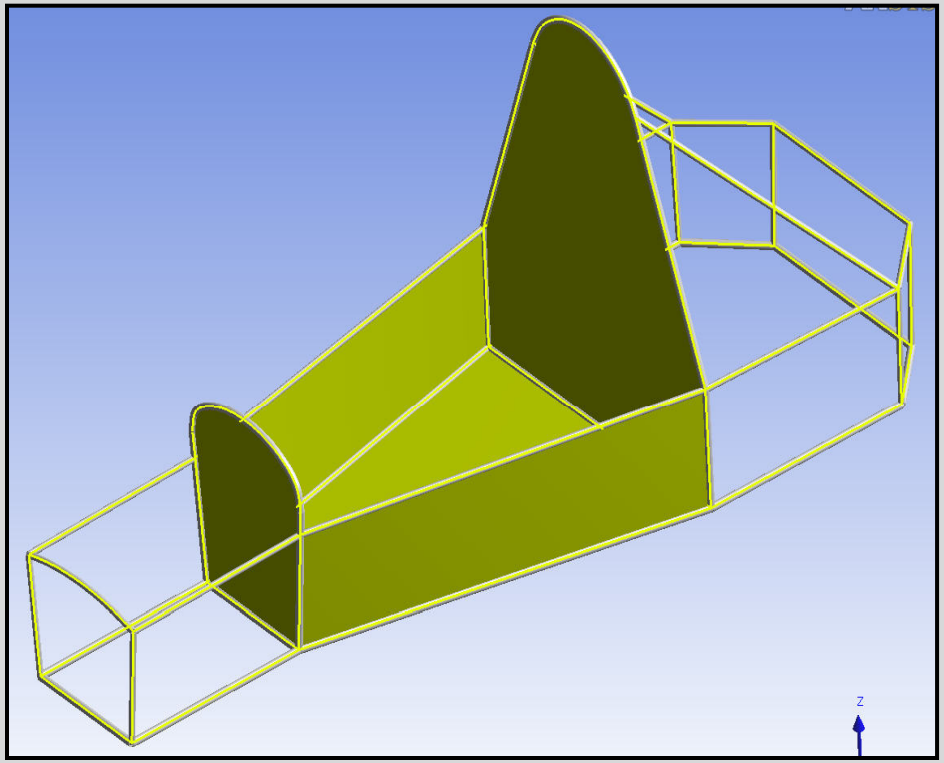
[Main Menu] Concept → Surfaces from Sketches

- Creates surface bodies using sketches as boundaries (single or multiple sketches are OK)
- Base sketches must be closed profiles which are not self intersecting
- May choose to “Add” or “Add Frozen” operations
- Can reverse normal direction “No” in Orient With Plane Normal field
- Can enter thickness which will be used in creating the FE model



Details of SurfaceSk3	
Surface From Sketches	SurfaceSk3
Base Objects	1 Sketch
Operation	Add Material
Orient With Plane Normal?	Yes
Thickness (>=0)	0 mm

Workshop 4b – Beam & Shell Modeling



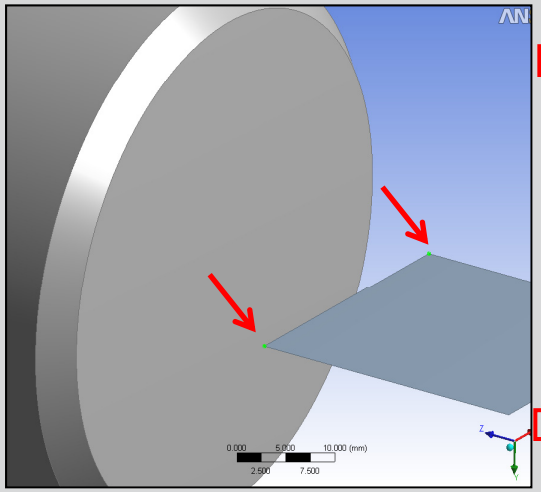
Appendix

Contents

- Projection
- Enclosure
- Symmetry
- Connect
- Surface from Edges
- Surface Patch
- Edge Joints
- Cross Sections

Projection: Example

Points on Edge/Face

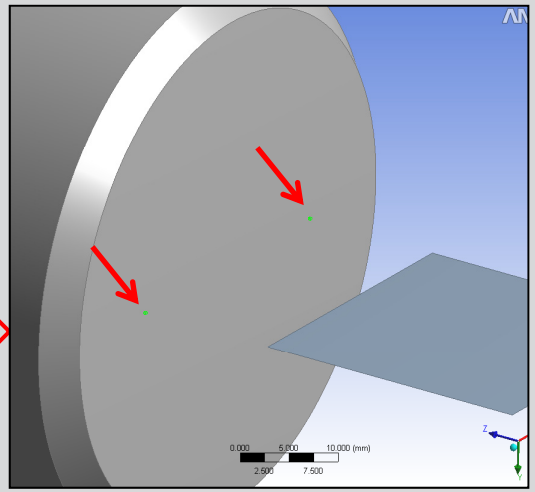


Points to project

Details View

Details of Projection1	
Projection	Projection1
Type	Points On Face
Points	2
Target	1
Direction Vector	None (Closest Direction)
Imprint	Yes

Type: Points on Face

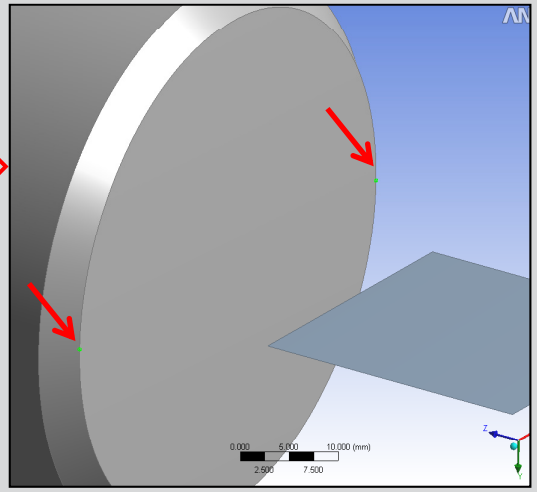


Points projected on face

Details View

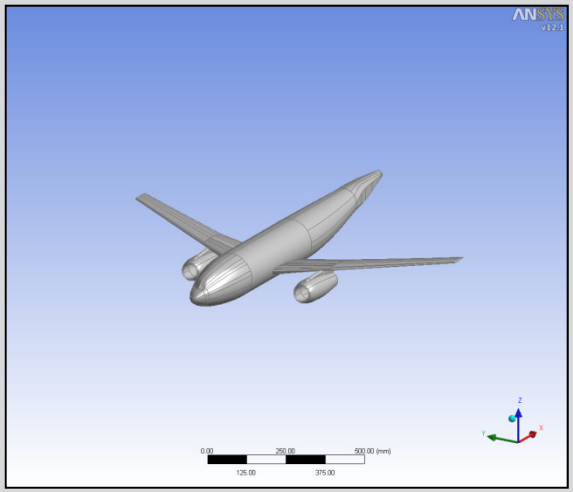
Details of Projection1	
Projection	Projection1
Type	Points On Edge
Points	2
Target	1
Direction Vector	None (Closest Direction)
Imprint	Yes

Type: Points on Edge



Points projected on edge

Enclosure: External Flow Example



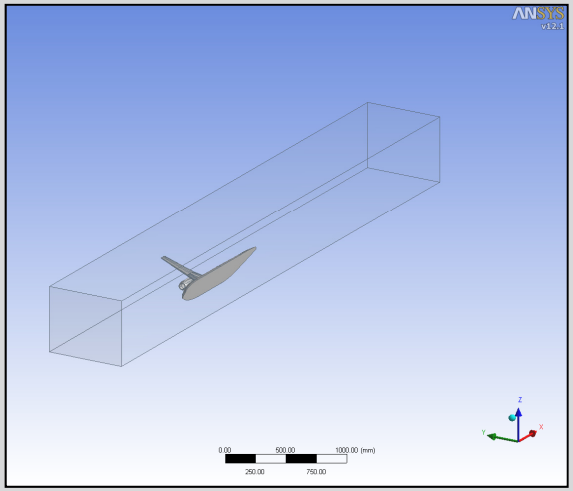
Model

Details View	
Details of Enclosure1	
Enclosure	Enclosure1
Shape	Box
Number of Planes	1
Symmetry Plane1	ZXPlane
Model Type	Full Model
Cushion	Non-Uniform
FD1, Cushion +X value (>0)	3000 mm
FD2, Cushion +Y value (>0)	100 mm
FD3, Cushion +Z value (>0)	200 mm
FD4, Cushion -X value (>0)	1000 mm
FD5, Cushion -Y value (>0)	100 mm
FD6, Cushion -Z value (>0)	200 mm
Target Bodies	All Bodies
Merge Parts?	No

0 1 2 3

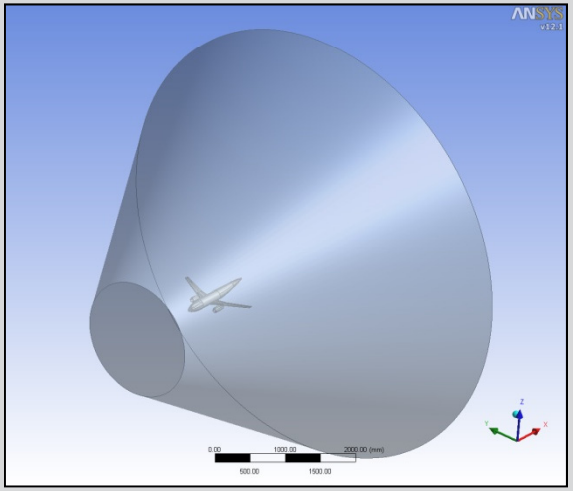
No Yes

Using Symmetry

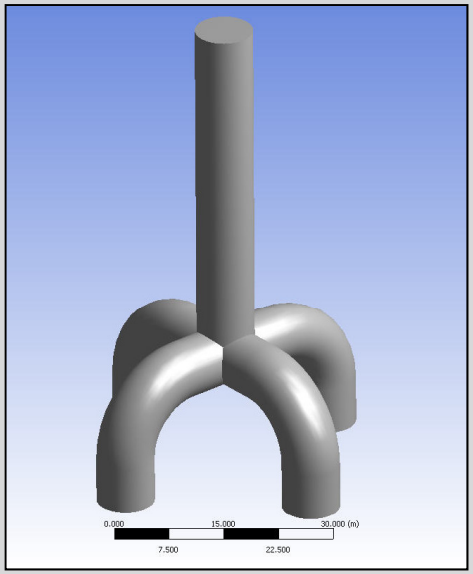


Details View	
Details of Enclosure2	
Enclosure	Enclosure2
Shape	User Defined
User Defined Body	Selected
Target Bodies	All Bodies
Merge Parts?	No

User Defined Shape Enclosure



Symmetry: Example



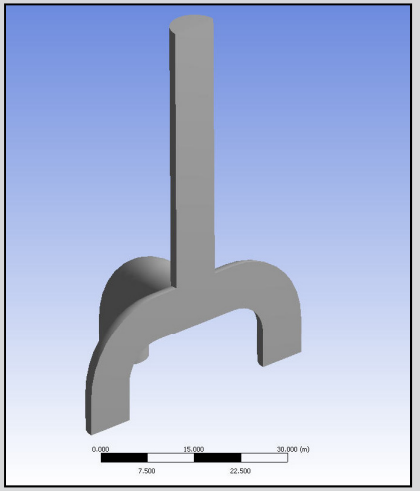
Full Model

Details View

Details of Symmetry1	
Symmetry	Symmetry1
Number of Planes	1
Symmetry Plane1	XYPlane
Model Type	Full Model
Target Bodies	All Bodies

Partial Model
Full Model

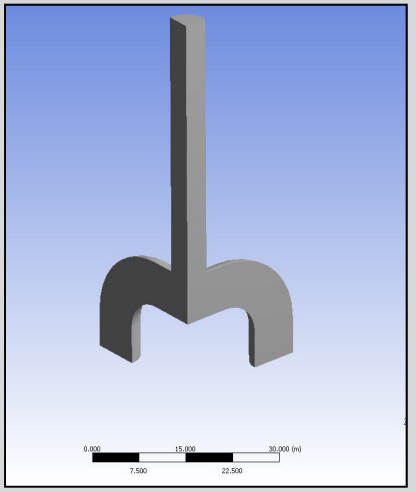
Symmetry using XY plane



Details View

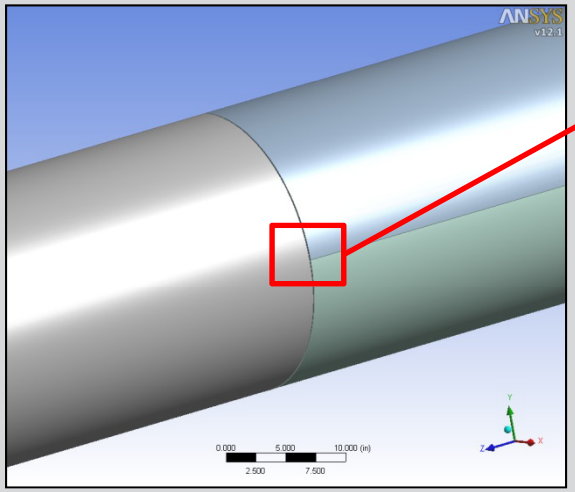
Details of Symmetry1	
Symmetry	Symmetry1
Number of Planes	2
Symmetry Plane1	XYPlane
Symmetry Plane2	ZXPlane
Model Type	Full Model
Target Bodies	All Bodies

Symmetry using XY & ZX plane

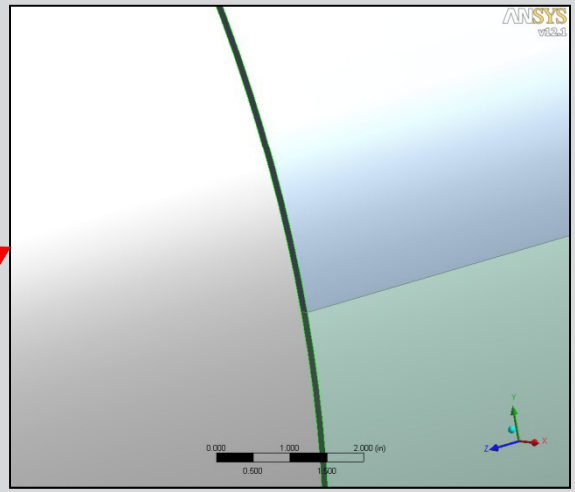


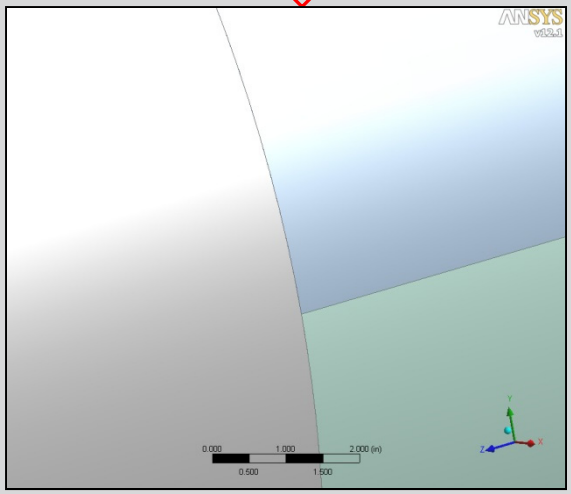
Connect: Example

Edge Connect



Model with a gap





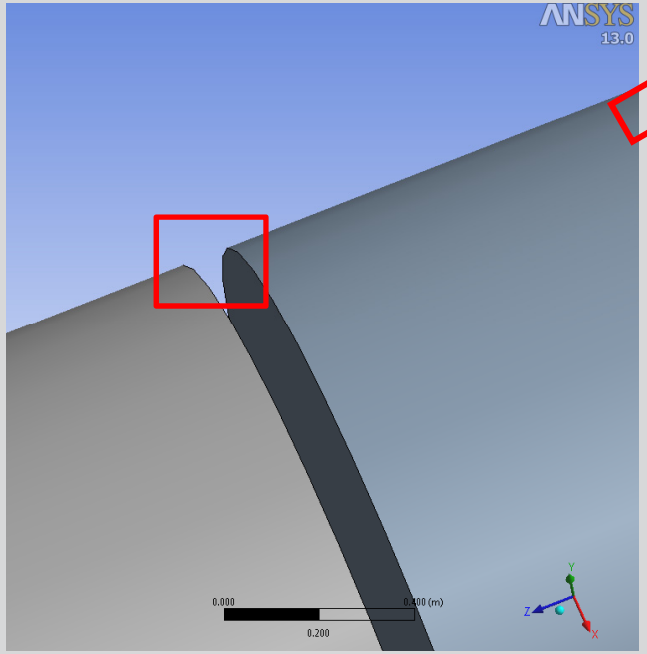
Tolerance	0.1 mm
Location	Preserve First
T-Junction	Interpolated

Using T-Junction

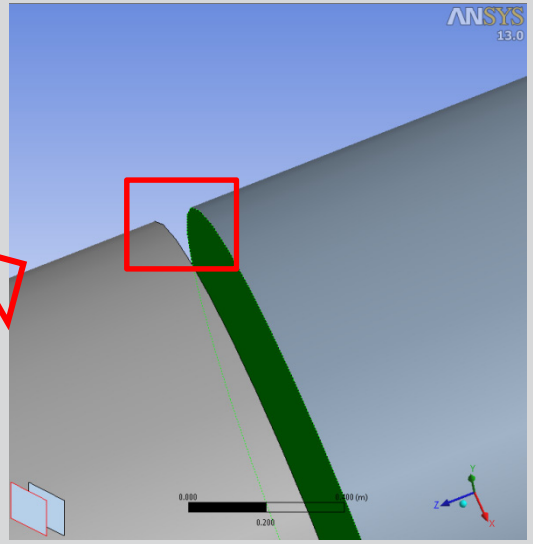
Connect: Example

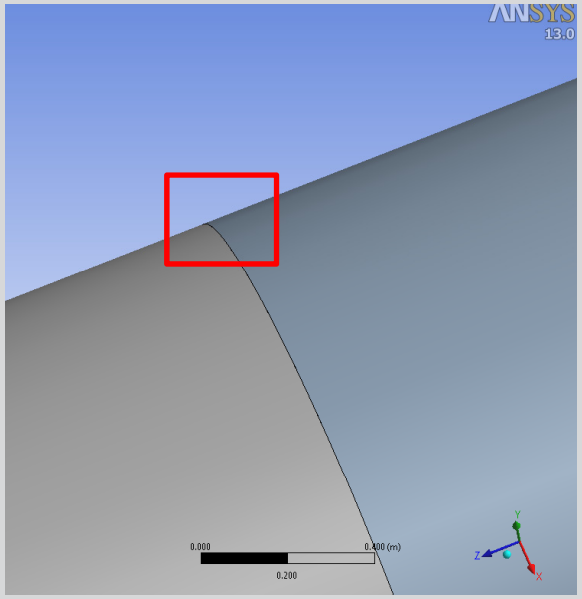
Face Connect

- Additional options as per edge connect



Model with a gap

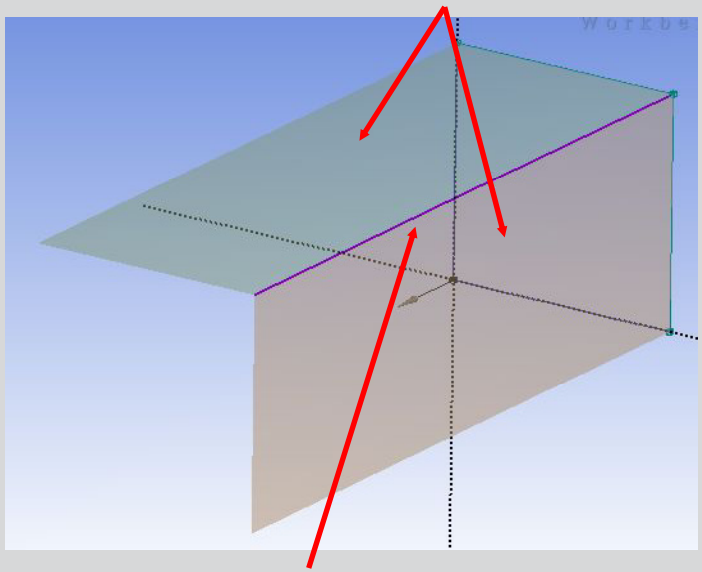




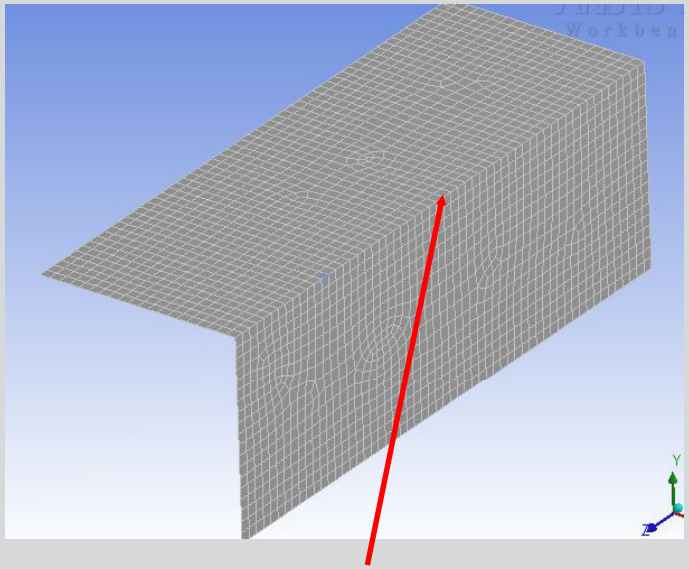
Surfaces From Edges

- A line body with no cross section can be used to tie together surface models
- In this case, the line body acts merely as a mechanism to insure a continuous mesh at the surface boundaries

2 Surface Bodies



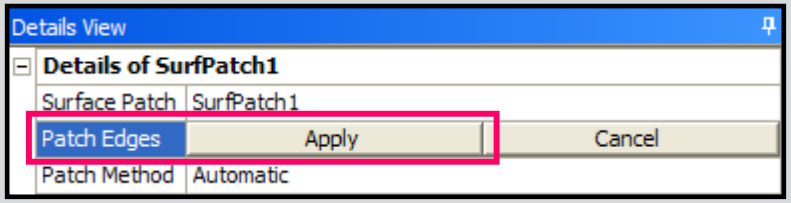
Line Body (no cross section)



Result is continuous FE mesh at surface interface

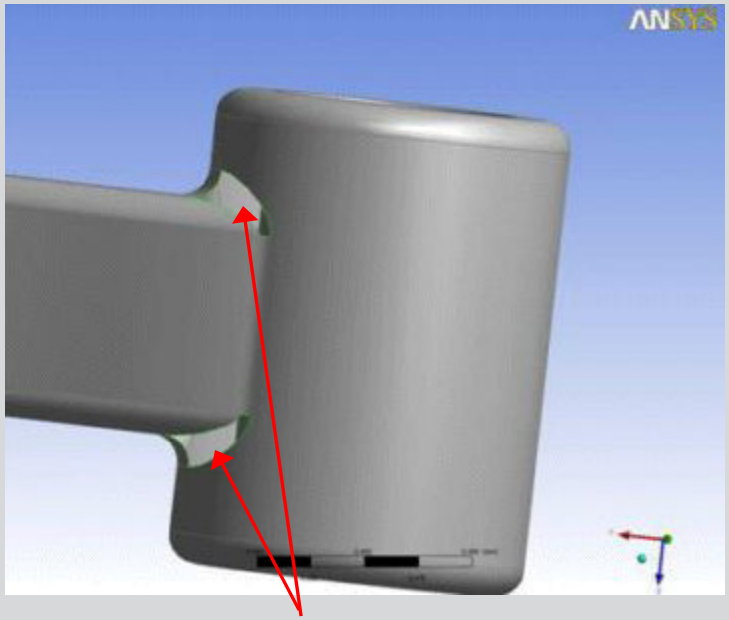
Surface Patch

Surface Patch

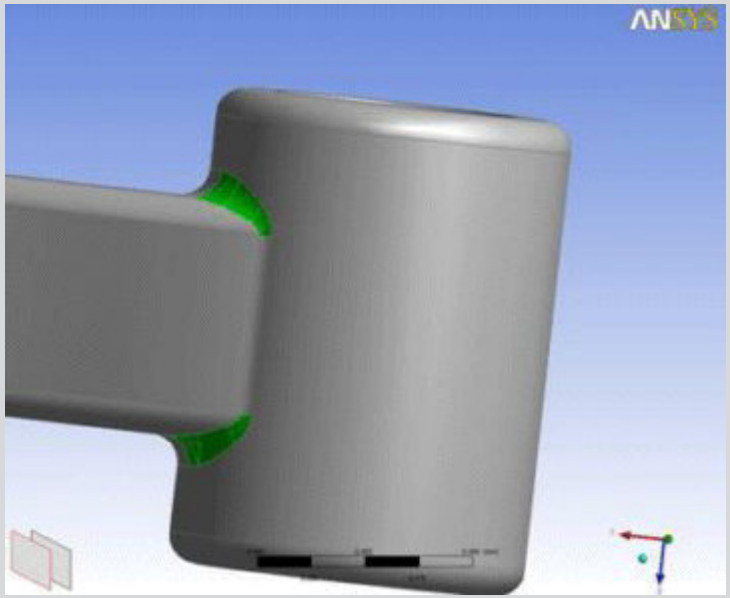


[Main Menu] Tools → Surface Patch

- Attempts to fill gaps in the model
- Uses similar healing methods as face delete (natural and patch)
- Complex gaps may result in multiple surfaces being created to fill them



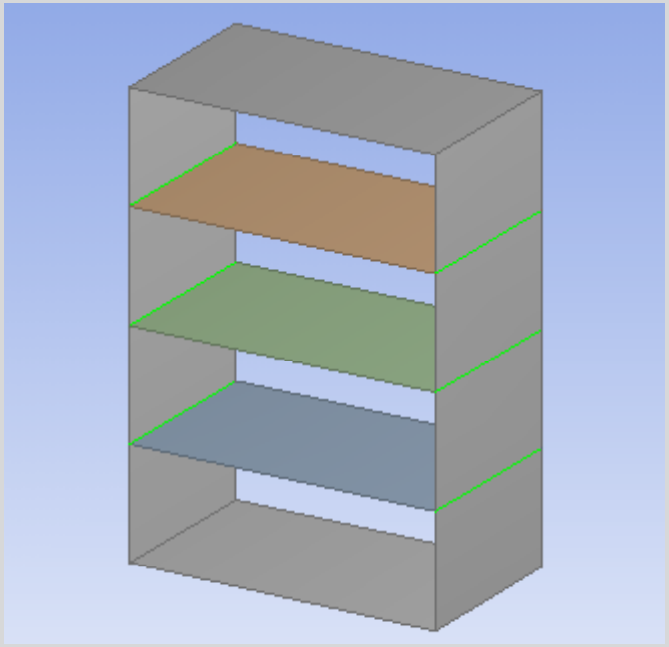
2 holes selected for patching

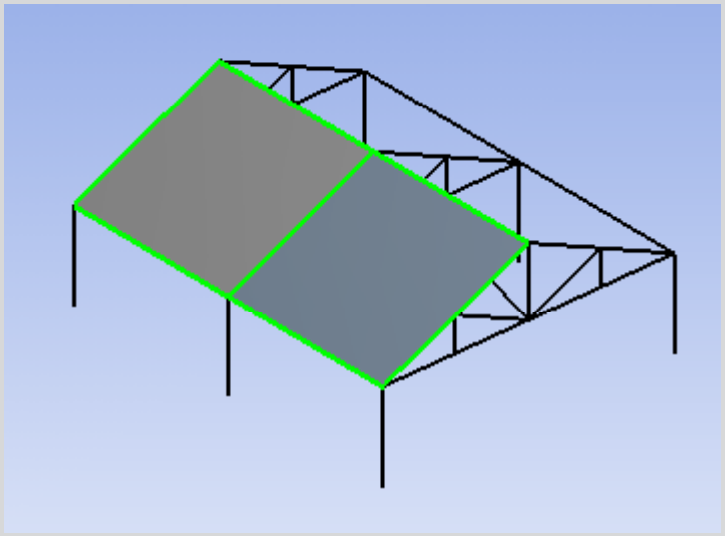


Two patches created using multiple surfaces

Edge Joints

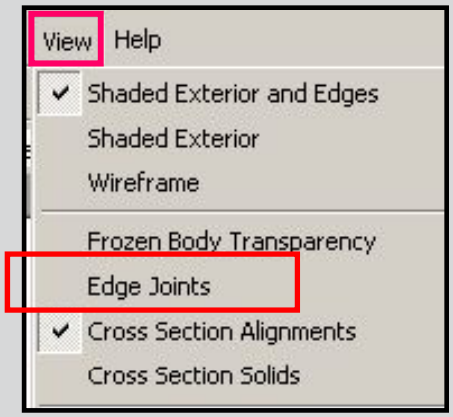
- Edge Joints are the glue that holds together bodies where a continuous mesh is desired
- Creating surface and/or line multi-body parts with coincident edges results in automatic creation of edge joints
- Joints can be created manually ([Main Menu] Tools → Joint) where no coincident topology exists

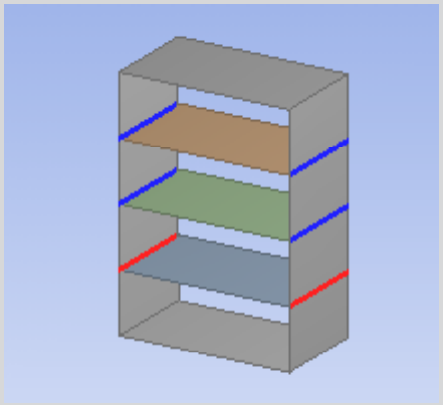


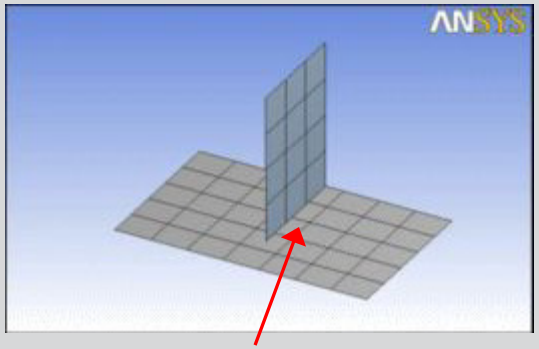


Edge Joints

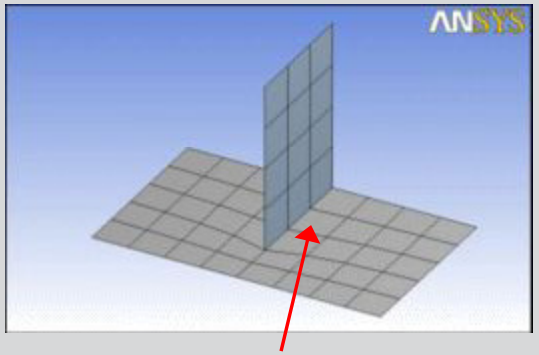
- Edge Joints can be viewed by turning on the Edge Joints option in the View menu.
- Edge joints are displayed in either blue or red.
  - Blue: edge joint is contained in properly defined multi-body part
  - Red: edge joint not grouped into the same part







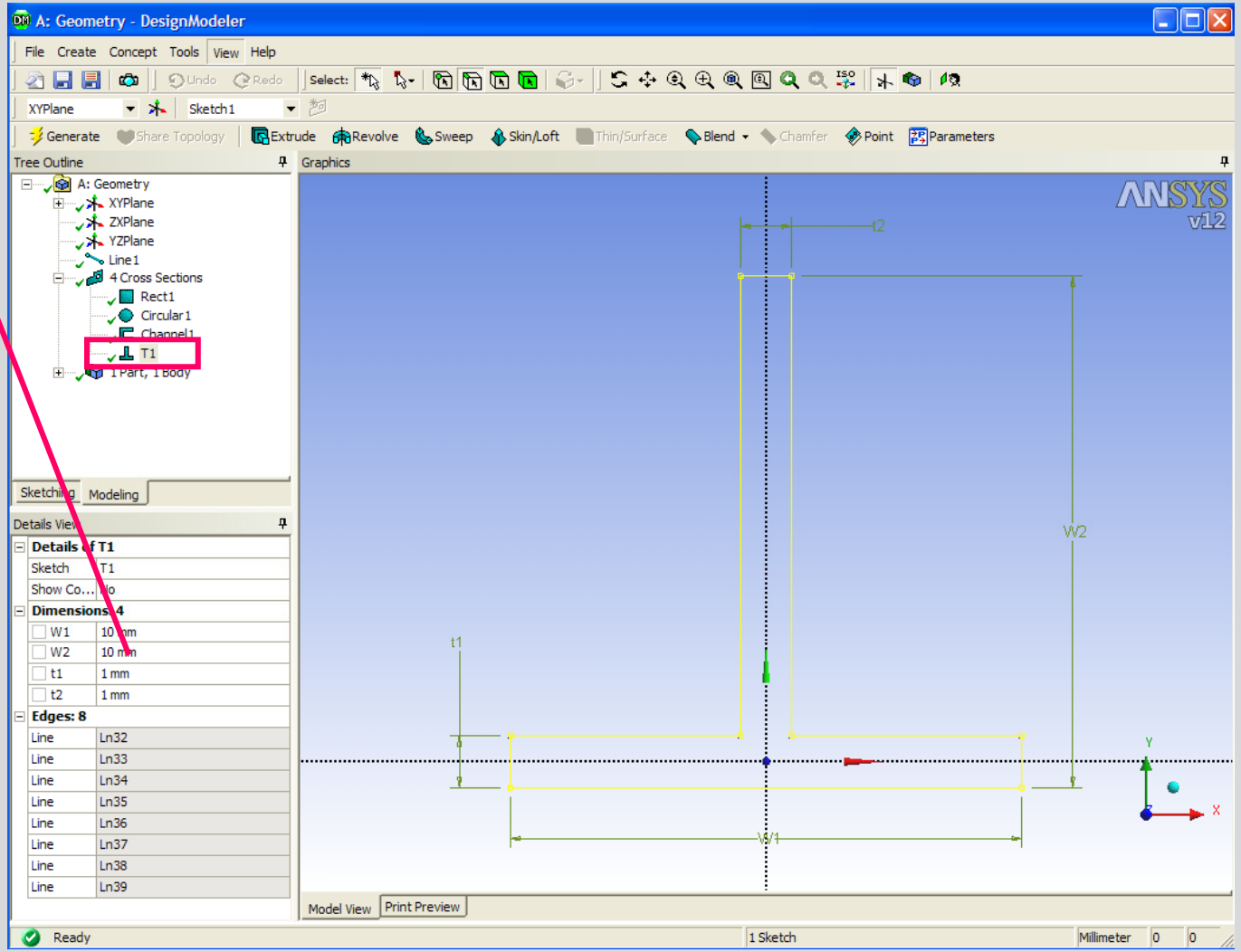
No Edge Joint



With Edge Joint

Cross Sections

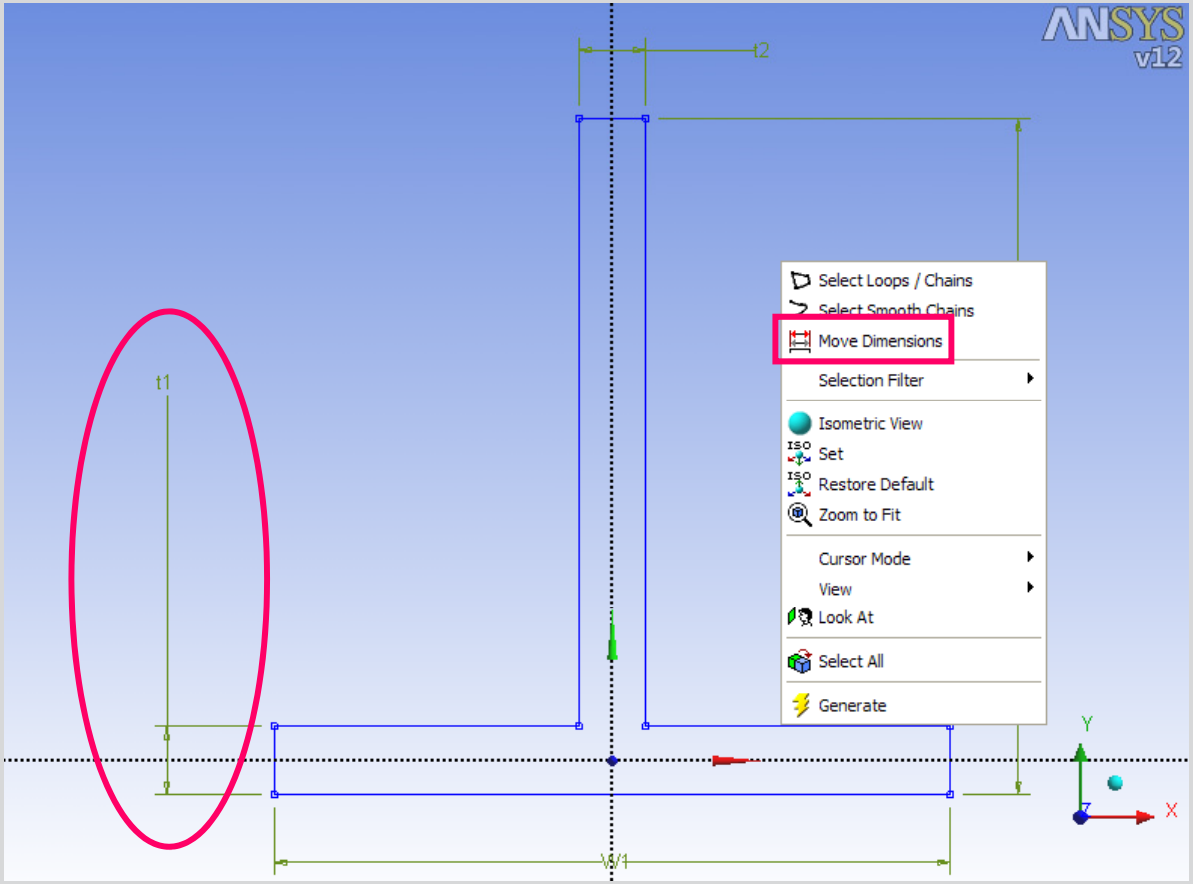
Highlight the cross section in the Tree to modify dimensions in the Details window

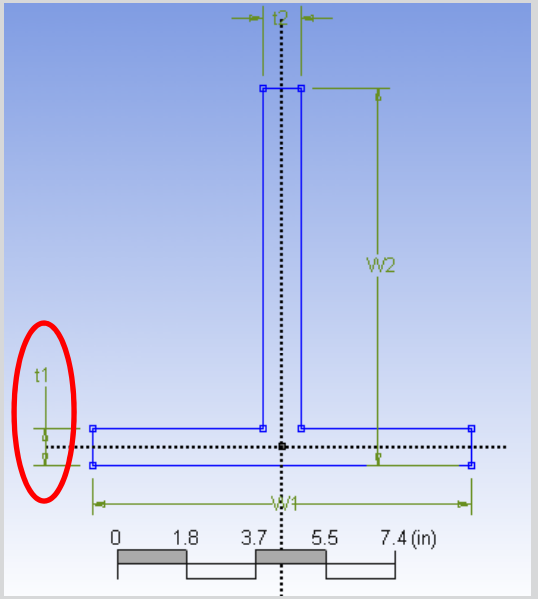


Cross Sections

Dimension Editing

– Cross section dimensions can be repositioned via a RMB and choosing Move Dimensions

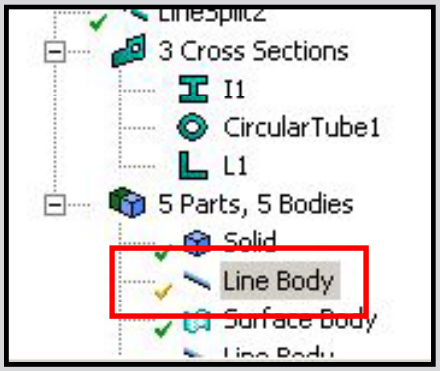


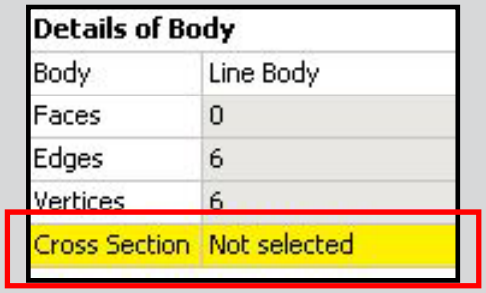


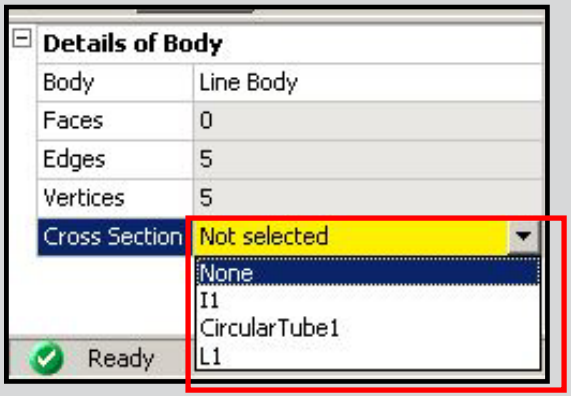
Cross Sections

Assigning a cross section to a line body:

- Highlight the line body in the Tree
- A cross section property appears in the detail window
- Click in this field and choose the desired cross section from the drop down list

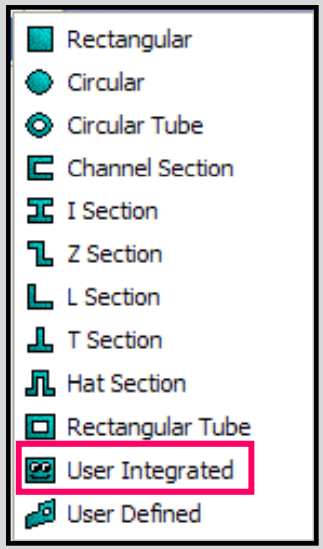


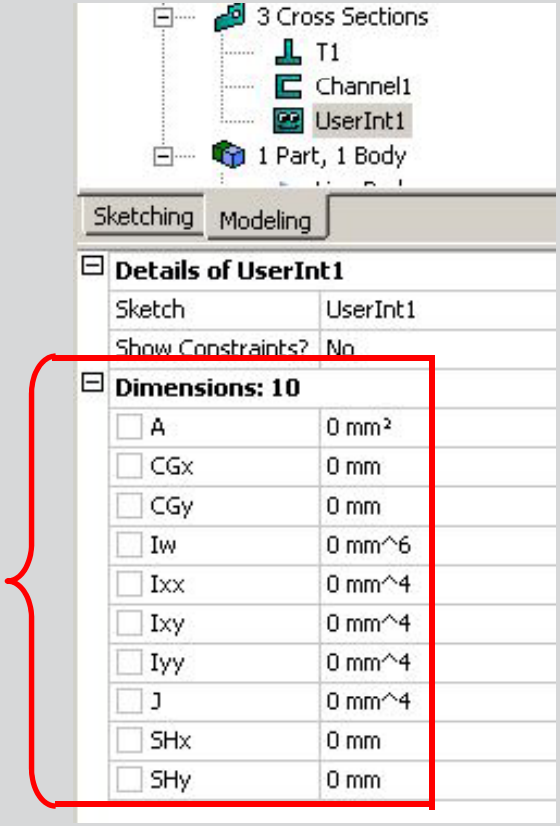




Cross Sections

- A User Integrated section can be defined in DM
- The cross section is not sketched, rather the cross section's properties are placed in the details window



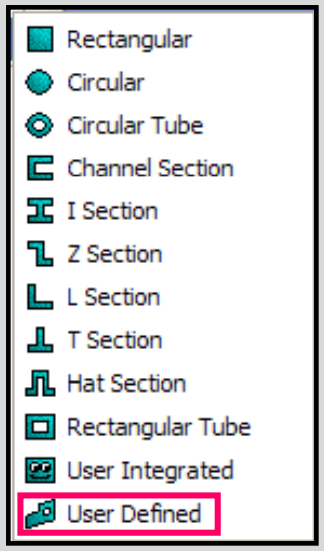


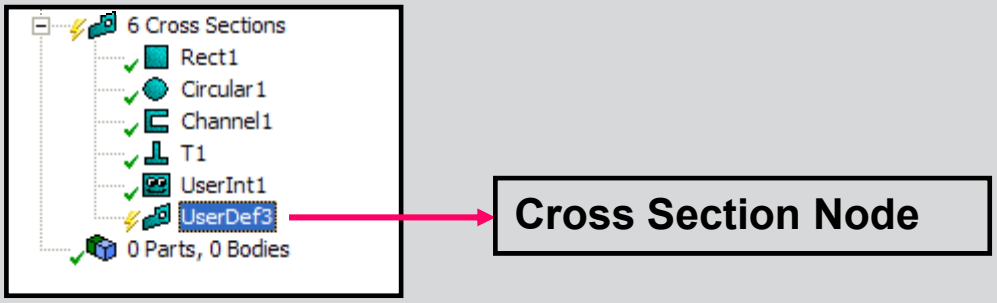
- **A = Area of section.**
- **Ixx = Moment of inertia about the x axis.**
- **Ixy = Product of inertia.**
- **Iyy = Moment of inertia about the y axis.**
- **Iw =Warping constant.**
- **J = Torsional constant.**
- **CGx = X coordinate of centroid.**
- **CGy = Y coordinate of centroid.**
- **SHx = X coordinate of shear center.**
- **SHy = Y coordinate of shear center.**

Cross Sections

Steps for creating a User Defined Cross Section:

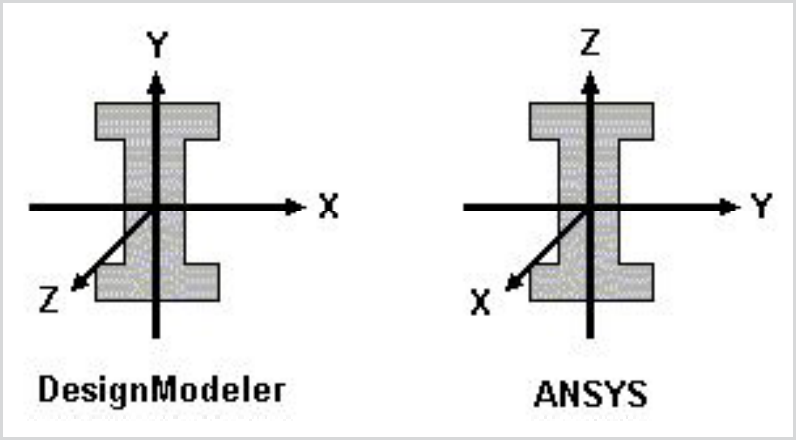
- Select Cross Section → User Defined from Concept Menu
- A Cross Section node with an empty sketch will be added in the tree outline
- Click Sketching tab to draw the required sketch (Must be a closed Sketch)
- Click Generate. DM will compute the Cross Section properties and show them in the details view. These properties cannot be changed.

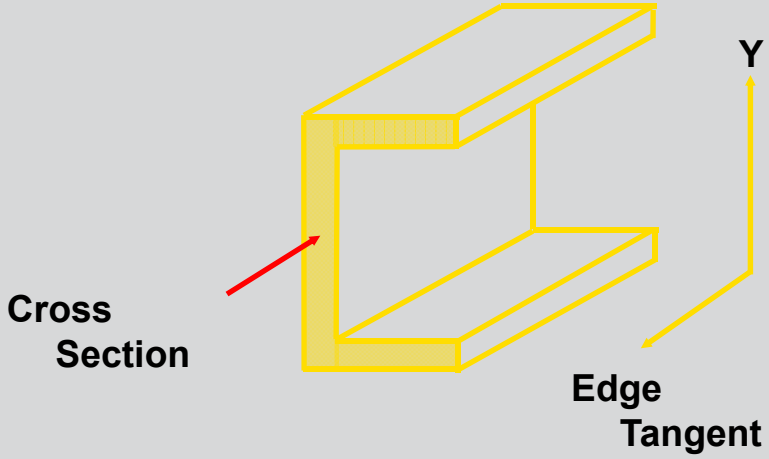




Cross Section Alignment

- **As shown below, in Design-Modeler the cross section lies in the XY plane**
- **Cross section alignment is defined by:**
  - A local or cross section +Y direction
    - Default alignment is with the global +Y direction unless that would result in an invalid alignment in which case +Z is used
  - Note: In the ANSYS Classic Environment, the cross section lies in the YZ plane and uses the X direction as the edge tangent. This difference in orientation has no bearing on the analysis.





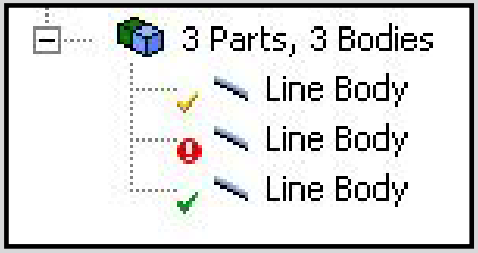
Cross Section Alignment

A color code is used to indicate cross section status for line bodies in the Viewer

- Violet: no cross section assigned
- Black: cross section assigned with valid alignment
- Red: cross section assigned with invalid alignment

The line body icons in the tree have similar visual aids

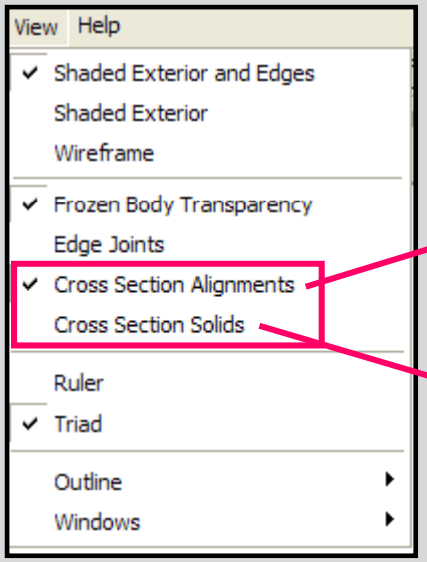
- Green: cross section assigned with valid cross section alignment
- Yellow: no cross section assigned or default alignment
- Red: invalid cross section alignment

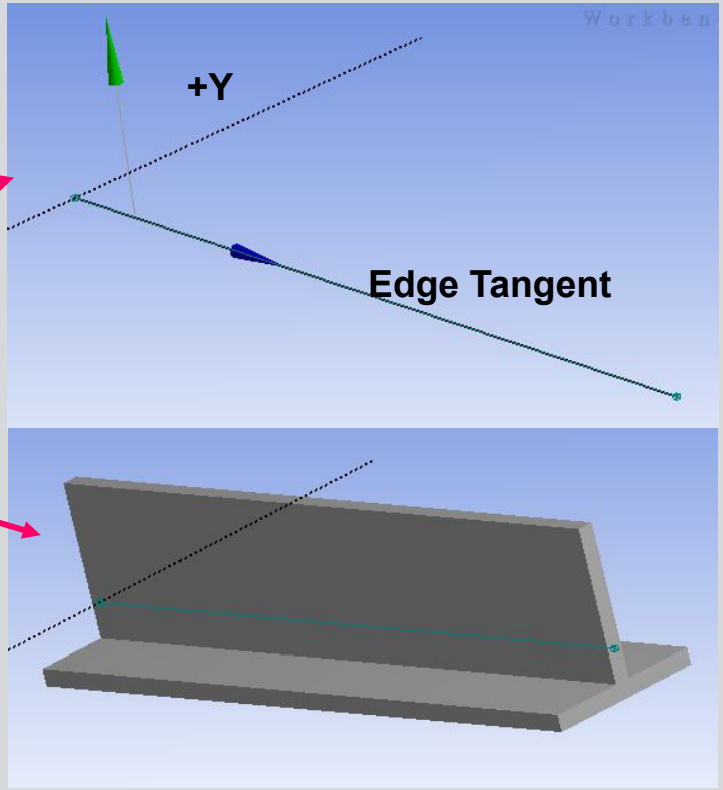


Cross Section Alignment

Checking alignment can be done graphically using the View menu

- Choose "Show Cross Section Alignments"
  - Green arrow = +Y, blue arrow = edge tangent of cross section
- Or choose "Cross Section Solids"





Cross Section Alignment

- **Because a default alignment is chosen, Cross Section orientation will almost always need to be modified**
- **There are 2 methods for modifing the Cross section alignment, “Selection” and “Vector”**
  - The selection method uses existing geometry (edges, points, etc.) as alignment reference
  - The vector method uses input according to X, Y, Z coordinate directions
  - For either method a rotation angle can be input and/or the orientation reversed

Selection Method

Line-Body Edge	
Alignment Mode	Selection
Cross Section Alignment	None (+Z by default)
Alignment X	0
Alignment Y	0
Alignment Z	1
Rotate	0 °
Reverse Orientation?	No

Vector Method

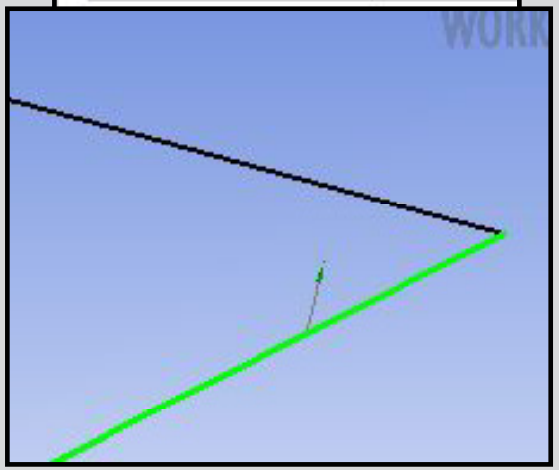
Line-Body Edge	
Alignment Mode	Vector
Cross Section Alignment	Vector
Alignment X	0
Alignment Y	0
Alignment Z	1
Rotate	0 °
Reverse Orientation?	No

- To access the Alignment Mode Details, click on the Line Body in the Tree
- RMB in the Viewer and Choose “Select All”
- Alignment Mode details show up

Cross Section Alignment

Modifying the Cross Section orientation by vector

Line-Body Edge	
Alignment Mode	Vector
Cross Section Alignment	Vector
Alignment X	0
Alignment Y	1
Alignment Z	0
Rotate	0 °
Reverse Orientation?	No



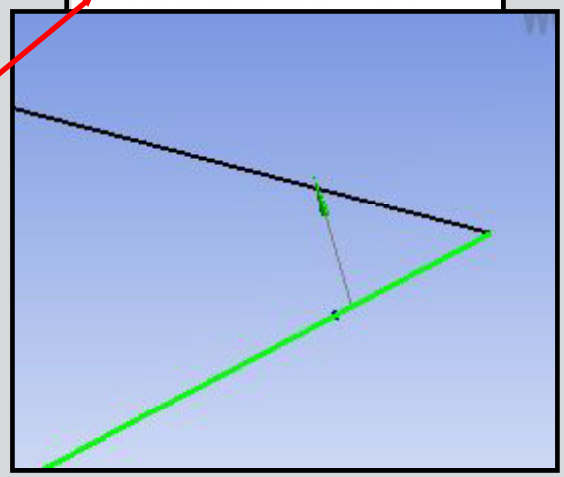
Switch to "Vector" alignment mode

Enter the desired coordinate values

Enter rotation angle if desired

Reverse orientation if desired

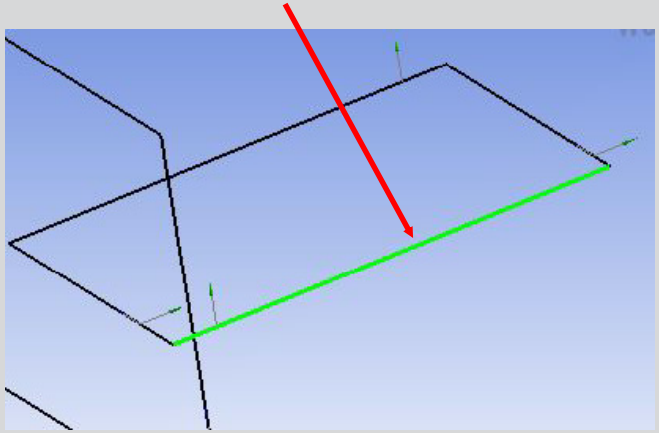
Line-Body Edge	
Alignment Mode	Vector
Cross Section Alignment	Vector
Alignment X	0
Alignment Y	1
Alignment Z	0
Rotate	30 °
Reverse Orientation?	No

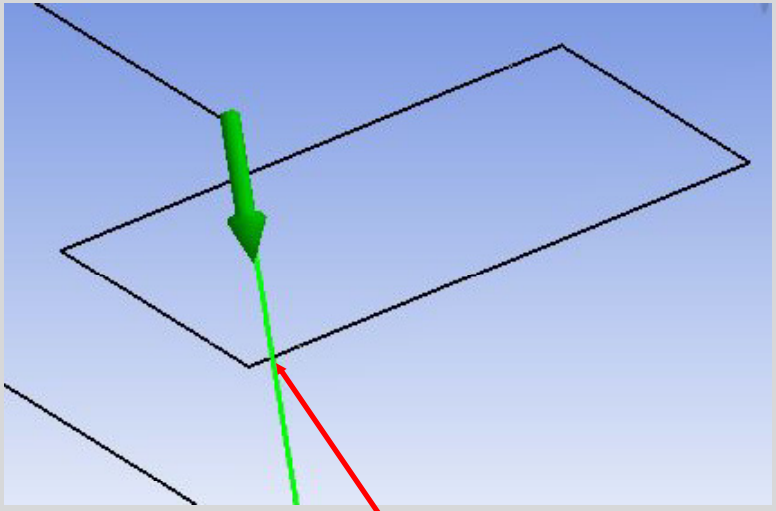


Cross Section Alignment

Modifying the cross section orientation by selection

1. Select the line body to be aligned in graphics window





3. Select the geometry to be used for alignment

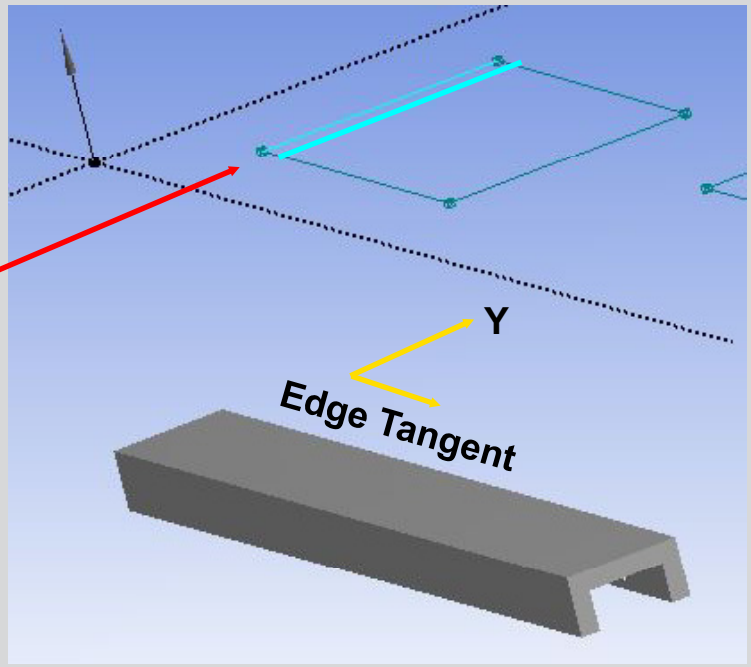
Line-Body Edge	
Alignment Mode	Selection
Cross Section Alignment	Apply / Cancel
Alignment X	0
Alignment Y	0
Alignment Z	1
Rotate	0 °
Reverse Orientation?	No

2. With “Selection” method active click in the alignment field

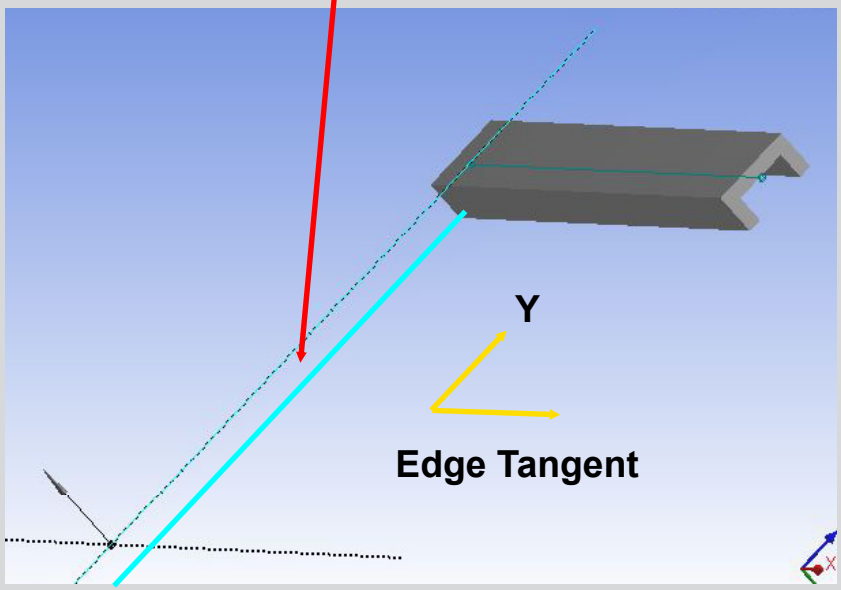
Cross Section Alignment

Alignment using lines or axes

Line chosen for alignment

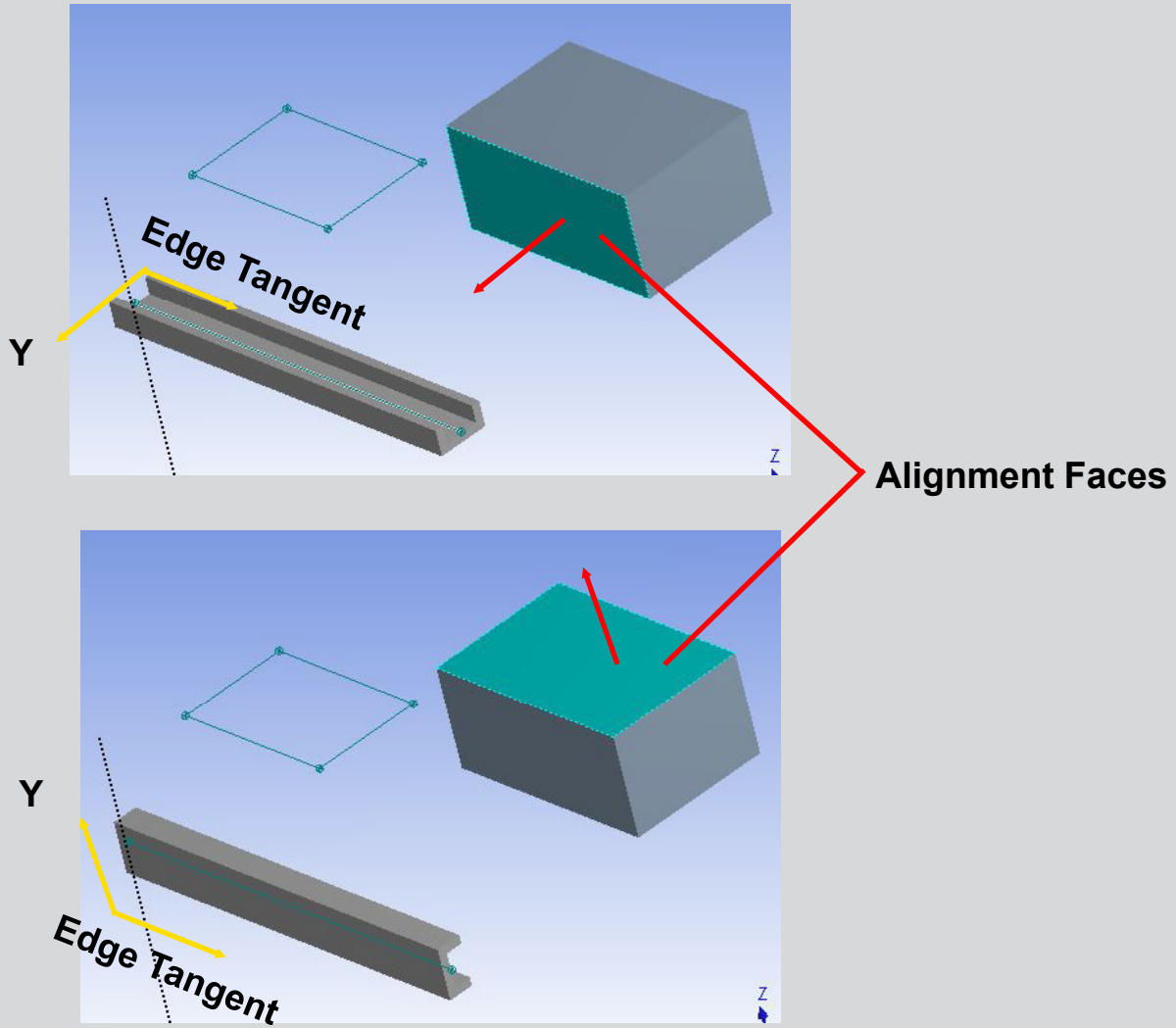


Axis chosen for alignment



Cross Section Alignment

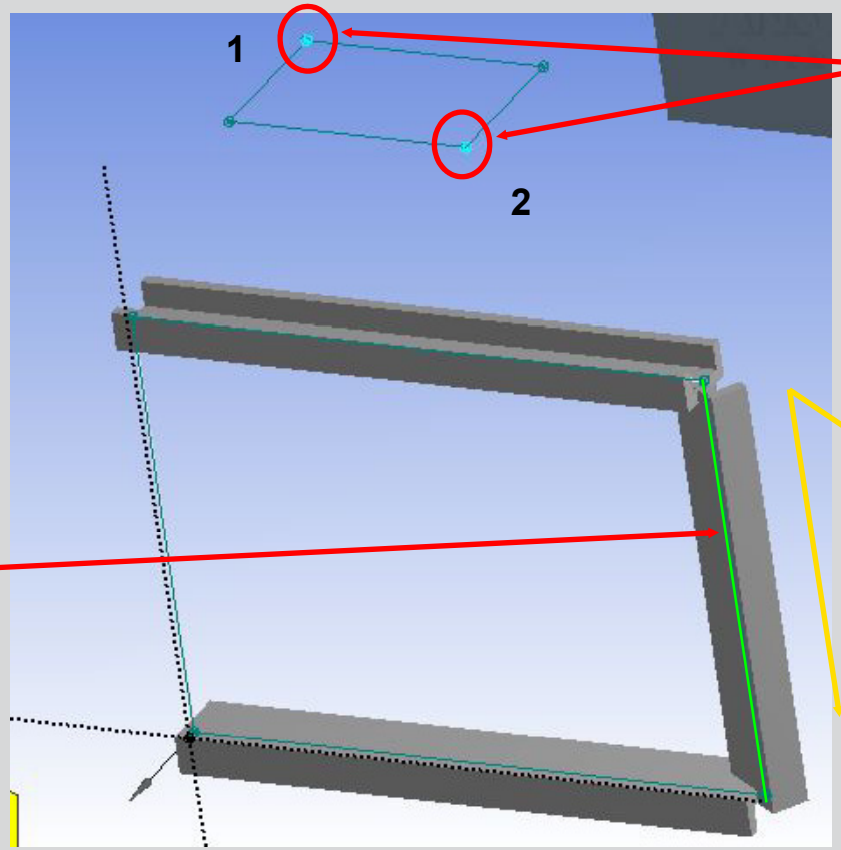
Alignment using face normal



Cross Section Alignment

Alignment using sketch points

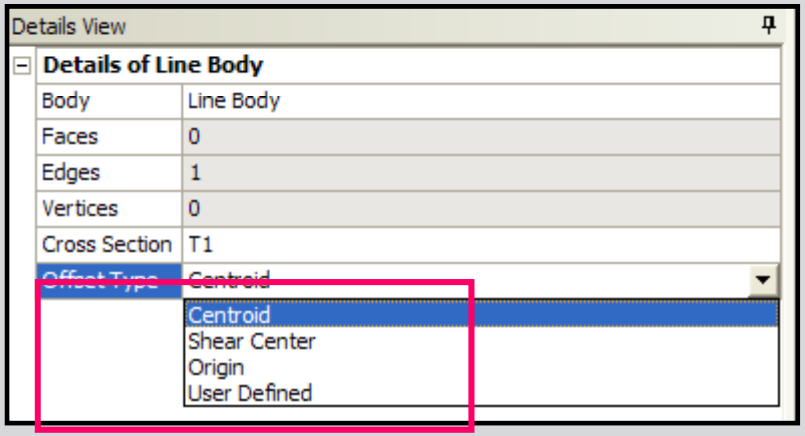
Note: The order of point selection determines cross section alignment



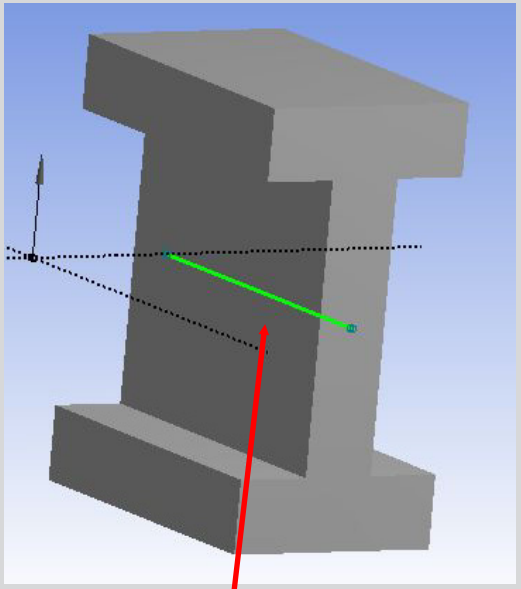
Cross Section Offset

Cross Section Offset

- After assigning a cross section to a line body, the Detail property allows users to specify the type of offset to use with the cross section:
  - Centroid: The cross section is centered on the line body according to its centroid (default)
  - Shear Center: The cross section is centered on the line body according to its shear center
    - Note the graphical display for centroid and shear center appear the same however. When analyzed, the shear center is used
  - Origin: The cross section is not offset and is taken exactly as it appears in its sketch
  - User Defined: User specifies cross section's X and Y offsets

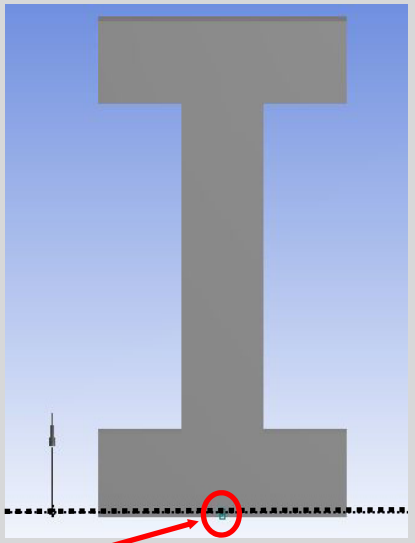


Cross Section Offset



Line Body with cross section displayed

Origin offset (no offset)



Line Body

Centroid/Shear Center offset